Status-Quo and Usage Behavior

# PRIVATE INFORMATION SYSTEMS AND SELF-TRACKING


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# Private Information Systems and Self-Tracking:
## Status-Quo and Usage Behavior

Dissertation
zur Erlangung des Doktorgrades doctor rerum politicarum (Dr.rer.pol)
an der Fakultät Wirtschaftsinformatik und Angewandte Informatik
der Otto-Friedrich-Universität Bamberg

Vorgelegt am 30.04.2019
und
verteidigt am 27.06.2019 von
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Datum der Abschlussprüfung: 27.06.2019

URN: urn:nbn:de:bvb:473-opus4-557080
DOI: https://doi.org/10.20378/irbo-55708

Dedicated to my parents, Arthur and Angelika

## Abstract

In the middle of the 20th century, computers were used for military, research, or professional applications. In the mid-1970s, the computer industry started selling personal computers (PCs) not only to companies and other institutions but also to households. Since then, PCs not only have conquered companies but also households. Today, PCs and other information systems (IS) have clearly expanded beyond professional use. The miniaturization and price decrease of IS and the Internet contribute to such a dissemination. In fact, a large share of IS-related overall spending, computing power, and interaction with IS – in the form of home PCs, phones, tablets, wearables, smartwatches, or smart sensors – is now taking place in private contexts, and ubiquitous IS are increasingly collecting data on various aspects of our private lives. This dissertation subsumes such systems that are being used in the private context under the term private information systems (PIS). One of the strongest among trending PIS technologies and applications is the class of self-tracking appliances. "Self-tracking" describes an individual's desire to collect, store, analyze, reflect, and act upon data on personal (often private) activities (e.g., counting steps, fitness tracking, observing health issues, stepping on a weight scale, checking financial expenditures, noting gas consumption). As such, the proliferation of self-tracking is an example of IS that rapidly gain further ground outside traditional firm boundaries because they enter the mass market.

Notwithstanding the dissemination of PIS and the increasing relevancy of self-tracking, IS scholars show opposing opinions about the status of PIS and self-tracking technologies within IS research. Moreover, academic studies that investigate the structure of the discipline mostly focus on the organizational context. On this account, the dissertation aims at answering the first overall research question:

*What is the status quo of PIS, especially self-tracking, in IS research?*

The first overall research question is addressed by means of a quantitative bibliometric analysis that counts the number of articles on PIS within IS literature. The analysis reveals that the share of articles on PIS is small (7% out of over 1,700 IS articles) but growing (from 2% in the first to 10% in the last year of the observation). While the IS community may lag behind the vast expansion of IS use to private contexts, as several prominent scholars have stated, IS scholars and the discipline's top outlets seem to increasingly address topics related to the growing ubiquity and use of IS in private contexts. Moreover, the analysis shows that scholars investigate research questions on the private context in a homogenous way. For example, this refers to a scholar's choice of tools, such as research methods, or the focus on specific journals and conference proceedings for publication. As a next step, this dissertation focuses on a specific field of application of IS in the private context: IS for self-tracking. A qualitative literature review gives an overview of current insights from 114 articles on self-tracking in three disciplines – IS, Human-Computer Interaction (HCI), and psychology. The resulting research agenda with identified research gaps helps to correctly propagate existing knowledge and streamline future research. One major research gap concerns the usage behavior of self-tracking IS.

As the literature shows, the role of IS and the circumstances that might shape the adoption and usage of such PIS are fundamentally different in private contexts compared to professional contexts. While IS research has traditionally concentrated on the use of IS in professional contexts, a growing share of research questions seem to constantly shift to contexts beyond organizations. In this sense, IS scholars underline the relevance of revisiting IS theories and models in this new context that is shaped by other circumstances. Such circumstances have been identified for example in the context of volitional and mandatory IS usage or hedonic and utilitarian systems. Thus, the dissertation sets out to investigate the second overall research question:

*How do individuals use self-tracking appliances?*

To answer the second overall research question, a field study with over 700 participants was conducted to assess the power of traditional IS models to explain adoption intention, continuous usage intention, and self-reported usage. As a result, the traditional IS models reveal strong predictive value for adoption, but much less for continuous usage, and none for self-reported usage. In order to improve such models, the dissertation reverts to a theoretical concept that IS research has neglected due to its center of interest on organizational contexts: attitudes. The dissertation develops a first version of a measurement instrument that assesses individual attitudes toward self-tracking.

The dissertation contributes to the discussion of the identity of IS and the role of IS in the private context. Moreover, the dissertation offers a systematic literature review on self-tracking research, with the goal to stimulate future research on self-tracking. Furthermore, the literature review also includes research on self-tracking from other disciplines, such as HCI and psychology, which offer valuable insights for IS scholars. The second part of the dissertation provides large-scale empirical insights that show that additional variables are needed to understand behavioral intentions and usage in the private context – especially regarding continuous usage intentions related to self-tracking appliances. The dissertation also contributes on a methodological level, including one of the rare studies that investigates UTAUT models in the context of a field study with longitudinal data, including self-reports on usage. Finally, the dissertation provides a new instrument to measure attitudes toward self-tracking, that can help to improve traditional instruments and explanatory models.

## German Abstract (Zusammenfassung)

In der Mitte des 20. Jahrhunderts wurden Computer vorwiegend in militärischen, wissenschaftlichen, oder kommerziellen Anwendungsfeldern eingesetzt. Als Mitte der 70er Jahre die Computer-Industrie damit begann, Personalcomputer (PCs) zu verkaufen, hielten diese nicht nur verstärkten Einzug in Firmen, sondern auch Haushalte. Heutzutage haben sich zusätzlich zu PCs auch andere Informationssysteme (IS) auch über den professionellen Einsatz hinaus in anderen Bereichen etabliert. Die Miniaturisierung und Preissenkungen von IS sowie die Verbreitung des Internets haben einen erheblichen Teil zu dieser Verbreitung beigetragen. In Form von Heim-PCs, Telefonen, Tablets, Wearables, Smartwatches oder intelligenten Sensoren findet mittlerweile ein großer Teil der IS-bezogenen Gesamtausgaben, der Rechenleistung und der Interaktion mit IS im privaten Kontext statt. Außerdem erheben ubiquitäre IS immer mehr Daten zu verschiedenen Aspekten unseres Privatlebens.

Diese Dissertation fasst Systeme, die eine vermehrte Verbreitung im privaten Kontext erfahren, unter dem Begriff Private Informationssysteme (PIS) zusammen. Ein prominenter Anwendungsfall von PIS ist das sogenannte “Self Tracking”. Self Tracking subsumiert verschiedene Arten der Selbstvermessung und trägt dem Wunsch vieler Menschen Rechnung, Daten über persönliche (oft private) Aktivitäten zu sammeln, zu speichern, zu analysieren, zu reflektieren und dementsprechend zu agieren. Regelmäßig erfasste Größen sind beispielsweise tägliche Schritte, das allgemeine Fitnesslevel, das Körpergewicht oder gesundheitliche Aspekte. Ziel dabei ist es häufig, das Bewegungs- bzw. Fitnesslevel zu steigern. Eine andere Art der Selbstvermessung ist die Überprüfung der finanziellen Ausgaben oder die Aufzeichnung des Treibstoffverbrauches mit dem Auto, um Ausgaben zu kontrollieren und zu verringern. Aus diesem Grund stellt die zunehmende Selbstvermessung ein passendes Beispiel dafür dar, wie IS außerhalb traditioneller Unternehmensgrenzen rasch Fuß fassen und die Technologie in den Massenmarkt vordringen kann.

Trotz der starken Verbreitung von PIS und der zunehmenden Relevanz von Technologien zur Selbstvermessung äußern einige IS-Wissenschaftler widersprüchliche Meinungen über den Status von PIS und Selbstvermessung in der IS-Forschung. Außerdem konzentrieren sich Studien, die die Struktur der Disziplin untersuchen, vorwiegend auf den organisatorischen Kontext. Aus diesem Grund zielt die Dissertation darauf ab, die erste übergeordnete Forschungsfrage zu beantworten:

*Wie ist der Status Quo zu PIS, insbesondere in Bezug auf Selbstvermessung, in der IS-Forschung?*

Zur Beantwortung der ersten Forschungsfrage dient eine quantitative bibliometrische Analyse, welche das Ausmaß von IS-Artikeln untersucht, die sich auf den privaten Kontext konzentrieren. Somit wird der Status Quo der wissenschaftlichen Forschung zu PIS ermittelt. Dieser zeigt, dass eine geringe (insgesamt 7% von über 1.700 Artikeln aus der IS-Disziplin) aber steigende Anzahl (mit einem Anstieg von 2% ersten und 10% im letzten untersuchten Jahr) an Artikeln sich mit PIS beschäftigen. Gemäß den Aussagen von prominenten Wissenschaftlern spiegelt die Auseinandersetzung mit Selbstvermessung in der IS-Forschung noch nicht die Bedeutung von Selbstvermessung in der Praxis wider. Jedoch sieht es so aus, als würden vermehrt IS-Wissenschaftler und Top-Outlets der Disziplin auch Themen, die mit der wachsenden Verbreitung und der Nutzung von IS im privaten Kontext zusammenhängen, behandeln. Außerdem zeigt die Analyse, dass Forscher eher einseitig auf die Fragestellungen im privaten Kontext eingehen. Dies bezieht sich zum Beispiel auf das gewählte Handwerkszeug, wie die Forschungsmethode, oder der Fokus auf bestimmte Zeitschriften und Konferenztagungsbände zur Veröffentlichung. In einem weiteren Schritt beschäftigt sich die Dissertation verstärkt mit einem Anwendungsgebiet von PIS: IS zur Selbstvermessung. Eine qualitative Literaturrecherche gibt einen Überblick über die aktuellen Forschungserkenntnisse aus 114 Artikeln aus drei Disziplinen: IS, Mensch-Computer-Interaktion (MCI) und Psychologie. Eine Forschungsagenda, welche identifizierte Forschungslücken aufzeigt soll somit zukünftige Forschungsvorhaben unterstützten und Wissen verbessert sammeln sowie zur Verfügung stellen. Ein Hauptthema umfasst das Nutzungsverhalten von Self Tracking-IS.

Die Rolle von IS und die Umstände, welche die Einführung und Nutzung dieser Systeme beeinflussen, weichen in mehreren Aspekten von den im organisationalen Kontext dominierenden Mechanismen ab. Während sich die IS-Forschung traditionell auf den Einsatz von IS in organisationalen Kontexten konzentriert (innerhalb von und zwischen Organisationen), befassen

sich aktuelle Forschungsfragen zunehmend auch mit dem privaten Kontext. Zugleich betonen zahlreiche Wissenschaftler, dass IS-Theorien und -Modelle in diesem neuen Kontext anders betrachtet werden müssen, da andere Gegebenheiten herrschen. Diese Gegebenheiten beziehen sich zum Beispiel auf die bereits in der Forschung identifizierten Unterschiede zwischen freiwilliger und vorgeschriebener IS-Nutzung oder hedonischer und nutzenbasierter Systeme. Somit beschäftigt sich die Dissertation mit der folgenden zweiten übergeordneten Forschungsfrage:

*Wie nutzen Einzelpersonen Selbstvermessungsanwendungen?*

Zur Beantwortung der zweiten allgemeinen Forschungsfrage wurde eine Feldstudie mit über 700 Teilnehmern durchgeführt, um die Aussagekraft herkömmlicher IS-Verhaltenserklärungsmodelle zu Verhaltensabsicht zur Nutzung („usage intention“), fortwährende Nutzungsabsichten („continuous intention“) und die wahrgenommene Nutzung („self-reported usage“) zu bewerten. Bei der Feldstudie weisen die traditionellen IS-Modelle eine hohe Vorhersagegüte für Verhaltensabsicht zur Nutzung von PIS auf, jedoch eine geringere Vorhersagegüte für fortwährende Nutzungsabsichten und keine Vorhersagegüte für die wahrgenommene Nutzung. Um die Vorhersagefähigkeit solcher Modelle zu verbessern, greift die Dissertation auf ein theoretisches Konzept zurück, welches von der IS-Forschung aufgrund ihres Fokus auf organisatorische Kontexte vernachlässigt wurde: Einstellungen („attitudes“). Die Arbeit entwickelt eine erste Version eines Messinstruments, das individuelle Einstellungen zur Selbstvermessung ermittelt. Inwieweit es die Vorhersagekraft erhöht, muss noch statistisch untersucht werden.

Die Dissertation trägt zur Diskussion über den Kern der IS-Forschung und der Rolle von IS im privaten Kontext bei. Darüber hinaus bietet die Dissertation eine systematische Literaturrecherche zur Selbstvermessungsforschung, wodurch das Ziel verfolgt wird, andere Forscher zur Vertiefung von Forschungsanstrengungen zu motivieren und ihnen bei der Ausrichtung künftiger Arbeiten zu helfen. Darüber hinaus bereitet die Literaturrecherche auch Forschungsergebnisse aus anderen Disziplinen wie MCI und Psychologie auf, welche sich für IS-Forscher als wertvoll erweisen können. Der zweite Teil der Dissertation liefert umfangreiche empirische Erkenntnisse, aus denen hervorgeht, dass andere Variablen benötigt werden, um Verhaltensabsichten und Verhaltensweisen in Bezug auf die Nutzung von Selbstvermessungsanwendungen im privaten Kontext zu verstehen. Die Dissertation leistet auch auf methodischer Ebene einen Beitrag, da sie eine der seltenen Studien enthält, die UTAUT-Modelle im Rahmen einer Feldstudie mit Längsschnittdaten einschließlich selbst eingeschätzter Nutzung untersucht. Schließlich stellt die Dissertation ein neues Instrument bereit, um die Einstellungen zur Selbstvermessung zu erfassen und traditionelle Instrumente und Verhaltenserklärungsmodelle zu verbessern.

# Acknowledgment

Completing this dissertation represents a major milestone in my academic curriculum vitae, which would not be possible without support and advice of many great persons. I would like to use the opportunity and thank them in the following.

First and most of all, I express my gratitude to my supervisor, Prof. Dr. Thorsten Staake, for his guidance and encouragements during the last years. Besides the excellent cooperation in the context of my activity as research assistant, he was always a great help for my scientific evolvement. Prof. Dr. Thorsten Staake represents a great source of motivation and optimism; even more, he allowed me the utmost liberty and trust to engage in exciting research projects and cared a lot for the successful development of my dissertation. Furthermore, he was always available for fruitful and constructive feedback and discussions, for which I am very grateful.

I would also like to thank Prof. Dr. Sven Overhage and Prof. Dr. Tom Gross for joining my PhD committee, for their interest in my dissertation, and their supportive advice.

Second, I would like to give a special thank-you to Dr. Verena Tiefenbeck, who supported me along the whole journey and with whom I undertook many of my intellectual endeavors. As an extraordinary researcher and colleague, even before starting my PhD, she openly provided advice and assistance for my decision to start this project. Her shared enthusiasm for my topics was essential in helping me complete this project. The same applies to my dear friend Liliane Ableitner; I am grateful for being able to work with her on various projects and topics. It was always with great pleasure and fun that I joined projects or discussed research matters with her.

Third, without the start-up Amphiro and the European Commission, most of my research would not have been possible. Thankfully, Amphiro offered the possibility to do research with an actual self-tracking appliance and in the context of the EU project DAIAD (funded by the European Commission) so I could undertake various empirical investigations.

Additionally, I am deeply grateful for the advice, support, and encouragement of my well-appreciated former and current colleagues of the University of Bamberg: Sarah Appeldorn-Betz, Viktoria Hirschfeld, Konstantin Hopf, Sebastian Günther, Ilya Kozlovskiy, Samuel Schöb, Carlo Stingl, Andreas Weigert, Jürgen Wenig. There are many amazing moments with all of them, for which I am very grateful. The same applies for all the colleagues of the Bits to Energy Lab, ETH Zürich and the University of St. Gallen, which cannot be all named here. Notably, I would like to list Christian Beckel, Flavius Kehr, and Dr. Tobias Kowatsch, who gave their valuable advice at different times and to various projects in the context of PhD seminars or collaborative projects.

Most importantly, this dissertation would not have been possible without my family and friends. They were always there for support and advice in various aspects during the last years. They always showed full understanding for any sacrifices the dissertation required and always made time if needed to offer encouragement or an open ear.

Last but not least, my sincere thanks go to my fiancé Dr. Christoph Weinert. During the last years he has been an incredible partner on all levels. Being a researcher himself, he did not only encourage me many times but also represented an unfailing source of professional and personal advice and reassurance. This kind of two-fold support made my PhD such a special time of my life. I am happy and grateful that we could share this, also often difficult, time together.

# Content

## Figures

## Tables

## Abbreviations

| | |
|---|---|
| # | Number |
| A | Judgments for an Item |
| Adj | Adjective |
| AIS | Association of Information Systems |
| AJP | American Journal of Psychiatry |
| AMCIS | Americas Conference on Information Systems |
| ANOVA | Analysis of Variance |
| APA | American Psychological Association |
| ARP | Annual Review of Psychology |
| ATB | Attitude Towards a Behavior |
| ATO | Attitude Towards an Object |
| AVE | Average Variance Extracted |
| B | Business |
| B2B | Business-to-Business |
| B2C | Business-to-Consumer (Private User) |
| BI | Behavioral Intention |
| BoE | Senior Scholars' Basket of Eight |
| BSC-HCI | British Computer Society Human Computer Interaction Conference |
| C | Consumer |
| C2C | Consumer-to-Consumer (Private User-to-Private User) |
| CHB | Computers in Human Behavior |
| CHI | Conference on Human Factors in Computer Systems |
| Cog | Cognitive |
| Con | Conative |
| COR | Coding Rules |
| CR | Composite Reliability |
| CVI | Content Validity Index |
| CVR | Content Validity Ratio |
| EA | Extended Abstracts |
| ECIS | European Conference on Information Systems |
| ECT/EDT | Expectation (Dis-)Confirmation Theory |
| EE | Effort Expectancy |
| EJIS | European Journal of Information Systems |
| FC | Facilitating Conditions |
| G | Government |
| G2B | Government-to-Business |
| G2C | Government-to-Consumer (Private User) |
| Gen | General |

| | |
|---|---|
| HA | Habit |
| HCI | Human-Computer Interaction (Journal) |
| HM | Hedonic Motivation |
| ICIS | International Conference on Information Systems |
| ICT | Information and Communication Technologies |
| I-CVI/ICVI | Item-Content Validity Index |
| IDT | Innovation Diffusion Theory |
| IEEE TMC | Institute of Electrical and Electronic Engineers Transactions on Mobile Computing |
| IIS | Individual Information Systems |
| IJHC | International Journal of Human-Computer Studies (former International Journal of Man-Machine Studies) |
| IS | Information Systems / Informationssysteme (German) |
| ISJ | Information Systems Journal |
| ISR | Information Systems Research |
| JAIS | Journal of the Association of Information Systems |
| JAP | Journal of Applied Psychology |
| JGP | Archive of General Psychiatry |
| JIT | Journal of Information Technology |
| JMIS | Journal of Management Information Systems |
| JPSP | Journal of Personality and Social Psychology |
| JSIS | Journal of Strategic Information Systems |
| K | Kappa |
| MCI | Mensch-Computer-Interaktion (German) |
| MISQ | Management Information Systems Quarterly |
| MKWI | Multikonferenz Wirtschaftsinformatik (International German Information Systems Conference) |
| MobileHCI | International Conference on Human-Computer Interaction with Mobile Devices and Services |
| N | Number of items that are subject of a content validation |
| $N_E$ | Number of experts who judged an item (set) |
| $N_e$ | Number of judgements as “essential” for an item (for CVR calculation) |
| Neg | Negative |
| $N_R$ | Number of judgements as “relevant” for an item (for CVI calculation) |
| P | Participant Number |
| $P_c$ | Probability of Chance |
| PE | Performance Expectancy |
| PIS | Private Information Systems / Private Informationssysteme (German) |
| PMC | Pervasive and Mobile Computing |
| Pos | Positive |
| PsychBul | Psychological Bulletin |

| | |
|---|---|
| PsychRev | Psychological Review |
| PUC | Personal and Ubiquitous Computing |
| PV | Perceived Value |
| QS | Quantified Self |
| RQ | Research Question |
| SAMM | Software Added Meeting Management |
| S-CVI//SCVI | Scale-Content Validity Index |
| SD | Standard Deviation |
| SI | Subjective Norm |
| SRU | Self-reported Usage |
| TAM | Technology Acceptance Model |
| TCS | Trends in Cognitive Sciences |
| TOCHI | Transactions on Human-Computer Interaction |
| TPB | Theory of Planned Behavior |
| TRA | Theory of Reasoned Action |
| UbiComp | Ubiquitous Computing |
| UTAUT | Unified Theory of Acceptance and Use of Technology |
| WI | Wirtschaftsinformatik (German Information Systems Conference) |
| α | Cronbach's Alpha |

## Work Published Previously

Parts of previously published papers and reports by me and my colleagues are included in this dissertation. These papers or reports encompass peer-reviewed conference papers, one deliverable report written for an EU-project, and a study report.

Of most papers and reports, I am the first or second author. Hereby, I declare that a substantial part of the scholarly work (content, concept, methods, writing) was conducted by me. For that reason, some sentences, text passages, and complete parts of the dissertation literally correspond to the previously published articles. The following list shows all the concerned papers and reports:

- Kupfer, A. (2018): Research Methods in the Information Systems Discipline: A Literature Analysis of Conference Papers, Americas Conference on Information Systems – AMCIS. (New Orleans, LA, USA)
- Kupfer, A. (2018): Self-tracking or Not? That is the Question. Item Generation for Construct Development, Multikonferenz Wirtschaftsinformatik – MKWI. (Lüneburg, Germany)
- Kupfer A., Tiefenbeck V., Staake T. (2018): The Ambiguous Boundary between Professional and Private Use of Information Systems, European Conference on Information Systems – ECIS. (Portsmouth, United Kingdom)
- Kupfer A., Ableitner L., Schöb S., Tiefenbeck V. (2016): Technology Adoption vs. Continuous Usage Intention: do Decision Criteria Change when Using a Technology? Americas Conference on Information Systems – AMCIS (San Diego, CA, USA)
- Kupfer A., Kehr F., Tiefenbeck V. (2016): Towards a Measurement Scale for Self-Tracking: Attitudes and User Characteristics, European Conference on Information Systems – ECIS. (Istanbul, Turkey)
- Staake T., Tiefenbeck V., Schöb S., Kupfer A. (2016): Effect of Real-Time Feedback on Hot Water Use, Final Study Report on the Amphiro-PWN study, https://www.amphiro.com/studien
- Tiefenbeck V., Kupfer A., Ableitner L., Schöb S., Staake T. (2016): The Uncertain Path from Good Intentions to Actual Behavior: A Field Study on Mobile App Usage, DIGIT Pre-ICIS Workshop. (Dublin, Ireland)
- Kupfer A., Schöb S., Staake T., Stiefmeier T., Athanasiou S. (2014): Deliverable 3.1.1 Design Studies, EU Project Deliverable, DAIAD-project

In more detail, Table 1 shows the sections that contain text passages from previously published articles (grey cells represent no re-usage at all). The table excludes Chapter 4 and Chapter 8, as they do not include text passages from previously published work.

**Table 1.** Overview of the Chapters Containing Previously Published Work

| Article | Chapter 1 | Chapter 2 | Chapter 3 | Chapter 5 | Chapter 6 | Chapter 7 | Appendix |
|---|---|---|---|---|---|---|---|
| Kupfer et al. (2018) ECIS | Text passages | Text passages and sentences in introductory part and 2.1, 2.1.1, 2.1.3 text passages in 2.5.1 | Some sentences in 3.3.1 Text passages in the introductory part, 3.1.1, 3.2.1, 3.2.2, 3.4, and 3.5 | | | Some text passages in 7.1 Some sentences in 7.2 | Subsection 10.3.1 |
| Kupfer (2018) AMCIS | | | Some sentences in 3.3 and 3.3.2 Text passages in 3.1.2, 3.2.1, and 3.5 | | | Some sentences in 7.1 | Text passages in Subsection 10.3.2 |
| Kupfer (2018) MKWI | Some selected sentences | Some selected sentences in 2.3 Text passages in 2.3.3 and 2.5.2 | A text passage in 3.1 and 3.4 | | Some selected sentences in 6.2.1, and 6.3 Text passages in 6.2.1 | | |
| Kupfer et al. (2016) DIGIT | | | | Sentences in 5.1 Text passages in 5.5 and 5.6 | | | |
| Kupfer et al. (2016) AMCIS | | | | Sentences in 5.4.1 Text passages in 5.5 and 5.6 | | | |
| Staake et al. (2016) | | | | | | | Subsection 10.5.1 |
| Kupfer et al. (2016) ECIS | Some selected sentences | Some selected sentences in 2.4 | | | Some selected sentences 6.1.1, 6.4, and 6.4 | | |

| Article | Chapter 1 | Chapter 2 | Chapter 3 | Chapter 5 | Chapter 6 | Chapter 7 | Appendix |
|---|---|---|---|---|---|---|---|
| | | | | | Some selected text passages 6.1, 6.1.1, 6.1.2, and 6.2 | | |
| Kupfer et al. (2014) | | A text passage in Subsection 2.3.1 | | | | | |

# 1 Introduction

During the mid-1970s the computer industry started selling personal computers (PCs) which have conquered households (The-Economist-Online 2012). Almost 35 years later, in 2010, Eurostat (2016) found that two-thirds of Europeans use a PC at home, compared to only 31% at work. Likewise, Urban et al. (2011) report a 75% ownership rate for desktop computers and 63% for notebook computers in U.S. households in 2010. In the ensuing decades, "with the development of the Internet and the ubiquity of devices such as smartphones, the volume of information outside the boundaries of the firm has escalated" (Lee 2016, p. 2), and the application of Information Systems (IS) has expanded beyond professional use. In fact, a large share of overall spending, computing power, and interaction with IS – in the form of such technology as home PCs, phones, tablets, wearables, smartwatches, and smart sensors – is now taking place in private contexts, and ubiquitous IS increasingly collect data on various aspects of our private lives. A growing variety of devices and applications eases the acquisition of information and news (media), facilitates everyday communication (e.g., social media), supports personal behavioral change (e.g., fitness, health, and sleep gadgets), optimizes household resource consumption (e.g., smart meters, thermostats), and simplifies various other private transactions (e.g., online shopping, interactions with service companies, tax declaration). Such systems are subsumed under the term (private information systems) PIS in this dissertation.

Among the most noticeably trending technologies and applications within PIS are self-tracking appliances. Self-tracking describes an individual's attempts to collect, store, analyze, reflect, and act upon data related to personal (often private) activities (Li et al. 2010). Such activities include counting steps, tracking fitness, observing health issues, stepping on a weight scale, checking financial expenditures, and noting gas consumption. The rapid technical development of Information and Communication Technology (ICT) and the effortless automation of many processes enable a broader public to easily engage in self-tracking (Gimpel et al. 2013). Various IT devices and applications that support PIS users in tracking a multitude of activities, expected to reach the mass markets in upcoming years (Forni 2016, Quinlan 2017), include so-called wearables or the Internet of Things (IoT) applications. Wearables include device sensors, displays, and communication modules, often worn close to the body (e.g., on wristbands, woven into textile) and providing direct feedback information on a display or indirect feedback through a smartphone application (Baumgart and Wiewiorra 2016). The concept of IoT describes the connection of everyday objects. For example, in a smart home environment the IoT includes the refrigerator, the washing machine, heaters, and other devices (Swan 2012) that can all measure and track activities that relate to their user. Market research institutes forecast that in 2019 alone, 3.6 billion fitness and activity trackers will be sold, with a steady increase expected in the following years (Hayward et al. 2016), compared to 1.5 billion smartphones were sold worldwide in 2016 (Gartner 2017). Demand for self-tracking technologies is likely to rise and the technology to enter the mainstream. Actually, according to Fox and Duggan (2013), almost 70% of U.S. adults track some health-related parameters. As such, the proliferation of self-tracking is an example of IS that rapidly gains further ground outside of traditional firm boundaries, and the technology enters the mass market.

Practitioners predict even greater importance of IS in the consumer sector with the increase of connected devices such as cars, smart home appliances, and wearables – by some estimates, up to 40.9 billion wireless connected devices for 2020 (Press 2014). These developments offer new possibilities for companies to gain customer insights and, at the same time, enable new applications that support individuals in their daily decision-making. As a consequence, private individuals tend to increasingly introduce aspects such as performance and productivity (Lupton 2014) into their private lives.

While IS research has traditionally focused on the use of IS in professional contexts, both within and between organizations (Baskerville 2011b, Beath et al. 2013, Crowston et al. 2010, Glass et al. 2004, Vodanovich et al. 2010), Hess et al. (2014, p. 249) find that "research questions are shifting more and more towards the use of ICT in physical, real-world everyday environments, that is outside of offices, production halls and warehouses". Previously, several scholars had called for more research on the use of IS also in private contexts (Brown 2008, Venkatesh and Brown 2001). As Baskerville (2011a, p. 6) points out, the IS community still perceives individuals mostly as

"clients, customers, or consumers of the organizational IS" instead of stand-alone users. Compared to professional contexts, the role of IS and the circumstances that might shape the adoption and usage of those systems are fundamentally different in private contexts (Baskerville 2011b, Brown and Venkatesh 2005):

- In private contexts, individuals generally use volitional (freely chosen) systems, in contrast to professional contexts, where mandatory systems dominate (Bhattacherjee et al. 2018, Brown and Venkatesh 2005, van der Heijden 2004, Hong and Tam 2006).
- In the case of dissatisfaction, professional users most often show resistance or use workarounds in order to avoid system usage, whereas in the private context, users just terminate the usage (Alter 2014, Chen and Karahanna 2014, Kwon et al. 2014, Turel 2015, Wang et al. 2016).
- Psychology research demonstrates that individuals behave differently at home than at work, which impacts their technology usage (Barnett et al. 2015, Donahue et al. 1993, Maier et al. 2012, Sheldon et al. 1997).
- A different motivational structure accompanies IS usage in organizations, where instead of hedonic systems, utility-based systems are employed (van der Heijden 2004, Middleton et al. 2014, Tuunanen et al. 2010, Venkatesh et al. 2011).
- In professional contexts, IS are used as tools and instruments that offer functionality in various departments, often much more complex and requiring user training; whereas IS for consumers is developed to be as simple to use as possible (Hassenzahl et al. 2003, Hornbæk and Hertzum 2017, Hsieh and Wang 2007).
- Efficiency is a rather important usage goal in the professional context, in contrast to flow or cognitive absorption in the private context (D'Arcy et al. 2014, Hsu and Lu 2004, Peters and Bodkin 2007, Tarafdar et al. 2015b, Turel et al. 2011, Vodanovich et al. 2010).
- In terms of purchase decisions, applications in organizations aim at fulfilling economic needs, whereas the private context is characterized by idiosyncratic and social needs of individuals (Baskerville 2011a, b), leading to personalization and identification criteria (Do et al. 2011, Hevner et al. 2004, Hong and Tam 2006, Melville et al. 2004, Verkasalo 2009).

Even though IS researchers are "uniquely equipped to deal with the broad transformations … in a way no other discipline can" (Beath et al. 2013, p. ii) and while scholars recognize the relevance of revisiting IS theories and models in this new context (Baskerville 2011b, a, Crowston et al. 2010, Hong and Tam 2006), research on PIS for consumers seems still in its infancy. Research on research offers an informed overview of whether IS research has acknowledged the relevancy of PIS and whether IS research questions (RQ) concerning issues outside the boundaries of professional applications are now gaining importance. Along these lines, several literature reviews make the attempt to quantify the share of all articles placed within the professional context. However, these literature reviews consider the context beyond professional applications more as a side note, part of a larger review, rather than concentrating on the private context. For example, Glass et al. (2004) note that two-thirds of all reviewed IS journal articles (488 articles published during a five-year period) fall into a professional context. Likewise, Sidorova et al. (2008), who analyzed 1,615 articles from IS journals from the previous 22 years, identify a stable core of IS research that resides within the professional context. Neither of the two studies treats the private context as a field of its own; both studies distinguish only between professional and societal (professional and nonprofessional) issues. This ignores the distinction between private and professional contexts that Baskerville (2011a, b) and Crowston et al. (2010) suggest. As a consequence, questions as to whether the research community has expanded its focus to the private context, whether recent calls for action have spurred more research activities in this domain, and whether articles resulting from such activities have made their way into top IS outlets, remain unclear. Furthermore, distinguishing between private and professional IS usage becomes increasingly difficult, as many new business models involve private individuals (e.g., social communities, open-source projects).

Together with Hess et al. (2014), Yoo (2010) acknowledges that digitalization now affects not only organizations but also individuals in other environments (e.g., everyday life) and that the IS discipline is especially equipped to contribute to solving current and future problems or challenges. IS scholars call for further investigations of the trend of quantification in our everyday lives, as well as of the usage of mobile ICT because such systems improve aspects about our private lives. Moreover, Agarwal and Dhar (2014) underline the potential of an individual's observations and

measurements to address grand societal problems. For example, eHealth applications can help to improve health care, and energy-consumption-tracking applications enable households to engage in energy-saving behavior (Tiefenbeck et al. 2016). For that reason, they call for exploring possibilities of such quantification and Big Data generation methods. Furthermore, Sørensen and Landau (2015) find a lack of academic agility when it comes to considering emerging socio-technical phenomena within a mainstream context, and they call for more academic reflection to offer relevant insights into practice that matters. Yet, there is an "intellectual void that needs to be filled to understand exactly the nature and consequences of digital mediation of human experiences" (Yoo 2010, p. 220).

On this account, taking together the potential of PIS, especially self-tracking, and the unanimity about the reflection of the relevance in practice within IS research, the dissertation derives the first overall research question:

*What is the status quo of private information systems, especially self-tracking, in information systems research?*

For this reason, the author undertakes two literature analyses. First, an analysis of the content of IS articles studies the share of articles that concentrates primarily on PIS and IS in the professional context. Thus, the dissertation contributes to the discussion on the intellectual core of IS and on the role of IS in the private context. Moreover, external and metadata collected on each article enable investigating more characteristics of PIS research. The results serve as motivation and orientation, particularly for scholars to engage in PIS research. Second, the author presents a more detailed look into one specific PIS domain: self-tracking appliances. As explained above, self-tracking appliances currently find their way into various situations of a person's private life. To that end, another literature analysis focuses not on the share of articles but on the detail of their research content, identifying relevant self-tracking articles and structuring their content and insights according to their research topics, methodologies, and theories employed, among other dimensions to be detailed later. This analysis of prior and current research also locates relevant research gaps for future research on self-tracking. Again, the research results aim to stimulate future research on self-tracking research. Moreover, the results also include findings from other disciplines, such as Human-Computer Interaction (HCI) and psychology, which can prove valuable for IS research.

Especially in PIS, the voluntary nature of usage, hedonic motivations, and the lack of sanctions in the case of discontinuance affect the interaction between private users and self-tracking appliances. Following Vodanovich et al. (2010), this dissertation addresses this issue and aims to shed light on how users engage with self-tracking appliances. First efforts within the self-tracking literature concern frequent termination of self-tracking use (Rapp and Cena 2016). Up to 30% of fitness-tracker users abandon their devices after a short usage time, a "serious problem for the industry" (Forni 2016), and various other researchers report contradictory behaviors when studying adoption or continuous intention (Buchwald et al. 2015, Pfeiffer et al. 2016). Thus, various insights, such as users' interests or design preferences, are yet to be obtained. Additionally, market research studies reveal diverse hurdles to adoption (including price, design, consumer attitudes, and short-lived interest), raising the question of what actually drives or inhibits technology adoption in the self-tracking domain (Insight CC 2014, Intelligence 2015, Lupton 2014, Nuviun 2015, Rooksby et al. 2014, Shih et al. 2015).

Even though IS research offers a wide range of theories, tools, and instruments to investigate IS use, surprisingly little is known about the adoption of self-tracking applications and devices (Sjöklint et al. 2015, Yoo 2010). In comparison to the vast field of insights into adoption within IS research, only a few empirical insights exist on self-tracking adoption. The problem is even more pronounced with respect to post-adoption behavior. This translates into the second research question:

*How do individuals use self-tracking appliances?*

To answer this question, a study investigates the use of a self-tracking appliance with traditional IS instruments in greater detail (Brown and Venkatesh 2005). It determines the explanatory power of the traditional IS instrument in a private context. In the course of a field study, the adoption intention, continuance intention, and actual usage is assessed with the help of self-reports and data recordings. Since one may assume that other factors govern the use of IS in a private environment, compared to a professional environment, traditional usage models likely need to be adjusted to the

private context. The results extend prior qualitative research with quantitative results of a rather large-scale study that also takes a longitudinal approach often neglected by continuance studies.

According to Bhattacherjee et al. (2018), scholars refocus on emotional and individual aspects when engaging in adoption research. This aligns with IS adoption research that differentiates volitional and mandatory systems. To this end, this dissertation concentrates on the concept of attitudes, a powerful concept that has been a part of explanatory models for different use scenarios in IS research, social psychology, or organizational literature. Attitudes combine cognitive and affective aspects and seem adequate to better explaining adoption in the private context. Furthermore, attitudes gain greater importance also in regard to continuous and discontinuous research, as attitudes better explain changing behavior within the life cycle of IS usage. Since scholars assert that self-tracking systems notably undergo early usage termination, a specific measurement instrument for assessing attitudes toward self-tracking could better explain adoption, continuance, and discontinuance. Consequently, the dissertation aims at developing such a specific measurement instrument to assess attitudes toward self-tracking, contributing to the self-tracking literature and IS research on (dis-)continuance.

The remainder of this dissertation is structured as follows. The second chapter identifies the relevant literature on PIS and the private context, usage behavior in IS, self-tracking, and attitudes. It includes primarily literature from the IS discipline. Psychological literature, especially concerning attitudes is also included. The chapter establishes research gaps and articulates detailed research questions that guide the subsequent parts of the dissertation.

The third chapter applies a bibliometric study to quantitatively investigate the relatively small amount of PIS research within IS research, by counting the number of published IS articles that address the private and the professional contexts. Additionally, the bibliometric study also provides information about the research methodologies employed, nationality, thematic content, and knowledge utilization of the articles from the private context. The chapter includes a short introduction, a description of the employed research methodology, a presentation of the data set as well as the research results, and a discussion of contributions and limitations, a format common to the two chapters that follow it as well.

Chapter 4 focuses on a specific field of PIS application, namely, self-tracking appliances. Accordingly, the chapter undertakes a qualitative literature review of the status quo of IS, <, and HCI research on self-tracking, providing an overview of insights into aspects such as research themes and interests, employed methodologies, and theoretical concepts used in the research. Furthermore, a research agenda for future work is generated.

In accordance with the research agenda from the previous chapter, the fifth chapter provides empirical insights about the adoption and continuance intention, as well as actual behavior of an actual self-tracking appliance. The traditional IS model UTAUT1 and its updated version UTAUT2 are applied within a two-wave field study with over 700 participants in the Netherlands. The results show that the models provide rather limited explanatory power for continuous usage intention and do not explain usage behavior.

To overcome the identified limitation of explanatory power, Chapter 6 aims at improving research instruments in order to increase it. To this end, the chapter answers several calls from scholars to include affective aspects in an explanatory model. Accordingly, the chapter develops a specific measurement instrument to assess attitudes toward self-tracking. The structure of the chapter slightly varies in comparison to the previous chapters as different types of data is captured and analyzed.

Chapter 7 summarizes the theoretical and practical contributions, and concludes the dissertation with an outlook on future work.

# 2 Theoretical Background

In IS research, different perspectives exist on the intellectual core of the discipline. The debate on the intellectual core or structure[1] of IS originates in the labor market's need for professional IS talent. This leads to a constant questioning of IS researchers engaged in education and teaching guidelines (King and Lyytinen 2006) in order to adequately follow the market needs. IS studies on the discipline (research-on-research) principally encompass issues for IS used in a professional context (e.g., software development, decision support, groupware for virtual teams, or big-data concepts for companies). Given the origins of the discipline in an era when most IS applications were costly and specialized systems confined to companies or the military, the focal point of the discipline Management Information Systems is hardly surprising. Yet, over the past 20 to 30 years, scholars (Avison and Elliot 2006, Ferstl and Sinz 2013, Kolbe and Brenner 1995, Vodanovich et al. 2010) did not get tired of emphasizing that the key IS domains and applications are no longer limited to professional contexts. Given the increasing ubiquity of IS and the ongoing digitalization of our private everyday lives, skilled IS professionals must be aware of the characteristics and key aspects of IS in private contexts. However, according to Baskerville (2011a, b) and Crowston et al. (2010), IS research has not acknowledged this trend in practice and still predominantly concentrates on professional issues. On this account, this dissertation is dedicated to investigating the phenomenon in more detail. The contributions of the dissertation serve as a call for more research on PIS and for laying a foundation of first empirical and non-empirical insights for future research.

This chapter has two goals. First, it defines and explains concepts and topics used in the first four subsections: PIS and the private context, usage behavior of (P)IS, self-tracking, and the usage of attitudes. Additionally, it aims at delimiting and refining the scope of the dissertation. Second, the chapter outlines shortcomings of current work and specifies detailed research questions that will guide the dissertation and lead to answers to the two overall research questions in the Introduction (p. 1).

To this end, the chapter has five sections. The first section defines private information systems and the private context, presenting current research in this domain in order to clarify the distinction between the private and the professional contexts for IS. Especially in the research stream of usage behavior, scholars have tried to distinguish the private from the professional context. Thus, the next section presents in detail the research on IS use through the lens of PIS. PIS represent a vast field of technologies and applications that make meaningful investigations difficult. On this account, the dissertation focuses in the third section on one specific domain: self-tracking. The section presents the domain and notably current research on self-tracking appliances. As IS literature and empirical results show, IS use in the private context requires an update of traditional instruments that explain IS use, even though in a professional context. For this reason, the fourth section is dedicated to the prominent concept of attitudes. Finally, the last section brings together all insights and presents research gaps, detailed research questions, and an integrated research framework.

## 2.1 Private Information Systems and the Private Context

Before distinguishing private and other IS must come defining the term IS. Many definitions exist within the IS discipline. For example, Alter (2008) collects about 20 definitions, mostly of which refer to computers and technology. Additionally, they often include organizations or management, as the discipline was previously called Management Information Systems. Increasingly, the definitions also imply societal issues. Summarizing his insights, Alter (2008, p. 451) defines IS "as a type of system in which human participants and/or machines perform work (process and activities) using information technology, and other resources to produce informational products and/or services for internal or external customers."

This and other IS definitions still concentrate on the terms "work" and "customers" and do not seem to be general enough to portray current IS use in practice. Over the four or five decades, "with the

[1] The first studies on the intellectual structure conceptualize the research topics as frameworks (Hirschheim et al. 1996). Then, scholars use the term "intellectual core" or "center" (Lyytinen and King 2004, Sidorova et al. 2008) to identify prominent research streams. Other studies include additional aspects of their studies. For example, Zhang and Li (2005) investigate the context of studies, research stream, research methods, and other aspects and name it the intellectual substance. On this account, the dissertation uses the term "intellectual structure" to refer to typical characteristics of a scientific article that helps to inform other scholars on typical aspects, such as research topics, research methods, and contexts that are often employed or chosen by the selected set of articles.

development of the Internet and the ubiquity of devices such as smartphones, the volume of information outside the boundaries of the firm has escalated" (Lee 2016, p. 2), and the application of IS has expanded beyond professional use. According to several senior scholars, such as Baskerville (2011a, b), Crowston et al. (2010), and Yoo (2010), the trends in practice (such as ubiquitous computing, IoT, digitalization) induce that IS gains an increasing role in individuals' private lives. ICT confronts private users all day long, and not only at their workplace. They use smartphones or tablets, fitness trackers, voice assistants, smart home appliances, connected cars, or their personal computer for many private activities fully disconnected from their jobs. Additionally, users are not only customers, but also creators of digital content. Hence, the limited scope of IS must be extended, especially to also capture its private use. This section explains how and why.

### 2.1.1 Private Information Systems

Different advances toward a definition or conceptualization of PIS exist. On the one hand, scholars focus on the individual as a user. On the other hand, scholars rather direct the attention toward private households or the home as a location or an entity.

As an example, for the first conceptualization, Baskerville (2011a, b) puts IS into context with the overall IS architecture (hardware and software) that one individual uses, both for professional and for private reasons. He defines Individual Information Systems (IIS) as "an activity system in which individual persons, according to idiosyncratic needs and preferences, perform processes and activities using information technology, and other resources to produce informational products and/or services for use by themselves or others" (Baskerville 2011b, p. 1). He builds on literature of personal IS subsuming traditional bibliographic systems (Burton 1981) that store selected information or annotations for an individual. Later, personal IS (based on personal information devices) was extended to "systems [that] provide information tailored to one individual and delivered directly to that individual … such as personal digital assistant handheld PC, or a laptop" (Silberschatz and Zdonik 1996, p. 770).

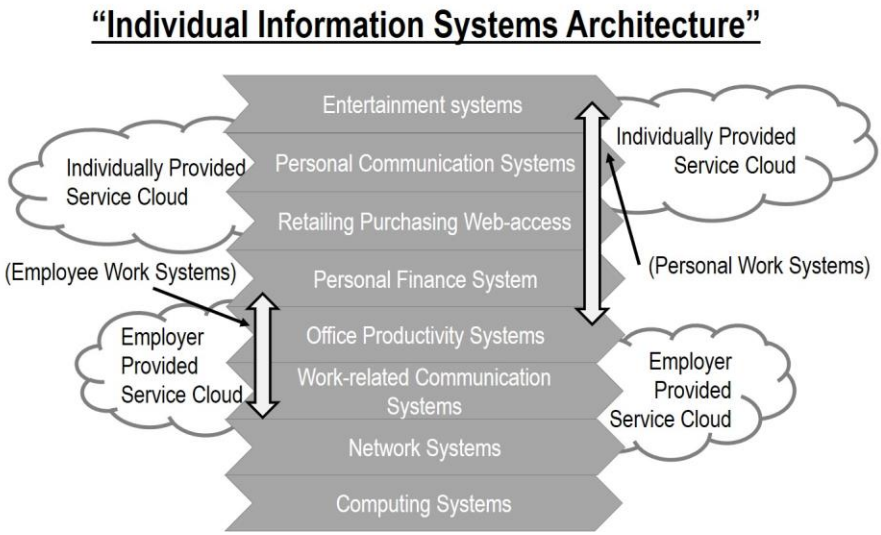



**Figure 1.** An Individual's Information Systems Architecture (Baskerville 2011b, p. 253)

Baskerville's (2011a, b) perspective, which emphasizes the attention to the individual, highlights the necessity to differentiate between private and professional use of IT. As private use influences the professional use of IS, he calls for better understanding private use first. He argues that there are strong differences between these two settings. In order to define IIS and distinguish private and professional contexts, he draws a system description which is shown in Figure 1. Even though it is not holistic, it offers a helpful framework to understand the scope of IIS using the example of some selected systems. For so-called personal work systems, Baskerville (2011a, b) enumerates entertainment systems (video on demand and games), personal communication systems (email, Voice over IP, social networking), retailing purchasing systems, and personal finance systems. By contrast, systems such as shared folders or virtual meeting rooms that increase office productivity and ease communication belong to the so-called employee work systems. Such systems also include computing (e.g., desktop, laptops, and smartphones) and network systems (e.g., service providers, access points, firewalls). Likewise, some office productivity and personal finance

systems are also used in both contexts (e.g., from office suites to tax software). As Baskerville (2011a, b) states, IS has benighted the fact that it has conquered households and private lives, and mostly perceives individuals as mere "retail consumers" (Baskerville 2011a, Vodanovich et al. 2010). On this account, research streams in IS already include PIS use but still concentrate mainly on organizational issues. Examples are IT consumerization, which refers to co-usage of privately owned IS for professional reasons (Niehaves et al. 2012), or consumer centricity, which describes the orientation of IS development and design toward the customer value proposition, needs, and preferences (Liang and Tanniru 2007, Spottke et al. 2015). Obviously, by using IS in a private context also involves economic gains for a company that provides a service or product (e.g., Facebook, Uber) used in individuals' everyday lives. So, complete isolation seems impossible. However, integrating a new lens or perspective might be profitable. So far, it is mainly the Human-Computer Interaction (HCI) community that studies the usage of IS in purely private contexts. In the research stream of personal informatics[2], they investigate artifacts that help to prepare, collect, integrate, reflect, and act upon information such as weight, SMS history, electricity bills, or moods, with the goal of raising awareness or inducing behavioral change (Choe et al. 2014, Froehlich et al. 2014, Li et al. 2010, Pirzadeh et al. 2013). Overall, the perspective is rather artifact-related (design and development of systems for private users).

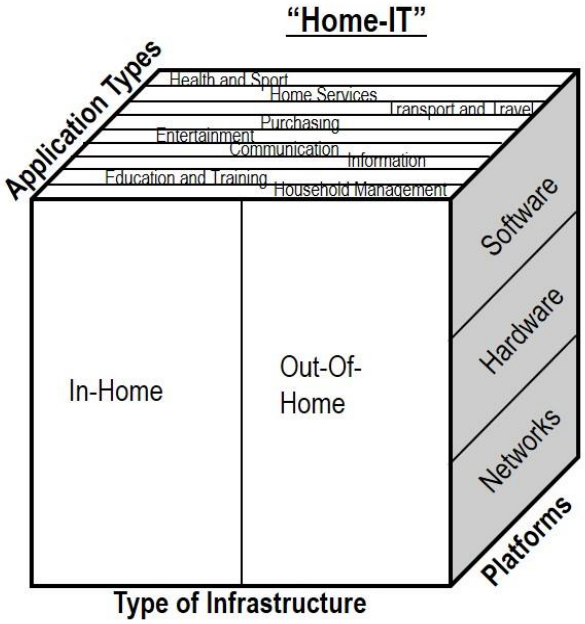



**Figure 2.** Home-IT: Computerized Information Processing in the Private Household (Brenner and Kolbe 1995, p. 100)

Figure 2 shows an example for the second conceptualization from Kolbe and Brenner (1995, p. 501) who asserted almost over 20 years ago that "computerized information processing influences every part of our private lives." On this account, they define the term "home-IT" as "all the infrastructures and applications the private user can take advantage of for private uses" (Kolbe and Brenner 1995, p. 502). They explicitly distinguish this private usage from a professional one (they call it "business issues"). Furthermore, Kolbe and Brenner (1995) argue that five major trends will increase the relevancy of the privately used IS: (1) home-ready hardware and software will exist due to intuitive usage and decreasing prices; (2) household members will automatically learn how to use IS with the help of education and society; (3) the Internet represents a global network that will connect users for various reasons; (4) IS will stimulate a convergence of markets that results in a more diversified offer of products and services for private users; and (5) IS will increase interactions between the private user and technology. In order to conceptualize "home-IT", shown in Figure 2, Brenner and Kolbe (1995) use three main factors: types of infrastructures (at home or mobile), platforms (software, hardware, networks), and application types. The latter is specified by nine application areas where IS support a private user in private activities. Two main support application areas (communication and information) and seven additional ones that are still relevant

[2] Systems "that help people collect personally relevant information for the purpose of self-reflection and gaining self-knowledge" (Li et al. 2010, p. 2, Rapp and Cena 2016).

and exist today: health and sports (e.g., self-tracking or electronical health records), home services (e.g., smart home, voice assistants), transport and travel (e.g., connected cars, Shared Economy), entertainment (e.g., games, VR, music), purchasing (e.g., shopping, eBay), household management (e.g., banking, taxation software, expense tracking), education and training (e.g., eBooks, language apps, YouTube Videos). The communication and information areas encompass Google, WhatsApp, Instagram, blogging, or Twitter.

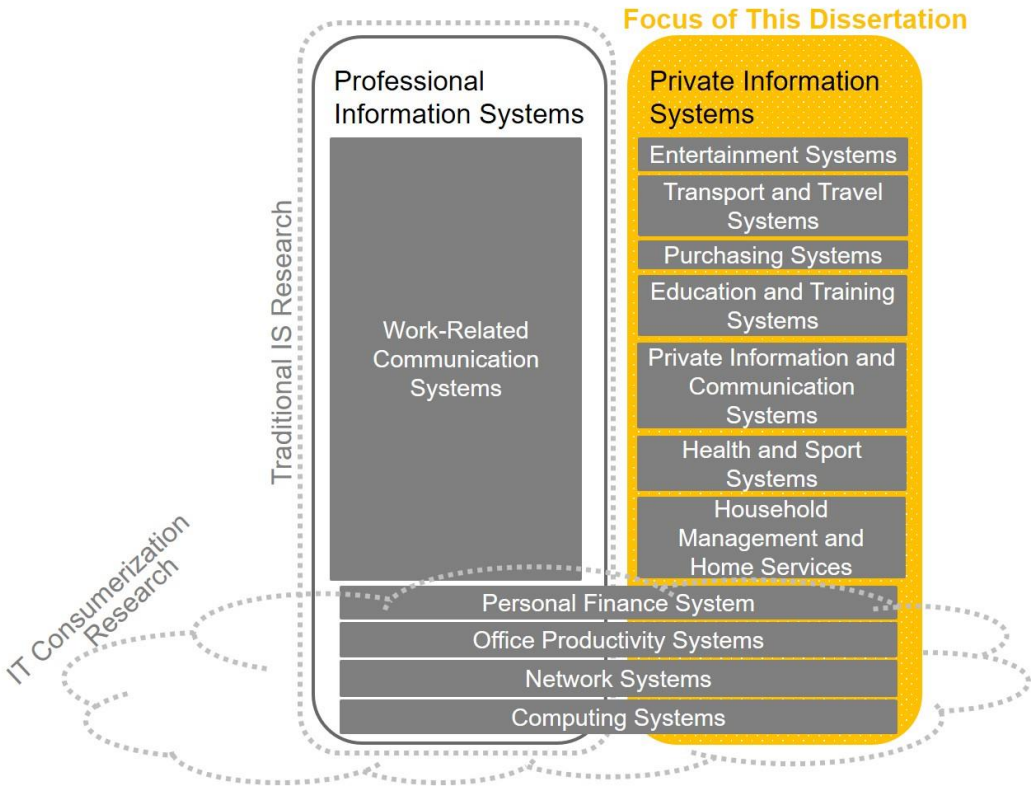



**Figure 3.** Visualizing Private Information Systems from the Dissertation's Perspective Amended from Baskerville (2011b, p. 253) and Brenner and Kolbe (1995, p. 100)

Even though IIS, personal IS, IT consumerization, or consumer centricity refocus on the individual on a personal level, those research streams still concentrate too much on a professional perspective – e.g., what IS usage in the private context means for organizations. In order to understand this interaction, IS research must understand IS within a purely private context, especially with the rising availability of ICT in the private context. For that reason, reorienting the perspective of Brenner and Kolbe (1995), the dissertation defines **private information systems** as:

> Hardware, software, and/or infrastructure that supports a private user uniquely in the course of private activities of everyday life. The spectrum of these activities is rather large and varies from entertainment to purchasing.

In order to update the view of Brenner and Kolbe (1995) with the insights from current research, PIS is conceptualized with the insights from Baskerville (2011a, b) and Niehaves et al. (2012). Figure 3 shows the different research contexts and integrates the system description from Baskerville (2011a, b) with that of Brenner and Kolbe (1995). It shows the two different contexts (professional and private) with some exemplary application areas (or system descriptions). It also includes existing research streams in order to identify current and missing research. The rectangle with dotted lines depicts the traditional IS research attention that investigates IS usage in the professional domain (Glass et al. 2004, Sidorova et al. 2008). The dotted cloud contains research that takes into consideration personal-activity systems, but, does not consider the usage of IS in purely private contexts. Those articles mostly focus on topics such as IT consumerization or consumer centricity and take an IIS-perspective. Even though IS strongly impact our private lives (Petter et al. 2012), most IS articles still concentrate on IS in a professional context. For example, Glass et al. (2004) note that two-thirds of all observed articles (488 articles from five years) in IS journals fall into a professional context. Likewise, Sidorova et al. (2008), who analyzed 1,615

articles from IS journals from the previous 22 years, identify a stable core of IS research and attribute that core to residing within the professional context.

As a result of these rather outdated studies, PIS seem to be understudied within IS research. Thus, to complement prior research and reorient to the perspective of Brenner and Kolbe (1995), this dissertation focuses on purely used IS for private reasons.

Succeeding to clearly defining PIS in relation to other research streams, it becomes apparent that the context of IS use is a main differentiator for private and professional IS. The next section pays particular attention to clarifying the relevancy of the private context (where PIS play the major role) in IS research.

### 2.1.2 The Relevancy of the Private Context in IS Research

The concept of contexts that play a role within IS use is not new for the discipline. Middleton et al. (2014), Tarafdar (2015a, b), and Vodanovich et al. (2010) acknowledge the relevance of specific contexts for studying negative phenomena of IS use (e.g., IT addiction, stress), mobile computing, or ubiquitous IS. Furthermore, the notion of contexts also appears in the discussion about generalization of research results. On this account, Johns (2016), Lee and Baskerville (2003), and Sarker (2016) refer to context as a setting or situational opportunities and constraints in which IT is employed or designed. They argue that scholars cannot easily draw conclusions from one context (e.g., organization) to another. Tarafdar (2015b, p. 163) recognizes that with an "increasing variety of IT users and usage situations," the context impacts behavior.

Notably, Middleton et al. (2014) distinguish the private and the professional ("organizational") contexts from an individual perspective. They theorize that technologies, especially mobile IS (hardware and software) have brought IS to contexts other than organizational ones. Issues of mobile IS touch more than the professional context and, according to Middleton et al. (2014), the center of interest for each research problem should be the individual and his/her role. They define such individual roles as private person, citizen/activist, or professional/employee. They use this philosophical and sociopolitical perspective to analyze mobile IS, considering both organizations and consumers. Baskerville (2011a, b) and Crowston et al. (2010) also support this reorientation of IS research, and it has borne some fruit: New research streams such as work-home balance or bring-your-own-device already soften the typical boundaries of IS, which prevailingly focus on organizations and the individual as an employee.

Apart from the role, there is also the perspective, the context defined in a spatial or physical setting. Tarafdar et al. (2015a, b) explain that the term context in IS "refers to the specifics of a given situation in which IT is used or developed" (Tarafdar et al. 2015b, p. 163). For example, investigations of interruptions and IT addiction research occur in work and non-work contexts. Yet, they also highlight the increasing difficulty of distinguishing between these two contexts, as problems with IS usage occur "seamlessly across life-activities" (Tarafdar et al. 2015b, p. 164) that are not easy to allocate to either a workplace or a non-work locale. Moreover, Vodanovich et al. (2010, p. 711) justify the blurring of the contexts with "the rise of the digital native" and the ubiquity of IS. Digital native describes the generation for which ICT usage is completely natural, born as they were into a world intertwined with ICTs in all areas of life. The authors argue that the implications of these developments impact IS research in particular. In order to structure such impacts, they establish the framework shown in Figure 4. The framework distinguishes:

- Users: digital natives and digital immigrants (who represent the generation before that) have grown up with ICT or learned how to use it at a later stage in life;
- Activities: personal or professional;
- Systems: traditional and ubiquitous;
- Contexts: home and office.

With the help of the framework, they posit that until now, IS research mostly concentrated on the inner circle, combining IS use for professional activities in an office context with traditional systems used by digital immigrants. Vodanovich et al. (2010) argue that due to the new circumstances of IT use for digital natives, their way of acting or decision making largely differs from the digital immigrants. This is rooted in social psychology that shows individuals who grew up in different cultural environments acting and deciding differently from those from another cultural environment.

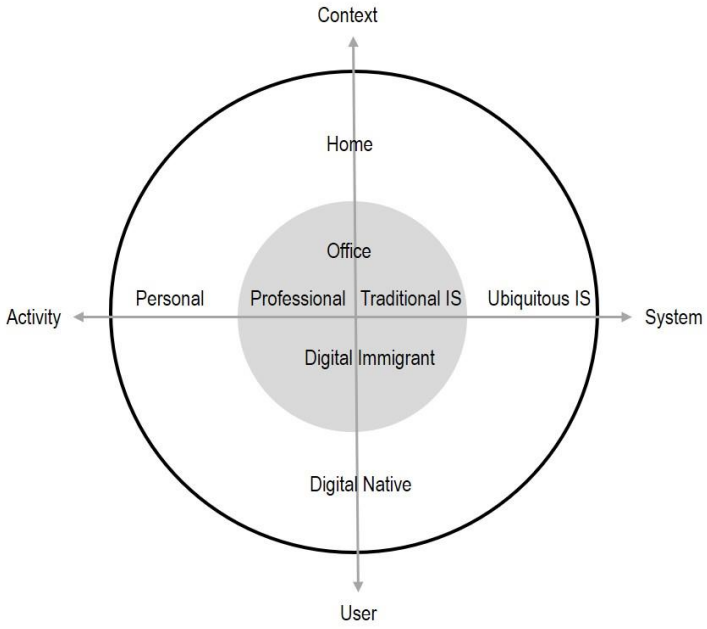



**Figure 4.** Dimensions for Understanding Digital Natives and Ubiquitous Information Systems (Vodanovich et al. 2010, p. 713)

In this sense, Baskerville (2011a, p. 2) reveals that IS research predominantly focuses on "social, organizational and managerial contexts" that are still strongly related to profession. Moreover, Crowston et al. (2010, p. 2) emphasize that "systems increasingly enable use and interaction where there is not only no identifiable organizational context, but also no clear output or task."

As mentioned above, IS scholars not only acknowledge the relevancy of contexts within IS research; they also discuss the boundaries of the IS field and point out that while IS are used "beyond traditional work environments" (Crowston et al. 2010, p. 2), IS scholars have largely ignored the phenomenon so far (Baskerville 2011a, b). Additionally, the same scholars also acknowledge that IS use in the private context has been increasingly relevant for IS research through the introduction of the personal computer. However, studies mostly stay within organizational boundaries, as research-on-research studies show (Glass et al. 2004, Sidorova et al. 2008). Topics with a strong focal point on the employee role (such as work-home conflicts or bring-your-own devices) outnumber by far research on topics such as IT-addiction (often related to IS purely used during leisure time, such as Facebook). Yet, IS research on the private context is vital because it affects everyone in many situations that are quite different from IS use in organizational settings.

Johns (2016), Lee and Baskerville (2003), and Sarker (2016) point out that even for different organizations/cultures, contextual differences exist. This leads Baskerville (2011a, b) and Crowston et al. (2010) to believe that the differences between the private and the professional context represent a specific challenge for IS scholars. Crowston et al. (2010) point out that typical IS approaches might not be applicable to the private context. The next section shows to what extent (IS) research already demonstrates that the private and professional context differ greatly, implying that IS research might need to adapt its approaches to this new context.

### 2.1.3 Contextual Differences between Private and Professional Use of IS

As suggested by the literature (Bhattacherjee and Premkumar 2004, Johns 2016, Orlikowski and Iacono 2001, Venkatesh et al. 2011), usage of IS in a private context differs from a professional context. This subsection presents selected differences as opposing pairs that must be taken with caution, as exceptions always exist, and the opposing pairs cannot be seen as generalizations.

Obligation: Mandatory vs. Volitional Systems

Use of an IS in the professional context is predominantly mandatory. In contrast, in the private context, system usage is almost fully at the discretion of the user. Bhattacherjee et al. (2018) posit a continuum of volitional and mandatory IS usage (also referred to hedonic and utilitarian). On one side are personal IS used at home (e.g., a taxation program) and on the other side the

organizational IS system that is already implemented and integrated, no matter what personal preferences exist (e.g., the enterprise resource system). Also, van der Heijden (2004) relates volitional systems to being "strongly connected to home and leisure activities" (van der Heijden 2004, p. 695), positively highlighting the existence of a private context. Yet, he underlines that volitional IS are also used in other contexts (e.g., professional uses) when employees have the liberty to choose a certain application provided by their company (e.g., for system development). Overall, an employee is bound to use a mandatory system and resistance may be sanctioned. In contrast, volitional system usage concedes the initial choice and the continuous-usage decision completely to an individual.

In that context, Brown (2008) and Hong and Tam (2006) note and empirically show that fundamentally different factors (e.g., in terms of interactions or type of tasks) shape the acceptance of IS in households, as distinct from at the workplace. As an example, a different societal structure accompanies IS usage, when instead of colleagues and superiors, family and friends become relevant interaction partners (Yoo 2010). In contrast to professional environments where managers typically decide to which systems employees have access and which they must use to carry out their tasks, in the private context, individuals themselves (impacted by their social fabric) voluntarily decide which system to use or not. According to empirical results (Venkatesh et al. 2003, Venkatesh and Davis 2000), IS scholars have also shown that different factors impact usage intentions, depending on volitional or mandatory use. For example, social norms do not have a significant effect on intentions in voluntary settings, but do in mandatory settings (Hartwick and Barki 1994, Venkatesh and Davis 2000). This also explains mixed results for social norms in previous technology-acceptance studies in purely organizational contexts (Bhattacherjee et al. 2018, Legris et al. 2003, Taylor and Todd 1995a). So, the opinion of colleagues or superiors impacts employees while adopting a new system, whereas the social influence in the private context (where voluntary/volitional systems are used) plays an insignificant role.

Dissatisfaction: Workaround and Resistance vs. Termination

In the professional context, a major unexpected reaction to mandatory IS usage, already discovered at the stage of implementation of a new system, is user resistance (Bhattacherjee et al. 2018). It is defined as "an adverse reaction to a proposed change which may manifest itself in a visible, overt, fashion (such as through sabotage or direct opposition) or may be less obvious and covert (such as relying on inertia to stall and ultimately kill a project)" (Hirschheim and Newman 1988, p. 398). Resistance in professional settings describes various behaviors such as reluctance or deviance. Deviant user responses to systems usage leads to workarounds (Alter 2014), opposing voices, or even sabotage of IT implementations. Bhattacherjee et al. (2018) also pay attention particularly to the emotional response of employees toward change.

For volitional systems, unexpected reactions of users relate to discontinuance (Chen and Karahanna 2014, Turel 2015). Another main issue is IT addiction, often related to video games (Sepehr and Head 2013) or social media (Kwon et al. 2014, Wang et al. 2016, Yahya 2017). Actually, smartphone app usage demonstrates the problem of discontinuance in the private context. In the case where an individual does not like an application on his/her smartphone, he/she just terminates usage or installs a new application. Especially for self-tracking devices, a big issue is that devices are easily lost. Yet, if an employee does not like an enterprise resource planning system, it is impossible to stop using the system or change to another system, as several hundred or thousand employees use the enterprise resource planning system.

Divided Self-Concept: Professional Role vs. Role at Home

According to (social) psychology, individuals may incorporate differently the varying roles in which they act, respond, or even feel. Aspects such as the environment and social context influence the way an individual feels or acts. For example, in a work context, an individual might be more reserved, whereas at home with his or her friends, he or she is rather outgoing. Another example concerns the openness to experiences, which is more lived out within a romantic relationship than in the employee role (Sheldon et al. 1997). This role changing refers to cross-role variability, divided self-concept, or self-concept differentiation, defined as the ability to adapt "to the varying requirements of different social roles" (Donahue et al. 1993, p. 834). Depending on specific rules and expectations, some individuals adapt their behavior, resulting in various self-conceptions. Such differing self-conceptions may consist of a stable "core" self (with various facets on the outer parts

of the core) or an individual is just an "interpersonal chameleon" (Donahue et al. 1993, p. 835) who completely adapts to various situations without having a stable core personality.

The IS discipline has shown that personality traits serve as predictors of usage intention and usage (Barnett et al. 2015, Maier 2011, Maier et al. 2012), and the divided self-concept is also likely to impact technology usage. One major research stream of the self-concept in psychology investigates the different roles individuals play in a private and a professional context.

Motivation: Utility vs. Hedonism

The distinction between hedonic and utilitarian IS discerns systems that induce pleasure, enjoyment, and happiness, and other systems that offer instrumental support to the user in performing a task (Sharma and Yetton 2007). Originally, professionally used information systems generally existed to provide functionality to the user. On this account, the user can fulfill a specific task in order to support ongoing operations of a company, such as billing or planning. The task fulfillment of each employee ensures strategic and operative success of the organization. Such systems are utilitarian IS and organizations rely heavily on them. In contrast, IS that primarily focus on the user's enjoyment are rather of secondary or no importance. A plethora of examples exists of systems used in the private context for purely hedonic reasons: social-network sites, games, or media (van der Heijden 2004). One specific example is Apple's prominent Fluid application for the iPhone, which gives the user the impression that the surface of his or her screen reacts like the surface of water with which he or she can interact (e.g., dip his or her finger into the water and create small waves). It has no exact utility for the user, however, the app was downloaded and used many millions of times because users just derived pleasure from it (Tuunanen et al. 2010). So, individuals "value different things when using a hedonic vs. a utilitarian IS" (Venkatesh et al. 2011, p. 529).

As another example, ownership rates of smartphones continuously increase. In emerging and developed countries, almost 80% of Internet users use social media such as Facebook or Twitter with their own smartphone or another device (Poushter 2016). This large share emphasizes Vodanovich et al.'s (2010) vision of the rise of the digital native, which induces a change in IS usage behavior in comparison to the current IS user, the digital immigrant. Digital natives grow up with IS and they naturally use a large variety of systems before entering work life. On this account, they have a completely different relationship to IS systems usage, one that also includes different expectations of aspects such as usability and enjoyment. The concept of the digital native emphasizes Yoo's (2010) vision of the rise of so-called experiential devices and tangible computing[3]. Such experiential devices "digitally mediate … embodied experiences in everyday activities through everyday artifacts that have embedded computing capabilities" (Yoo 2010, p. 213). He exemplifies this with the example of wearing contact lenses, which represent an inherent value – not only improving sight but also making improved sight completely natural and more comfortable, helping the user to experience private life differently. A more IS-related example consists of self-tracking devices that can be considered experiential devices (Sjöklint et al. 2015). Self-tracking devices such as pedometers mediate the everyday-life experience of running by "increasing reflection, changing behavior and driving personal insights" (Sjöklint et al. 2015, p. 2). Moreover, users respond rationally and emotionally to such devices, especially when interacting with smart everyday artifacts with embedded computing capabilities, connected in networks of digitalized objects (actors and sensors). Individuals also personify their IS appliances (e.g., the laptop is referred to as "he"). At a later stage of the process of embodiment, "computers will be forgotten by the users and are hidden" (Yoo 2010, p. 220), and future generations face hedonic IS sooner than they face utilitarian IS.

Complexity: Training vs. Usability

Furthermore, van der Heijden (2004) shows that a user of a volitional and hedonic IS decides to use such a system that is rather rooted in a setting at home and in leisure time based more on aspects such as usability or fun than a user of a mandatory system. Mandatory IS often reveal a higher complexity because they represent sophisticated processes in large organizations with many interactions (Hsieh and Wang 2007). Additionally, system developers combine requirements and functionality by avoiding any distraction (van der Heijden 2004). For example, enterprise

[3] Tangible computing "refers to a mode of computing in which users interact directly with the system by physically manipulating objects instead of" (Yoo 2010, p. 215) using graphical interfaces or hardware such as keyboards or remote controls.

resource planning systems digitize organizational processes over various divisions, triggering and placing orders, managing production, and billing customers. Successful usage of such systems is most often only achievable with adequate training (Sharma and Yetton 2007) that helps individuals to better understand how to use the system in their daily routine and overcomes anxieties related to system usage. In contrast, end-user appliances are expected to be easy to use even without training. Aspects such as usability have paid particular attention to the end-user, especially the consumer. In this context, another research stream has developed due to experienced limitations of usability models, namely, user experience (Hornbæk and Hertzum 2017). In comparison to usability, user experience solely focuses on hedonic aspects and neglects utility. Unlike traditional explanatory models that rely on rational and utility-based predictors (e.g., perceived usefulness, perceived ease of use) to explain adoption or usage, user experience models take emotional reactions or appeal into consideration (Hassenzahl et al. 2003). On this account, simplicity is key when designing IS appliances for consumers (Marr and Prendergast 1993, Schierz et al. 2010).

Usage Goals: Efficiency vs. Cognitive Absorption

Vodanovich et al. (2010) posit traditional IS focus is improving user efficiency and effectiveness while performing a task (Hevner et al. 2004). In contrast, modern systems do not only concentrate on functionality; other aspects gain increasing importance. Interactivity, usability, flexibility, and connectivity constitute characteristics of IS that the digital natives highly appreciate (see section above) in their professional and private lives. These characteristics ensure that IS infiltrates individuals' lives on other levels than increasing productivity or supporting task fulfillment. Whereas playfulness and involvement also imply negative effects (such as longer duration of task completion, distraction, and over-involvement) that endanger efficiency and time-saving advantages acquired through IS (Webster et al. 1993), playfulness and involvement represent desirable goals of individuals in their private lives, In the course of introducing the Internet and PCs into individual homes, such aspects have been shown to explain IS usage behavior. Notably, flow or cognitive absorption (Hsu and Lu 2004) are coveted for games or multimedia applications. Flow refers to state of total involvement during a specific activity (Hsu and Lu 2004). An individual is absorbed to such an extent that he or she does not pay attention to anything else in the environment. Cognitive absorption is an extension of the notion of flow and represents a state, a trait, and an attitude. The concept of flow appears in many leisure-related activities such as dancing, gaming, and shopping, and has gained importance in the field of IS, especially in the context of consumer behavior while navigating the Web (Hsu and Lu 2004).

Cognitive absorption in the context of IS/IT can also lead to addiction.[4] Such IT addiction has been predominantly studied in non-work contexts (Tarafdar et al. 2015b): the Internet, online video games, social network sites, online auctions, or mobile texting (D'Arcy et al. 2014, Griffiths 2012, Peters and Bodkin 2007, Salehan and Negahban 2013, Turel et al. 2011). It may also occur in the professional context; yet, it represents a major dark side of IS use in the private context. Technostress or interruptions represent typical negative effects that often occur within organizations.

Purchase Decision: Value of IT vs. Identification and Personalization

Since the beginning of IS as a discipline, one key topic addresses the contribution of IT to organizational performance of a company (Kohli et al. 2008, Melville et al. 2004). For example, the contribution consists of an increase in productivity, cost reduction, or the limitation of inventory (Melville et al. 2004). Financial decision criteria frequently guide IT investments/purchases that offer such contributions (Bacon 1992, Dehning et al. 2005).

In contrast, purchase decisions in the private context also depend on other considerations. First, for individuals, IS may even become a part of an individual's identity (Baskerville 2011a, Yoo 2010). For example, Hong and Tam (2006, p. 172) reveal that with respect to understanding adoption in a non-work setting, "the desire to be unique in a community and the need to comply with a social group can exist at the same time". On these grounds, IS do not only serve as a tool to achieve a

[4] Turel et al. (2011, p. 1044) define it as: "as a psychological state of maladaptive dependency on the use of a technology to such a degree that the following typical behavioral addiction symptoms arise: (1) salience – the technology dominates a user's thoughts and behaviors; (2) withdrawal – negative emotions arise if a person cannot use the technology; (3) conflict – the use of the technology conflicts with other tasks, which impairs normal functioning; (4) relapse and reinstatement – a user is unable to voluntarily reduce the use of the technology; (5) tolerance – a person has to use the technology to a greater extent to produce thrill; and (6) mood modification – using the technology offers thrill and relief, and results in mood changes."

goal; they become personal accessories related to someone's identity. Studies show that especially iPhone users seem to see their smartphone as a status object and feel more affiliated to other users of the same manufacturer (Diel et al. 2018). Additionally, in Japan, teenagers add specific accessories (pendants, casings, and colors) to their smartphones, which integrates the smartphone with their identity (Lamb and Kling 2003). Another prominent example are Apple products that imply a certain "coolness" (Tuunanen et al. 2010) and preference for technological appliances (including the importance of appearance, intuitive usage, proprietary system with other devices). Second, beyond the application of IS to fulfilling economic needs in a professional context, idiosyncratic and social needs of individuals gain in importance, especially within the private context (Baskerville 2011a, b). This results in a high variety of products and services. The research stream of IT consumerization and personalization contributes to this development. Additionally, research on smartphone usage (intensity interactions with the smartphones and employment of functions) reveals that application usage largely differs from one person to another (Falaki et al. 2010) but also from one context to another, e.g., at home or at work (Do et al. 2011, Verkasalo 2009).

Overall, the IS discipline is uniquely equipped with its already acquired insights and its interdisciplinary role to contribute to research on the private context. A first issue omnipresent in the literature review above concerns usage. It is evident that IS research has already acknowledged existing differences between the contexts. The selection of a relevant research stream here follows Vodanovich et al. (2010) who suggest addressing behavioral engagement with digital natives as a first step. This suggestion is applied to the research on IS in the private context. To this end, the next section presents current IS research on usage behavior with a special focus on PIS.

## 2.2 Usage Behavior of (Private) Information Systems

IS have a great potential to provide "gains in efficiency, effectiveness, or productivity" (Bhattacherjee and Sanford 2006, p. 805). However, these gains depend on successful adoption and usage of IS. When it comes to trying to understand usage of PIS, IS research offers a plethora of models and theories of professional IS usage. The following section clarifies relevant basic terms and the status quo of IS usage research. First, the general IS life cycle provides an overview of the main phases of IS usage that scholars have considered. Second, for each step of the life cycle, the most prominent theories are presented.

In order to structure the IS life cycle, the user transformation model (see Figure 5) from Maier et al. (2015) illustrates the different IS usage phases a user may experience. It helps to refine the term "usage" with pre- and post-phases. To begin with pre-usage, an individual chooses to use an IS, often also labeled as IS adoption or acceptance (especially when mandated). Then, the actual usage phase starts. Moreover, after successful adoption or acceptance, the user can engage in making use of the IS (also called continuous usage). For certain reasons, the user might end (terminate) the continuous usage of a system, called discontinuance. The state model in Figure 5 also illustrates the very first articles that set the ground for research on adoption, continuous usage, and discontinuance.

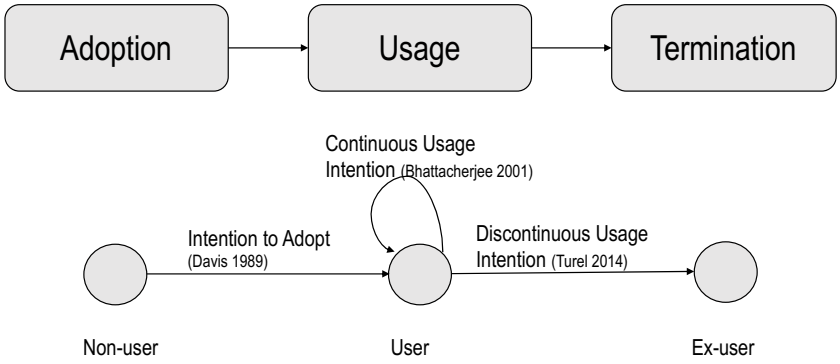



**Figure 5.** IS Life Cycle (Maier et al. 2015, p. 278)

The following section summarizes the most prominent theories and models (also based on Figure 5) concerning each usage phase, specifically emphasizing the distinction between the professional and the private contexts. A complete overview and more details of each theory and model can be found in Appendix 9.1 (p. 175).

### 2.2.1 Theories and Models for Adoption

Technology acceptance is one of the oldest and most largely studied topics in IS research (Williams et al. 2009). Since its beginning, scholars have engaged to investigate why individuals adopt or refuse to adopt IS, with the goal of ensuring IS usage, of course. Williams et al. (2009, 2015) provide an excellent meta-study (previously called research-on-research) and enlarge various other meta-studies with a broader perspective (e.g., reviewing more than one model, not all usage contexts are considered, only methodological aspects are considered, and the database is restricted or outdated).

According to Bhattacherjee and Sanford (2006), research from the forty decades focused on explaining individual perceptions and intentions, and external factors of such interactions within networks that explain behavior. For the former, the most prominent models and theories are the theory of planned behavior (TPB), theory of reasoned action (TRA), technology acceptance model (TAM), and more recently, the unified theory of acceptance and use of technology (UTAUT). Several variations exist, e.g., a model for explaining the adoption of IT within households (Brown and Venkatesh 2005). Altogether, they integrate "salient user cognitions" (Bhattacherjee and Sanford 2006, p. 806) toward an IS, such as attitudes, beliefs, subjective norms, values, satisfaction Appendix 9.1 (p. 175) provides a more detailed overview. Another research stream pays particular attention to the innovation diffusion theory (IDT), which concentrates more on the effects within a network, such as the influence of early adopters. Relevant adoption attributes or determinants are "the relative advantage, the complexity, and compatibility with existing work procedures" (Bhattacherjee and Sanford 2006, p. 807) of an innovation.

Overall, Benbasat and Barki (2007, p. 214) critically reflect the usage of TAM and imply that due to the "changing nature of IT applications" the original model needs to evolve. This also explains the number of existing models in the literature. At the publication of their article, they had principally described a trend of "users interacting with multiple entities consisting of both technology and online merchants as well as other customers in on-line settings" (Benbasat and Barki 2007, p. 214). This reflects a shift from IS usage in only organizational contexts to more attention to the end users.

Three meta-studies exist on determining the usage of theories and models in the private context:

(1) The meta-study from Williams et al. (2009) reveals that only a small number of all studies have concentrated on a private or personal context. Additionally, the examined technologies are first and foremost used in a professional setting (e.g., electronic applications for businesses, IS at the enterprise, enterprise IS development, software, and Internet/online). For that reason, Williams et al. (2009, p. 9) call for more adoption research in other contexts than "the purely organizational" one. Furthermore, they ask editors and reviewers to consider more articles touching "under-researched but contemporary issues such as mobile devices".
(2) In contrast, with their HCI and IS meta-study of technology and user-experience studies from 2010 – 2014, Hornbæk and Hertzum (2017) reveal that 40% of their 37 studies originate from a (so-called) leisure context, and only 17% of all articles originate from a work context.
(3) Furthermore, Dwivedi et al. (2008) conducted a literature review focusing only on articles on adoption from the (so-called) residential/household perspective from 1998 until 2008. They discover that the typical IS models (TAM, TRA, TPB) are applied in almost 50% of all 80 articles under investigation, and the remaining articles used 21 other theories and models. The large number of theories and models (including 45 theoretical measurement instruments in total) reveals the diversity of the application of IS in the private context.

Even though the research results seem quite different, especially between Hornbæk and Hertzum (2017) and the others, the chosen disciplines for the articles might be at the source. Hornbæk and Hertzum (2017) used IS and HCI literature, whereas Williams et al. (2009) and Dwivedi et al. (2008) used IS or Management literature. After having extensively studied adoption, current research, such as Bhattacherjee et al. (2018), pays particular attention to negative effects of adoption or IS usage overall. They also state that in light of these problems, IS research should reorient itself to the important role of attitudes within IS use.

All in all, the private context (in the form of households or usage at home) has slowly been acknowledged in adoption research, but remains by far overlooked, especially facing distinguished

issues when compared to the professional context. Moreover, other issues experience more attention from the community: contradicting behavior (resistance) and the question of what happens after the adoption (post-adoption). Presentation of the second issues in more detail follows.

### 2.2.2 Theories and Models for Post-Adoption: Continuous Usage

As adoption results in first-time usage, “IT continuance refers to long-term or sustained use of an IT by individual users over a period of time” (Bhattacherjee and Lin 2014, p. 1). This ensures exploiting the full potential of IS for individuals or organizations. As an example, when it comes to the diffusion of online services (for B2B or B2C relationships), customer retention is less expensive than customer acquisition. This new focal point translates into recognition by the IS community of the rise in volitional IS and notably brings the customer to the center. With the Internet, cloud computing, and online services, business partners become customers and can choose an IS service provider or an IS much more freely than before, when a complete software or stand-alone system was needed. Also, for the private context, Middleton et al. (2013) underline the relevance of continuous usage in the context of health and life style behavior-change programs that can only be effective when they are continuously used (e.g., self-tracking devices for nutrition, weight, or fitness). However, Bhattacherjee and Lin (2014) emphasize overall that other models and theories still remain within the limits of professional contexts.

Based on the expectation-confirmation theory (ECT) that originates from post-purchase consumer behavior, Bhattacherjee (2001) develops an explanatory model of continuous usage. As ECT posits, consumers evaluate the performance of a product or service after first usage, in relation to their expectations. In the case that their expectations are confirmed, satisfaction or affect is reached. This satisfaction, representing evaluations of affects/attitudes and more experience-based, determines repurchase or continuance. Beyond that, Bhattacherjee (2001) finds (in the context of private online banking) that satisfaction represents a stronger predictor than usefulness. The influence of usefulness wears off over time, but the effect of attitudes increases, because incorrect beliefs from the beginning are updated by experiences. Based on this knowledge, prominent and current models of continuance (Bhattacherjee and Premkumar 2004, Xu et al. 2017) follow Bhattacherjee et al. (2001, 2018) and consider attitudes as a focal measurement instrument to explain continuous usage. They refer to the transformation of attitudes that can change during the usage process. As attitudes and beliefs are key measurement instruments in explaining acceptance and continuance, now the transformation of intentions can be understood. They also found that a change in attitude may explain the intention of IS continuance, even though acceptance is low.

Lately, IS research especially focuses on diverse reactions of users of IS systems. Continuance reveals an adverse reaction when it is terminated: discontinuance. The following section defines that concept.

### 2.2.3 Theories and Models for Post-Adoption: Discontinuance

Turel (2015) follows Bhattacherjee et al. (2018) by challenging existing theories and models, and comes back to emotional aspects (in this case, satisfaction). However, he considers IS usage in hedonic settings. He explicitly acknowledges the existing differences when choosing to discontinue IS usage in a hedonic (often personal IS usage, such as video games or social networking sites) or a mandatory (enforced by the company) situation. In the latter case, individuals do not have the possibility of freely choosing to discontinue system usage.

For example, users of social-network sites perceived IS usage as a distraction, time waster, and source of negative emotions (Baumer et al. 2013, Sheldon et al. 2011, Vanman et al. 2018) which may result in discontinuance. Furthermore, Turel (2015) suggests that discontinuance is not simply the behavioral opposite of continuance. Thus, both concepts can coexist, and different factors determine them. As discontinuance is a post-continuance phenomenon, an individual can experience high or low continuance and discontinuance intentions at the same time, which may lead to serious decision problems. On the one hand, the user is curious about finding out something new about his/her friends or watching another video. On the other hand, the user knows that using the social-network site just represents a waste of time. Such a situation rather exists in the settings of hedonic systems, where the user can freely choose to use a system that may be just for entertainment. Turel (2015) also explains a decision to discontinue with Bandura’s (1986) social

cognitive theory. Social cognitive theory "portrays individuals as proactive self-regulators who assess the environment and reflect on their experiences, feelings, self-beliefs and states, and utilize this information for deciding how to act" (Turel 2015, p. 434). Thus, self-reflection on environmental, personal, and behavioral factors leads to a decision to discontinue an IS. The process of self-reflection takes into consideration the act of self-observation (of all factors) and the judgmental process – according to their values. From social- and health-related studies, Turel (2015) derives important personal factors involved in such a discontinuance decision – e.g., guilt feelings, addiction, or discontinuance self-efficacy. Additionally, behavioral factors that include satisfaction and habit play an important role, as discussed, for example, by Bhattacherjee (2001) in the continuance domain.

Even though some IS research within post-adoption opens up to the private context, general insights about the usage behavior of PIS are still rather limited and do not fully take into consideration the distinction between the private and the professional contexts. The differentiation of volitional (hedonic) or mandatory (utilitarian) systems and the increasing attention to discontinuance (rather observed in the private context) already push in the needed direction. They serve as an important foundation that can help to better explain the usage of PIS. In order to contribute to this field, this dissertation focuses on one specific domain of PIS: self-tracking. Self-tracking relates to various PIS (e.g., health, entertainment, education, household management), and first research attempts show that such system usage poses specific problems within the post-adoption phase. The next section gives a more detailed description of self-tracking and the usage of such systems.

## 2.3 Self-Tracking and Usage Behavior of Self-Tracking Appliances

In 2007, Kevin Kelly and Gary Wolf (editors at *Wired* magazine) inspired a group of tech savvy early adopters to intensively develop and discuss self-tracking devices and applications (Sjöklint et al. 2013). Such artifacts helped them to "know" themselves better by quantifying personal activities (e.g., nutrition, movement, communication, finances, moods) (Baumgart 2016). The community was rapidly subsumed under the umbrella term Quantified self (Choe et al. 2014) and encompasses rather a specific type of individuals – mostly white males in their 20s or 40s (Lee and Briggs 2014). Ten years later, not only Quantified selfers – individuals who follow the Quantified-self movement – engaged in self-tracking. An increasing number of individuals started self-tracking, from adults who use fitness trackers (e.g., www.fitbit.com) to school kids who track the number of books they read in elementary school (e.g., www.antolin.de). Those two applications already reveal the eclectic deployment of self-tracking for various activities and generations. Individuals have been self-tracking personal data with analogue/manual techniques (e.g., paper and pen, weight scale) for since the more than one century (Ayobi et al. 2016, Crawford et al. 2015). Now, with the trend of digitization and miniaturization, self-tracking is enhanced by technology-based devices that ease the tracking process, such as smartwatches for activity tracking (e.g., pedometers), consumer devices that measure electrical activity of the brain (EEG), energy-consumption monitoring, or smart home automation (Swan 2012). In the literature, various definitions exist that determine the main aspects about self-tracking. Table 2 shows a selection of definitions from IS scholars.

**Table 2.** Selection of Definitions of Self-Tracking from IS Scholars (Including Citing Scholars)

| Source | Definition |
|---|---|
| (Li et al. 2010, p. 2, Rapp and Cena 2016, p. 2, Sjöklint et al. 2013, p. 3) | "self-tracking is understood as an individual activity that pursues the **collection of quantitative personal data** on various **aspects of life**, such as physical performance and mood, with the aspiration to gain **self-knowledge** and **motivate behavioural change**"<br>"that help people collect **personally relevant information** for the purpose of **self-reflection** and gaining **self-knowledge**" |
| (Baumgart 2016, p. 1, Baumgart and Wiewiorra 2016, p. 1, Choe et al. 2014, p. 2, Li et al. 2010, p. 557, Whooley et al. 2014, p. 1) | "as utilizing technology **to monitor one's own behaviour** e.g., steps, running pace, pulse or mood for the purpose of **self-reflection** and inactivity"<br>"the process of recording one's own **behaviours, thoughts, and feelings,** which can enhance **self-knowledge** and foster reflection" |
| (Buchwald et al. 2015, p. 2, Lupton 2014, p. 5,8, Pfeiffer et al. 2016, p. 3) | "**current trend** to collect and analyse **specific features of the life** on a regular basis through mobile and wearable digital devices" |

Lupton (2014, p. 1) defines self-tracking as "the practice of gathering data about oneself on a regular basis and then recording and analyzing the data". Table 2 shows a selection of typical definitions for self-tracking in the IS and HCI domain that correspond to some aspects of Lupton's (2014). The definitions all have in common that individuals (with the help of a device) collect data

on everyday activities or inner state (focusing on private and personal ones) to increase self-knowledge, to initiate self-reflection, and to motivate behavioral change. More precisely, the following definition for this dissertation is derived from most of them:

> **Self-tracking** refers to actions implying one or more of the following self-tracking components: self-measurement, data collection/storage, analysis, reflection, and behavioral change concerning private activities.

Other terms such as “lifelogging”, “quantified self” (QS), “personal informatics”, “self-monitoring”, “self-measurement”, “self-experimentation”, or “personal analytics” are used interchangeably (Choe et al. 2014, Li et al. 2010, Lupton 2014).

The following subsections describe self-tracking systems in more detail and present current research and hurdles.

### 2.3.1 Self-Tracking Appliances and Process

The first subsection presents exemplary self-tracking systems and fields of applications. Additionally, it explains the process of self-tracking. Li et al. (2010) record various types of information collected with self-tracking. They distinguish automatically and manually collected data (see Table 3), which already reveals a wide variety of tracked information that originates from various private activities, such as reading, training, dreaming, communicating.

A B


**Figure 6.** Smart Water Meter for Self-Tracking Water Consumption while Showering (A) – Garmin Activity Tracker (B)

**Table 3.** Self-tracking Information Manually and Automatically Tracked Amended from Lie et al. (2010, p. 558)

| Manual | Manual (continued) | Automatic |
|---|---|---|
| • Calendar events | • Health | • Bank statements |
| • Status updates | • Medication intake | • Email history |
| • Work activities | • Caloric intake | • Credit card bills |
| • Blog posts | • Symptoms | • Phone call history |
| • Weight | • Miles ran | • SMS history |
| • Exercise | • Sports activities | • IM history |
| • Browser bookmarks | • Blood pressure | • Financial software |
| • Time at work | • Blood sugar level | • Electricity bill |
| • Social bookmarks | • Dream journal | • Browsing history |
| • Mood | • Step counts | • Search history |
| • Journal/diary | • Relationship status | • Heating bill |
| • Pictures taken | • Books read | • Travel |
| • Sleeping habits | • Habits of newborn baby | |
| • Food consumption | • Transportation | |
| • Productivity | | |

The range of existing self-tracking appliances covers a broad spectrum. For example, self-tracking appliances help to track physical activity (Figure 6, B) or water consumption (Figure 6, A). The Garmin activity tracker incorporates various sensors in order to measure physical activity. It

measures pulse, burned calories, heart rate, sleep, trainings, and steps. On this account, it offers multiple interventions for the user: automatic recognition and tracking of trainings (e.g., burned calories), goal-setting, real-time step counting and feedback, movement reminder, and breathing exercises. Additionally, it also allows the user to communicate, pay, or be updated concerning dates or the weather. The smart water meter amphiro b1 constitutes an in-situ feedback device that measures and displays water consumption (in liters or gallons), water temperature, and heat energy for hot-water production. In order to include psychological nudges to the direct feedback device, an energy-efficiency scale (from A to G) and a metaphoric climate animation are displayed. The various metrics alternate on the top (1) and the middle (2) of the monitor. At the bottom, a dynamic climate animation relates hot and long showers to the degradation of an arctic environment: A polar bear is standing on an ice floe that shrinks step-by-step during the shower until the polar bear and its habitat disappears. In addition, the consumption information can be transferred to an online portal that allows analytical feedback. The device has been shown to lead to behavioral change, such as during two short-term interventions (three to five months), savings of 22% were achieved in two samples with 700 and 60 households (Staake et al. 2011, Tasic et al. 2012, Tiefenbeck et al. 2013, 2016). Other studies have confirmed the saving effect. A more recent version integrates a mobile application that helps to track water consumption metrics over time.

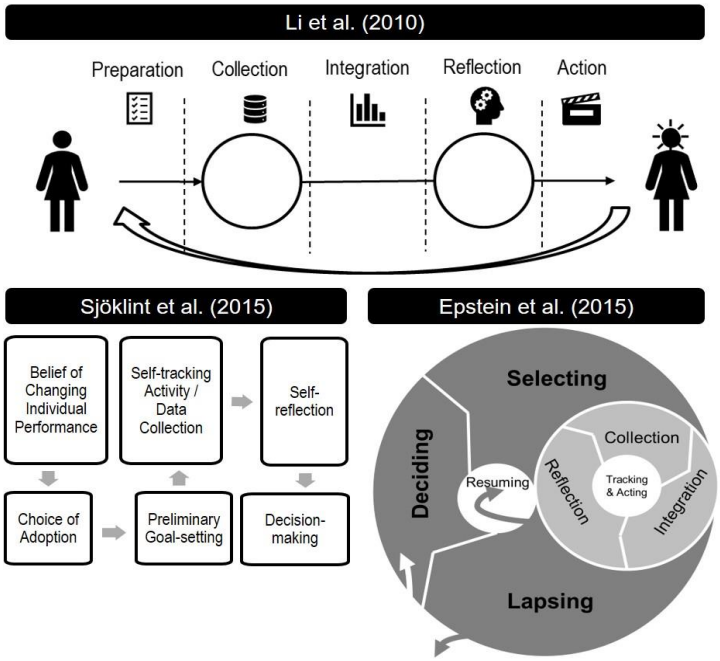



**Figure 7.** Conceptualizations of the Self-Tracking Process (Epstein et al. 2015, p. 5, Li et al. 2010, p. 561) and Described by Sjöklint et al. (2015, p. 3)

Although diverse technologies support individuals in tracking various activities and inner states, Li et al. (2010), Sjöklint et al. (2015), and Epstein et al. (2015) attempted to conceptualize a general self-tracking process applicable to all self-tracking endeavors (see Figure 7). Li et al. (2010) coined a whole research stream in HCI called personal informatics. All process models include an initial stage, before the actual self-tracking. In this stage, the individual has a certain belief (Sjöklint et al. 2015), makes an explicit decision (Epstein et al. 2015), and prepares the self-tracking (Li et al. 2010). Individuals begin preparation where they might choose a specific artifact (manual or automatic) to engage in self-tracking. Eventually, a specific goal or aim is defined. Then, the actual data collection (tracking, measurement) proceeds, with or without technical support. The collected data is integrated over time and visualized for the user. The way of displaying data is very critical. After a certain period of data collection, enough data is collected and integrated for individuals to start self-reflection and learn something new about themselves. The reflection phase is characterized by discovery (finding out what goals are important or identifying impact factors on behavior) or maintenance (when a behavioral change is achieved, individuals tend to continue with self-tracking to maintain the behavioral change) (Li et al. 2011).This helps them make an informed decision or take action. Even though Sjöklint et al. (2015) represent a sequential process, Epstein et al. (2015) and Li et al. (2010) emphasize that the process might pass through different iterations. Notably, Epstein et al. (2015) emphasize that self-tracking does not follow a strict process and that

stages can be skipped, or individuals may relapse into previous stages. They also theorize that stages can occur simultaneously, such as reflection and data collection. With their model, they coined the term "lived informatics."[5]

Notably, Epstein et al. (2015) and Li et al. (2010) highlight the fact that at many stages and at different barriers and potentials, an individual may stop the self-tracking activity. Li et al. (2010) call it the "barriers cascade," and Epstein et al. (2015) refer to "lapsing." For example, discontinuation happens within the collection stage because the data accuracy of a self-tracking appliance is not satisfying, or the motivation is not strong enough, or at the reflection stage because there is not enough data, or they do not want to be criticized.

The next section presents other scholars and their concepts that are often alluded to in the literature and show the broad applicability of the phenomenon within the literature and practice.

### 2.3.2 Self-Tracking Research and Concepts

Self-tracking is often referred to with other concepts around the "self." First the hype about quantified selfers was especially striking because they introduced self-experimentation for private activities and personal reasons. They formulated and tested a hypothesis and analyzed the collected data in a quasi-scientific manner (Karkar et al. 2015). Pfeiffer et al. (2016) posit that a self-tracking individual somehow shows entrepreneurial and self-optimizing traits. In this context, the concept of self-efficacy is often taken into consideration (Kim 2014, Kim and Park 2012). Self-efficacy describes an individual's belief or tendency to hold onto the possibility of reaching personal aims (Casimir et al. 2012). Rapp and Cena (2016, p. 1) emphasize that self-tracking devices and applications (called personal informatics tools or personal IS in HCI) "allow users to self-monitor … their behaviors in a variety of contexts simplifying data collection, management, and visualization." The term self-monitoring actually is derived from clinical techniques from cognitive-behavioral therapy, such as recording thoughts or emotions to allow awareness, comparisons, and behavioral feedback (Baumgart 2016, Rapp and Cena 2016). It is enhanced by the comfortable new ways of automatic self-measurement enabled by low-cost devices. The most prominent example is weight measurement, undertaken for more than a century with the so-called penny scale or health-o-meter, or modern weight scales that nowadays automatically send measurements to our smartphones (Crawford et al. 2015). In the same sense, eHealth articles often speak of self-management methods. It "is an effective way of managing chronic disease and avoiding illness in healthy people" (Kamal et al. 2010, p. 47) by "monitoring and assessing [their] own health state and care needs" (Wac 2014, p. 3). A prominent example is diabetes (Nam et al. 2011). Additionally, Baumgart and Wiewiorra (2016) assume that individuals with a higher degree of self-control are more interested in self-tracking. They define self-control as "the ability to modify and adjust the self as well as interrupt undesired behavioral tendencies" (Baumgart and Wiewiorra 2016, p. 4). So, individuals with high levels of self-control more easily change habits or control emotions.

As most concepts already reveal, appliances (e.g., devices or mobile apps) play an important role in self-tracking and its increased attention in the literature and in practice. To that end, self-tracking is also interesting for IS research in the context of PIS. Therefore, the following section presents current IS research that predominantly concentrates on the usage of self-tracking appliances.

### 2.3.3 Overview of Insights into Usage Behavior of Self-Tracking Appliances

Information systems (IS) find their way into private lives with individuals tracking and analyzing data concerning such activities as sleep patterns, nutrition, expenditures, or physical activity (Li et al. 2010). Research (Buchwald et al. 2015, Li et al. 2010, Pfeiffer et al. 2016) and practice (Snyder 2015) recognize the potential of self-tracking technology to become a major emergent trend and mainstream technology. For example, market research institutes predict that 160-245 million wearables will be sold in 2019 (Intelligence 2015) and already between 2014 and 2015 their adoption had already doubled (Deborah and Lieberman 2016). Yet, research (Epstein et al. 2015, Li et al. 2010) and practice (Deborah and Lieberman 2016) acknowledge many barriers at different stages of self-tracking, which encompass design and functionality issues or the motivation and attitude of individuals that leads to contradictory behavior (purchase refusal, discontinuance).

[5] Previously defined by Rooksby et al. (2014, p. 2) as "a view that emphasizes the practical, prospective and felt aspects of personal tracking for health and wellbeing."

In this sense, IS research investigates several theoretical explanations and models (such as cognitive-dissonance[6] or adoption models) for contradictory reactions to computer-mediated self-tracking activities (Buchwald et al. 2015, Pfeiffer et al. 2016). Considering the factors that lead to contradictory behavior, the price appears to be the most important factor. Then, other factors follow, such as the tracking device helps one to be more productive, no utility is seen, usage is unforeseen (Deborah and Lieberman 2016). As one of the few articles that directly study the phenomenon of self-tracking, Gimpel et al. (2013) developed a five-factor-framework and psychometrical measurement instrument for self-tracking motivations; yet, their focus is limited to the health care domain and to the motivation of individuals who already consider themselves active self-trackers. Sjöklint et al. (2015) conducted 42 interviews to study user experience with the adoption and use of wearables, which are part of self-tracking devices. They conclude that individuals tend to use wearables not as a precommitment device, e.g., to restrain or motivate a future behavior (Hoch and Loewenstein 1991), but as a way to reflect on their behavior. For that reason, they stress that current IS theories will not be easily applicable to wearables.

In the HCI domain, the literature review identified a growing body of work on self-tracking. While these contributions enhance the basic understanding of the phenomenon, they prevailingly concern the novelty of the technology and prototypes of specific applications (mainly in the health and fitness domain). Most of those contributions are experimental in nature, not deeply rooted in theory, and draw on interviews with early, tech-savvy adopters with close ties to the HCI domain to identify motivations, styles of self-tracking, pitfalls and barriers, the role of social aspects, and design aspects (Cena et al. 2016, Choe et al. 2014, Karkar et al. 2015, Li et al. 2010, Lupton 2014, Rooksby et al. 2014). The existing literature offers very few insights into self-tracking as a mass-phenomenon or into the attitudes of basic users (no early QS adopters). Rooksby et al. (2014, p. 9) states that “it seems unlikely that cognitive models can explain … tracking” which reveals that new types of theories and models are needed in order to understand this phenomenon.

Overall, scholars engaged in the adoption and continuous usage of self-tracking technologies only started to revisit and adapt current IS theories (theory of planned behavior) and models (discontinuance model) predominantly in a conceptual and interpretivist manner, concentrating on qualitative data such as interviews, content analyses of presentations, and observations (Baumgart 2016, Buchwald et al. 2015, Sjöklint et al. 2015). Just recently with Pfeiffer et al. (2016), first quantitative and empirical methods emerged.

As indicated above, for self-tracking, the conflicting adoption behavior and the issue of discontinuance especially challenge researchers. Furthermore, self-tracking clearly represents volitional system usage (even chronically ill individuals have the free possibility to choose a system they prefer). In order to understand issues of self-tracking usage, IS theories and models from Section 2.2 (p. 14) provide a first orientation. However, two insights from the scholars above are worth noting: first, the insights from Crowston et al. (2010), who question the applicability of typical IS theories and models within the private context and call for future research focusing on the private context to consider testing and even adapting typical IS theories and models. And second, the fact that IS scholars (re)orient (especially regarding discontinuance) to the concept of attitudes indicates that attitudes may play a more important role in the private context. Seeing that the measurement of attitudes has a long history in different disciplines, the next section presents their role within IS usage in more detail.

## 2.4 Understanding Information Systems Usage through Attitudes

Attitudes represent a popular concept used in various theories in social psychology:

- Learning theory: “the processes whereby a given response becomes associated with a given stimulus” (Fishbein and Ajzen 1975, p. 22);
- Expectancy-value theories: an individual chooses a certain behavior depending on the subjectively expected utility of the behavior, which can be reinterpreted as an attitude (Fishbein and Ajzen 1975, p. 30); and
- Cognitive-dissonance theory (see Subsection 2.3.3, p. 20).

[6] The theory from Feistinger (1954) reveals that individuals feel uncomfortable when they do not act according to their attitudes, such that they might adjust their attitudes accordingly to reduce this aversive state (Maio and Haddock 2009).

In IS, attitudes depict a core element within technology adoption (Lee 2010, Williams et al. 2009). The concept of attitudes plays an important role in many models explaining the adoption and use of different IS (Ajzen 1991, Davis et al. 1989, Fishbein and Ajzen 1975, Jensen and Aanestad 2007, Yang and Yoo 2004).

As mentioned above, the concept of attitudes is derived from social psychology, which has cared about attitudes for over 70 years (Maio and Haddock 2009).

> **Attitudes** can be generally defined as a latent tendency or "disposition to respond favorably or unfavorably to an object, person or institution" (Ajzen 2005, p. 3) or as evaluative/judgmental "meaning to an object or person by placing it within the existing structures held by an individual" (Hendrick et al. 2013, p. 1538).

The tendency or disposition describes a person's internal state for a certain time, which can be learned through experience. The evaluation or the response has several occurrences: "overt or covert, cognitive, affective, or behavioral" (Eagly and Chaiken 1998, p. 1–2). For example, such evaluations "express approval or disapproval, favor or disfavor, liking or disliking, approach or avoidance, attraction or aversion" (Eagly and Chaiken 1998, p. 3). Thus, attitudes indirectly influence the behavior of individuals, or at least their intention to engage in a behavior. For that reason, the following section clarifies knowledge about attitudes in general, as well as IS research on attitudes, and gives on overview of existing attitude-measurement instruments in IS research.

### 2.4.1 Properties and Conceptions of Attitudes

The following subsection presents typical aspects of attitudes that have already been investigated within social psychology and IS research. The aspects encompass the direction (toward an object or behavior), components (affective, cognitive, and conative), the formation (central and peripheral), and manifestations (implicit and explicit) of attitudes, and conceptual demarcations that exist in the literature.

Direction of Attitudes

Moore and Benbasat (1991, p. 196) reinforce the distinction of attitudes from Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975). Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975) distinguish attitudes toward an object (ATO) and attitudes toward a particular behavior (ATB). This distinction is still supported by other IS scholars: Zhang (2007) and Wixom and Todd (2005). The first, ATO, "is defined as a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly and Chaiken 1998, p. 269, Zhang 2007, p. 2). The entity can be abstract (e.g., work-life balance) or concrete (e.g., computer). Another definition from Crites et al. (1994) refers to evaluative judgements. The latter, ATB, "is defined as an individual's positive or negative feelings evaluation of performing the behavior" (Ajzen and Fishbein 1980, p. 6, Zhang 2007). According to the current research, a person possesses both attitudes, which can be contradictory in nature. An individual may have negative attitudes about an object, yet, she/he might be positive toward using the object, e.g., diabetes-measurement devices.

Referring to the diffusion of innovations, Moore and Benbasat (1991) explain that the ATB is generally a stronger predictor of actual usage (Ajzen and Fishbein 2005, Hartwick and Barki 1994). Yet, Hartwick and Barki (1994) found that in the post-implementation phase, ATO impacts ATB as an antecedent. So, it might be useful to examine both types of attitudes (ATO, ATB) because they are closely linked. Once an attitude about an object has been established, a behavior (also seen as a response in psychological literature) concerning this object might be linked to it (Eagly and Chaiken 1998). Zhang and Sun (2009) are among the few scholars who studied the influence of the different attitude types on each other and on behavioral intentions in a longitudinal setting with mandatory information technology. Their results show a strong influence of both types of attitudes on behavioral intentions in the initial (rather the adoption) and continued-usage phases. However, the different attitude types show varying strengths of impact over time. Once an ATO is formed, it is more stable over time. ATB points to those more easily updated, and so more unstable over time.

Scott (1968) offers another perspective on the direction of attitudes. He refers to a favorable or an unfavorable aspect when considering the direction of attitudes. He also defines positive or negative appraisals, feelings, and tendencies as "degree of (un)favorableness" (Scott 1968, p. 206). Additionally, Rainer and Miller (1996) relate the type of behavior to the direction of attitudes. For

example, they suggest that different types of IS usages exist (e.g., computer usage at work, computer usage at home, computer usage in the library, or general computer usage). Depending on the type of IS usage at the center of the researchers' attention, a specific attitude exists (attitude toward computer usage at work, attitude towards computer usage at home).

Having understood the direction of attitudes, the next part focuses on more details about the attitudes themselves, explaining the component of attitudes.

The Components of Attitudes

Attitudes are largely considered to be multidimensional.[7] Three main concepts exist: a one-dimensional view, dual-theory, and the tripartite/multicomponent view (Joyce and Kirakowski 2015, Zhang 2007). The tripartite view differentiates an affective (emotions, feelings), a cognitive (beliefs, thoughts, and attributes), and a conative (past behavior or experiences) component (Maio and Haddock 2009). The dual-theory mostly combines affective and cognitive attitudes, as they are supposed to guide behavior (Teo et al. 2003), and many scholars just use a single perspective, the affective component of attitudes. Following are explanations and exemplifications for each dimension.

Attitudes refer to emotions, moods, feelings, or sympathetic-nervous-system activity. Such emotions or feelings about an attitude object lead to positive or negative evaluations. So, the affective dimension is defined as "an emotion that charges the idea, a feeling that may be good or bad when thinking about the attitude object" (Joyce and Kirakowski 2015, p. 507). The emotions can be influenced by evaluative conditioning (combining unknown stimuli with positive, known stimuli) or mere exposure (Maio and Haddock 2009). For example, someone may feel angry or fearful in contrast to hopeful and optimistic toward a nuclear plant (Eagly and Chaiken 1998, Fishbein and Ajzen 2010). When measured with a questionnaire, such attitude components express a like or dislike toward an object of behavior (Al-Khaldi and Al-Jabri 1998). Attitude is often also conceptualized or called "affect" (Limayem and Hirt 2003, Thompson et al. 1991, Zhang and Sun 2009).

Cognitive attitudes allude to opinions, thoughts, attributes, cognitions, and beliefs – "the beliefs and ideas a person has about the attitude object" (Joyce and Kirakowski 2015, p. 507). A person is consciously aware of such opinions and beliefs formed through a consideration undertaken before the awareness stage. Such beliefs are represented by expectancies about an object combined with the subjectively perceived value of the object (Fishbein and Ajzen 1975, Maio and Haddock 2009). For example, on the one hand, individuals think that nuclear power plants may represent a great danger as they can induce nuclear contamination. On the other hand, individuals think that such power plants represent a great supply of cheap electricity. Both ideas represent a positive or negative evaluation or association of the attitude object of nuclear power plants (Eagly and Chaiken 1998). When measured with a questionnaire, statements in the context of questionnaires encompass positive or negative statements on beliefs or values (Al-Khaldi and Al-Jabri 1998, Teo et al. 2003).

The conative or behavioral attitude describes "the individual's predisposition to action with regard to the attitude object" (Joyce and Kirakowski 2015, p. 507). It encompasses what an individual tends to do, actually does, or intends to do in the future (Al-Khaldi and Al-Jabri 1998). This intention or previous behavior supports or opposes the attitude object – e.g., when individuals circulate petitions or participate at demonstrations opposing or supporting nuclear power (Eagly and Chaiken 1998). A "mere belief in having performed a behavior is sufficient to shape attitudes" (Maio and Haddock 2009). In this context, cognitive-dissonance also plays an important role. When measured with a questionnaire, participants are asked if they would engage or have been engaged in a specific behavior. Sometimes, also a certain time horizon is given (Juster 1966). Behavior can also be measured objectively, e.g., within IS research, while tracking system usage.

So, the components are interrelated. Besides attitudes and behaviors, strong affects/emotions are associated with beliefs of the same evaluative direction. They are antecedents and directly impacted from attitudes. Moreover, some individuals are more led by cognitions and others more by affect.

[7] A dimension refers to some part of a phenomenon that groups similar aspects of the phenomenon (Petter et al. 2007).

Attitude Formation and Manifestations

Two routes to attitude formation exist: the central way and the peripheral way. On the one hand, an individual cognitively forms an attitude about an object or a behavior. This is called the central route and requires a critical examination of the object in question. It includes "effortful processing, careful thinking, attending to any presented information, attempting to access relevant information …, comparing information with background knowledge and standards …, and drawing conclusions about the merits of attitude objects or recommendations (Zhang and Sun 2009, p. 2051). On the other hand, a person forms an attitude with the help of approaches such as heuristics, which establish associations with so-called valence objects or experiences. Additionally, through inferential approaches, a person may quickly evaluate information as positive or negative, without detailed processing or comparison of such information (Zhang and Sun 2009). For that reason, prior information and judgments serve as an anchor for new information processing (Kim and Malhotra 2005). When attitudes are salient (accessible), the less cognitive effort must be invested for the evaluation.

Both ways to attitude formation are directly translated in the differentiation of implicit and explicit attitudes. A wide range of scholars concentrates on measuring explicit attitudes with self-reported measures, as individuals are consciously aware of them (Zhang and Sun 2009). For that reason, after attitude formation, they are stored in the long-term memory and can be easily recalled. Thus, they can be measured with explicit measurement methods (Weinert et al. 2015). Moreover, depending on the strength/intensity of attitudes, they represent a reliable self-reported measure that predicts behavior. Various aspects define the strength of an attitude – e.g., the "extremity of evaluations, amount of experience with the attitude target, consistency between affective and cognitive evaluations" (Hendrick et al. 2013, p. 1539) or "magnitude, intensity, ambivalence, salience, affective salience, cognitive complexity, overtness, embeddedness, and flexibility" (Krosnick and Abelson 1992, p. 178, Scott 1968). However, attitudes can coexist. An individual can inherit positive and negative evaluations about the same object, also called attitudinal ambivalence (Maio and Haddock 2009). Moreover, even though attitudes can be stable/rigid, they also can be updated due to experiences or persuasion. This reflects a certain kind of flexibility of attitudes (Scott 1968). For that reason, an individual may inherit an updated attitude but still remember the previous attitude.

Implicit attitudes are "introspectively unidentified (or inaccurately identified) traces of past experience that mediate [a] favorable or unfavorable feeling, thought, or action towards social objects" (Greenwald and Banaji 2015, p. 8). So, an individual is not consciously aware of such a feeling, opinion, or experience. Thus, such attitudes cannot be recalled or easily be measured. Specific measurement scenarios have been developed and help to measure implicit attitudes through neural mechanisms (Ortiz de Guinea et al. 2014, Weinert et al. 2015). Those types of attitudes are activated automatically. Yet, depending on the motivation and cognitive effort, they can be updated with a new attitude (Ajzen and Fishbein 2005). This mainly concerns prejudicial attitudes.

Whereas explicit attitudes tend to predict controlled and volitional behavior, implicit attitudes predict subconscious behavior (such as facial expressions) (Ajzen and Fishbein 2005). For that reason, explicit attitudes are measured far more often.

In the context of explicit and implicit attitudes, the salience of attitudes plays a vital role. According to Scott (1968), salience is defined as the prominence of or readiness to express an attitude by an individual. Salience also refers to the relevancy of the object or the behavior to an individual. Salience can be further differentiated in affective/cognitive/conative salience. Moreover, Scott (1968), also differentiates the embeddedness or isolation of an attitude object/behavior to other concepts. Depending on the connection of attitude objects or behaviors, the appraisal might be equal. For example, the object "mother" might be related to other concepts such as woman, care-taking, or protectiveness.

### 2.4.2 The Relevance and Challenges of Attitudes within IS Research

The concept of attitudes was introduced in IS research with the TPB and TRA. Davis (1989) developed the TAM, widely been applied within IS research (Williams et al. 2009). Later models, including modifications and adaptations derived from TAM, such as the UTAUT, started to focus on perceived usefulness to the detriment of attitudes. This resulted from the lack of support for its

role as full mediator in some empirical results. Instead, attitudes were employed as the second most often used external variable in UTAUT (Williams et al. 2015).

However, other scholars achieved opposing results (Zhang and Sun 2009)of the empirical evidence for the mediator role of attitudes. This difference seems to be rooted in external factors of IS usage: the organizational context in which perceived usefulness is much more relevant than individual attitudes (Al-Hujran et al. 2015, Davis et al. 1989, Davis and Venkatesh 1996, Sun and Zhang 2006). Additionally, Yang and Yoo (2004) revive a discussion about the different components of attitudes (Goodhue 1988, Thompson et al. 1991) and show that IS literature has neglected the tripartite view (Davis et al. 1989, Sun and Zhang 2006). Notably, the cognitive part of attitudes was disregarded, and therefore the research results indicate that affective attitudes in an organizational environment did not play an important role when explaining IS usage (Taylor and Todd 1995a, Venkatesh et al. 2003, Venkatesh and Davis 2000). Yang and Yoo (2004) also show that including affective and cognitive attitudes separately results in empirical evidence for the relevance of attitudes to explaining behavioral intention. Further studies illustrate that it is also necessary to differentiate another aspect of IS usage: Attitudes are especially relevant for voluntary IS usage in contrast to mandatory IS usage. This mostly encompasses adoption in the context of consumer IS (Al-Hujran et al. 2015, Venkatesh et al. 2012), because individuals form their intention based not on normative beliefs (what a superior expects from them) but on their personal preferences.

Furthermore, attitudes within continuance and discontinuance research are gaining importance, as they help to explain the process that leads to continued or discontinued usage (Bhattacherjee and Premkumar 2004; Xu et al. 2017; Zhang 2007). Through usage experience with a system, an individual updates her/his attitudes and beliefs. Such an update may possibly lead to dual existence of attitudes, as they are not immediately replaced. The coexistence of attitudes helps a changed intention to use an IS and results in opposing behavior (e.g., from a positive intention to adopt a system to discontinuance).

Interestingly, when it comes to adoption or notably IT continuance, scholars agree that emotional, rational, and behavioral aspects influence a usage decision (Bhattacherjee and Lin 2014, Ortiz de Guinea and Markus 2009). As Figure 8 depicts, the three components of attitudes (affective, cognitive, and conative) exactly represent all those three aspects (emotional, rational, and behavioral) from usage behavioral models (see Section 2.2, p. 14). For that reason, the tripartite view of attitudes represents a suitable theory and a tool that helps to explain usage decisions, and therefore behavior. Yet, in IS research, most models include specific emotional, rational, and behavioral aspects, such as beliefs, perceived usefulness, habits. This fact is predicated in large part on the work of Fishbein and Ajzen (1975, p. 11–12) who define each dimension as a single measurement instrument: affect (“essential part of attitude”, “a person’s feelings toward and evaluation of some object, person, issue, or event”), cognition/belief (someone’s information about an object, i.e., “knowledge, opinion, beliefs, and thoughts about the object”), and conation/behavioral intention (an intention or “actual action with respect to or in the presence of the object”). However, Fishbein and Ajzen (1975) also mention that the multicomponent view is predominantly used for overt (observable) behavior.

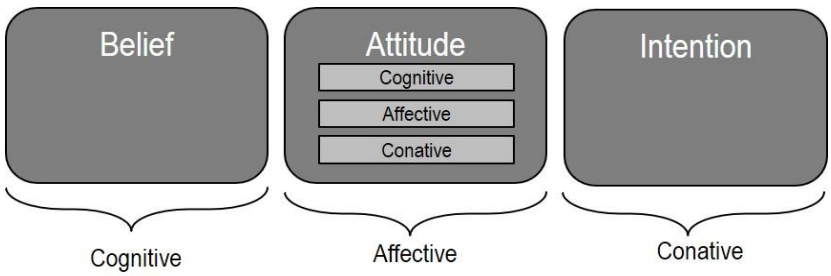



**Figure 8.** Overview of Different Views on the Components and Context of Attitudes

Already, Goodhue (1988) had shown the absence of consistency within IS research in the underlying focal center of the attitude measurement instrument. Some scholars measure attitudes as subjective and emotional, others as beliefs (objective opinions), or both. In contrast, Goodhue (1988) clearly distinguishes emotional and rational (information-based) aspects. He says that beliefs refer to information about something or someone, and attitudes only emphasize feelings. The information can be a fact or another person’s opinion, which can be positive, negative, or

without evaluative implications at all. To the same extent, Katz and Stotland (1959, p. 430) differentiate a belief from an attitude by the evaluative (for or against something) character of attitudes that is assigned within a "motivation and emotional process". Furthermore, they state that attitudes (also seen as an evaluation) always include a cognitive evaluation (also called intellectual appraisal). A belief consists of purely cognitive judgements. So, a positive or negative attribution differentiates the (cognitive) attitude from a belief.

Moreover, social psychology also identifies different perspectives on the tripartite view of attitudes. Triandis (1980, p. 214) recognizes that attitude is "an imprecise, all-inclusive term", highlighting that a more precise distinction would take both beliefs and affects into consideration. Thus, beliefs represent the cognitive component of attitudes. In this sense, Zhang (2007) reveals that Harrison and Rainer (1992) and Sambamurthy and Chin (1994) define even two dimensions of attitude as perceived usefulness and perceived ease of use, even though in some models (e.g., TAM), they represent specific beliefs different from attitudes.

Finally, Eagly and Chaiken (1998) follow Rosenberg and Hovland (1960) and distinguish the three observable responses that result from an attitude (Katz and Stotland 1959) and the three antecedents/processes that lead to attitude formation (Breckler 1984, p. 1192, Rosenberg and Hovland 1960, Triandis 1971):

- Affective responses: "sympathetic nervous responses and verbal statements of affect";
- Cognitive responses: "Perceptual responses and verbal statements of beliefs":
- Behavioral responses: "Overt actions and verbal statements concerning behavior"

Eagly and Chaiken (1998) show that under some circumstances, all or only one process (affective, cognitive, conative) is relevant for attitude formation and that an attitude can be manifested by one or more evaluative responses (affective, cognitive, conative). Additionally, Eagly and Chaiken (1998, p. 5) differentiate attitudes from other concepts that describe someone's "implicit tendencies or dispositions." Such tendencies and dispositions encompass, for example, personal traits that are defined by many more stimuli and produce a larger variety of responses; and moods, one evaluation and response to different stimuli/entities. On the contrary, attitudes refer to an inference of an evaluative response to a specific entity.

As (Scott 1968, p. 205) states, "[i]t is unrealistic to expect a single, final definition of 'attitude' to emerge within the foreseeable future", as scholars in all disciplines cannot really find consensus about the exact constellation of affect, cognition, and conation. However, he clearly distinguishes attitudes from terms such as ability, capacity, intelligence, or habit.

Overall, the concept of attitude does not seem to become trivial, so the tripartite view stays an important aspect perspective when considering attitudes, which current work should not neglect. The following section shows how explicit attitudes can be measured.

### 2.4.3 Measurement of Explicit Attitudes

Scholars attempting to explain social and behavioral phenomena often must confront the fact that the phenomena are not measurable in an objective way. For example, such phenomena encompass motivations, intentions, perceptions, and attitudes. To find a way to measure these unobservable (latent) variables, scholars build up abstract concepts (London et al. 2017) called hypothetical constructs[8] that help them to infer the phenomenon from observable responses. The responses range from extremely positive to extremely negative (Eagly and Chaiken 1998). These constructs are "designed for a special scientific purpose, generally to organize knowledge and direct research in an attempt to describe or explain some aspect of nature" (Peter 1981, p. 134). Constructs are also called scales, variables, or instruments.

Studies in IS research have used attitude constructs in various ways. Sun and Zhang (2006) identify such differences according to the direction (toward an object or a behavior), the measures themselves, or the conceptualization (affective, cognitive, and conative). Following the example of Sun and Zhang (2006), Appendix 9.2 (p. 180) illustrates an overview of existing attitude constructs in IS research in order to investigate the structure (measures, direction, dimensions, cumulative tradition) of various attitude constructs in the IS literature. This section shows a summary of the

[8] A specific type of measurement instrument predominantly employed for research including surveys. A more precise definition can be found in Section 6.1, p. 112.

listed attitude constructs, in the form of direct, adjective (or adverbial) evaluations and indirect, general evaluations.

The classical attitude constructs ask survey participants to agree/disagree on an evaluation scale (Likert-type[9] or semantic differential[10]) to a collection of statements. Both construct types range from 4 to 10 points (often, 7 points are used). In general, the survey directly assesses attitudes with questions like "using [the technology] is…." (Bhattacherjee and Sanford 2006, Wixom and Todd 2005, Yang and Yoo 2004) or "I [evaluation] using [the technology]" (Agarwal and Prasad 1999, Brown et al. 2004, Shih et al. 2015). Various adverbs and adjectives are being used for the evaluation. The overview in Appendix 9.2.1 (p. 181) shows 36 articles using such attitude constructs, which result in at least 48 adjectives or pairs of adjectives used for attitude evaluation. The most often employed are wise/foolish, bad/good, beneficial/harmful, pleasant/unpleasant, positive/negative, favorable/unfavorable, and like/dislike. The participants evaluate technologies ranging from spreadsheet software to online shopping. Overall, two interesting aspects appear. First, there is no real heterogeneity when it comes to attitude construct development. Most authors use or adapt constructs or items that originate from a handful of authors (Ajzen 1991, Davis 1989, Fishbein and Ajzen 1975, Taylor and Todd 1995b). Second, even though the tripartite view has been largely discussed by the IS community, only two authors in Table 33 and Table 34 (5%) take into consideration at least two of these dimensions (cognitive and affective).

The second type of attitude constructs are shown in Appendix 9.2.2 (p. 185). They represent indirect, general evaluations for specific attitude constructs focusing on one technology or aspect. The constructs measure the attitude toward computers (Al-Khaldi and Al-Jabri 1998, Harrison and Rainer 1992, Nickell and Pinto 1986, Rainer and Miller 1996, Webster et al. 1990, Webster and Martocchio 1992), microcomputers, the Internet (Joyce and Kirakowski 2015), PC use (Thompson et al. 1991, 1994), E-HRM (Voermans and van Veldhoven 2007), or the CEO attitude toward adoption of IT (Thong and Yap 1995). Beside one construct, all rely on a five- or seven-point Likert-type evaluation scale. The remaining one uses a seven-point semantic differential. Typical statements are very specific for a particular technology:

- "**Computers** make me uncomfortable because I don't understand them" (Rainer and Miller 1996, p. 98);
- "I feel at ease using the **Internet**" (Joyce and Kirakowski 2015, p. 516);
- "Using a **microcomputer** can take up too much of my time in performing tasks" (Igbaria and Chakrabarti 1990, p. 239).

Almost every construct has up to four dimensions and 2 to 64 items. The dimensions very often relate to the tripartite view of attitudes – cognitive, affective, conative (Igbaria and Chakrabarti 1990, Thompson et al. 1991) or anxiety, liking, confidence, usefulness (Al-Khaldi and Al-Jabri 1998; Compeau et al. 1999; Compeau and Higgins 1995). Other forms of dimensions are positive and negative aspects (Joyce and Kirakowski 2015, Rainer and Miller 1996).

Having presented concepts and current research for PIS, IS usage behavior, self-tracking, and attitudes, the chapter's following section summarizes the research gaps and arrives at detailed research questions that will guide the chapters hereafter.

## 2.5 Research Gaps, Questions, and Framework

So far, Chapter 2 has offered basic definitions and explanations for relevant concepts in relation to PIS. Additionally, the chapter presents prior (IS) literature for these concepts. The final section of this chapter aims at summarizing the most important aspects in combination with an identification of research gaps that this dissertation addresses. The following subsections carry out this task for the subsequent overall research questions established in the Introduction (p. 1):

1. What is the status quo of private information systems, especially self-tracking, in information systems research?
2. How do individuals use self-tracking appliances?

[9] As an example: A 7-point Likert-type scale has the following evaluations: 1="strongly disagree", 2="disagree", 3="rather disagree", 4="neither agree or disagree", 5="rather agree", 6="agree" 7="strongly agree"

[10] As an example: Two opposing terms are given and the participant needs to choose an evaluation with a tendency to one side (e.g., on a four-point evaluation scale, he or she needs to decide whether a technology is rather easy to use or difficult to use).

Finally, the detailed research questions derived will be integrated in a research framework that gives an overview of the dissertation. As a first step, the status quo of PIS and self-tracking is defined.

### 2.5.1 Research Gaps and Questions for the Status Quo of Private Information Systems and Self-Tracking

Building on the insights of this chapter, the first overall research question that aims at uncovering the status quo of PIS and self-tracking is disentangled in two steps.

First, while various senior scholars have expressed that the IS community needs to expand its focus to the private context, there is little quantitative evidence for whether these calls for actions have spurred more research activities in that domain, and whether articles resulting from such activities have made their way into top IS outlets. Additionally, contradictory statements from various scholars characterize the actual status quo. More than 20 years ago, Kolbe and Brenner (1995, p. 501) recognize that consumer electronics "shift the importance from business to residential issues". Surprisingly, IS scholars many years later still envision this shift and evolution of the IS discipline (Hess et al. 2014, Yoo 2010). Likewise, some scholars have acknowledged the relevancy of the distinction of a private and a professional context within IS usage. With the differentiation of volitional and mandatory systems, the private context has also gained recognition within one of the most relevant IS topics: IS usage behavior. Yet, 20 years later, scholars still discuss the relevancy of IS used for private reasons (Baskerville 2011b, Crowston et al. 2010). In any case, IS research on the discipline itself seems to give focal attention to organizational issues (Glass et al. 2004, Sidorova et al. 2008) and practically ignores the private context within status quo observations.

Section 2.1 (p. 5) identifies three gaps in the research: (1) the need for a comprehensive study on the status quo of IS research that also takes into consideration purely private contexts of IS use, thus challenging and helping to redefine the core and boundaries of IS research; (2) a quantitative trend analysis that investigates whether the expansion of IS to private contexts going on in practice is increasingly reflected in key IS outlets; and (3) the need to generate more recent results, as several developments regarding PIS use date only a few years back, including the rise of the Internet of Things and the increasing adoption of wearables. These gaps led to identifying the following detailed research questions.

*RQ1a: To what extent do top IS outlets reflect the trend in practice toward the private use of IS, currently and over the last two decades?*

Beyond determining the significance and a basic trend of some research streams within IS literature, research-on-research studies on the IS discipline also seek to gather information about the intellectual structure of the IS articles under investigation. This helps to acquire additional knowledge, which provides guidance and orientation for scholars and helps them identify research gaps or make informed decisions about strategic publication. Questions related to the intellectual structure encompass different aspects, including the research method (Glass et al. 2004), core topics (Sidorova et al. 2008), cumulative tradition and typical authors (Culnan 1987), or journal nationality (Galliers and Meadows 2003). Scholars benefit from insights on which topics are relevant to the community or under researched, or which journals may be more open to publishing articles for a specific context. Thus, answering the following detailed research question supplements the first:

*RQ1b: How does the intellectual structure of research in the private context of IS use look like and how has it evolved?*

To that end, this dissertation aims at providing rich insights into different aspects of IS research in the private context, in combination with the quantification analysis. A more detailed look into additional externals and metadata on the 1,766 articles from above will serve to satisfyingly provide insights into the research on PIS, as typical research-on-research studies do. The results of the study contribute to the general discussion on boundaries and trends in IS research and serve as motivation and orientation, notably for scholars engaged in research on the use of IS in the private context.

Second, in order to contribute to more research on PIS, a closer look is taken into one specific PIS domain: self-tracking appliances. Guided by the insights from this chapter, self-tracking as a

specific domain was chosen for two reasons. First of all, the practical relevance and positive market predictions suggest that many individuals and companies will be concerned with self-tracking due to the mass-market advancements. Second, self-tracking touches various systems and topics that currently trend in the literature and journalism – e.g., IoT, Wearables, Smart Home. It is a concept that revives increased attention due to miniaturization and digitization.

To date, several IS scholars have dedicated their work to investigate underlying mechanisms for self-tracking (Baumgart 2016, Baumgart and Wiewiorra 2016, Sjöklint et al. 2013, Zhou et al. 2016) or the adoption and continuance of self-tracking appliances (Buchwald et al. 2015, Gimpel et al. 2013, Pfeiffer et al. 2016, Sjöklint et al. 2015). However, the links to other studies on PIS seem to be weak, especially if the related work has been published in other disciplines such as HCI and IS scholars could benefit from a concise review of relevant studies and insights. As a result, the following research questions:

*RQ2a: What research insights currently exist about the phenomenon of self-tracking?*

*RQ2b: What research gaps and future research directions can guide IS researchers?*

Following De Moya and Pallud (2017), Kersten-van Dijk et al. (2017), and literature reviews (vom Brocke et al. 2009, Fettke 2006, Glass et al. 2004, Sidorova et al. 2008, Webster and Watson 2002), this study aims to assess the status quo and uncover areas lacking research, with a literature analysis that concentrates on structuring current insights and identifying future research potential. To that end, a structured literature review is undertaken on self-tracking in IS literature, extended by two other disciplines: HCI and psychology. First, 114 relevant articles are identified from a subsample of 1,846 articles employing one or more selected keywords related to the phenomenon of self-tracking. Second, the articles are analyzed by their topics and research insights. Finally, future research potential is identified.

The detailed research questions structure the analysis of the status quo of PIS and self-tracking. They provide insights about relevancy and extent of PIS to motivate researchers to engage in research in the private context and guide their future endeavors on a strategic level (e.g., support decisions about cooperation, journal/conference selection, employment of research methods). Thus, managers and companies can derive useful insights from IS research that finally reflects trends from practice. Furthermore, the status quo of a specific domain of PIS helps to streamline the first efforts from several IS scholars who have dedicated their work to investigating underlying mechanisms for self-tracking (Baumgart 2016, Baumgart and Wiewiorra 2016, Sjöklint et al. 2013, Zhou et al. 2016) or the adoption and continuance of self-tracking appliances (Buchwald et al. 2015, Gimpel et al. 2013, Pfeiffer et al. 2016, Sjöklint et al. 2015). A structured overview of relevant aspects and the current status quo may help to enhance the quality of findings and guide scholars in focusing on relevant aspects. The insights will also help practitioners to quickly find access to interesting research results.

The next subsection digs deeper into the PIS research arena. To further contribute to research and practice, more discoveries of a prominent IS topic are sought, but within a private context: usage behavior. The specific domain of self-tracking appliances serves as the field of application of IS in the private context. So, the second part of the dissertation concerns understanding the use of self-tracking appliances.

### 2.5.2 Research Gaps and Questions to Understand the Use of Self-Tracking Appliances

In order to specify the second overall research question, findings about the usage of self-tracking technologies are generated. Thus, the overall research question is split into two steps.

First, even though the majority of IS usage research pays particular attention to organizational contexts (Williams et al. 2009), scholars are increasingly interested in consumer or household contexts in combination with volitional or hedonic IS (Bhattacherjee 2001, Turel 2015). Williams et al. (2009) reveal that only 1% of all studies took households and 14% took consumers into consideration. So, IS adoption research mainly encompasses an organizational level of analysis, and specifically in 345 articles on adoption studies investigations of the level of analysis took place. This result reveals a certain state of homogeneity within the IS field of usage behavior, which is still sparse within IS research in the purely private context. In order to tackle this research gap in the dissertation, a specific field of application of PIS, self-tracking, was selected for analysis. Self-tracking represents a domain with increasing relevancy due to the employment of self-tracking in

different private activities and areas (e.g., IoT, Wearables). Yet, there are only little qualitative insights on usage behavior of self-tracking appliances, and the existing findings provide mainly contradictory results: e.g., individuals are interested in adopting and using self-tracking appliances; however, they do not purchase them or do not really use them (Buchwald et al. 2015, Pfeiffer et al. 2016). The rare empirical studies that exist on self-tracking adapt traditional models or introduce alternative theories for investigating these contradictions. However, they do not explore whether the traditional models are helpful as they are. For that reason, this study follows Crowston et al. (2010) and derives the following detailed research question:

*RQ3: To what extent do traditional usage models explain usage behavior of self-tracking appliances?*

In order to investigate this detailed research question, a traditional usage model (UTAUT1 and UTATU2) was selected. In a field study with over 700 participants, empirical results about the explanatory power of the models for self-tracking appliances are derived. The results contribute to the literature by providing an attempt to answer Crowston et al.'s (2010) question. Furthermore, the study extends research on adoption, as well as continuous usage of self-tracking appliances.

Second, scholars have recently enhanced and sometimes tested a short range of methods and theories to better understand self-tracking behavior. Baumgart (2016), for example, used cognitive-dissonance theory to explain the controversial reactions to self-tracking devices. She shows that individuals often experience cognitive-dissonance when they discover they have not reached their goals. One of three possible ways to reduce this dissonance consists of changing attitudes (as an environmental cognitive element). Baumgart (2016) calls for more quantitative studies to test their model.

For several decades, attitudes served as an essential predictor of behavior, especially in social psychology (Eagly and Chaiken 1998). In scientific terms, social psychologists would say that attitudes explain a response (behavior) to a certain stimulus (object or behavior). All in all, the IS community has investigated a multitude of constructs that predict or explain IS usage. In this sense, early on, scholars also employed this core construct from social psychology. Then, constructs such as usefulness, social norm, or habit were integrated. Since IS research originates in an organizational context, more cognitive aspects have been shown to impact IS adoption. On this account, attitudes have disappeared from traditional IS models. Yet, in the last two decades, IS scholars have enlarged the perspective of IS adoption in two ways. First, the acknowledgment that not all systems are utility-based (especially when it comes to interactions outside the company with partners or customers) brings volitional systems into focus. Empirical studies with such systems have proved more dependent on intrinsic aspects such as satisfaction, enjoyment, and attitude. Furthermore, just recently, Dwiwedi et al. (2017) called for reintegrating attitudes to the UTAUT model, as explanatory power of that model increases significantly. Second, IS researchers have understood that not only the adoption decision is vital for IS usage, but also continuous system usage. For that reason, scholars (Bhattacherjee 2001, Bhattacherjee and Lin 2014, Turel 2015, Xu et al. 2017) also revert to an affective component for explaining continuance or discontinuance.

The insights above uncover the following shortcomings in the literature. First, it remains unclear if traditional IS instruments explain the contradictory behavior of self-tracking appliances. Those instruments mainly exclude attitudes as they pay particular attention to IS usage in a professional context. Yet, for volitional systems that are rather applied in a private context, scholars suggest integrating attitudes again. Moreover, the little existing IS research on self-tracking goes in the direction of attitudes (with cognitive-dissonance theory). Thus, in light of these developments, this dissertation supports the return to attitudes by dedicating to them its final part.

However, as identified above, most attitude constructs show a strong heterogeneity and still originate from Fishbein and Ajzen (1975). On this account, the constructs result from research in a purely professional context. Furthermore, existing attitude constructs mostly ignore the tripartite view (Goodhue 1988, Sun and Zhang 2006, Swanson 1982, p. 19, Yang and Yoo 2004). Thus, following the call for construct development from Moore and Benbasat (1991), this research tries to set as its first impulse to specify a particular attitude construct that can be used within IS usage behavior research. Attitudes toward a specific technology constitute one of the major antecedents to the adoption of knowledge-sharing systems and self-management tools (Casimir et al. 2012, Esmaeilzadeh et al. 2011, Kwok and Gao 2005, Nam et al. 2011). At the same time, however, existing consumer-attitude constructs (Davis 1985, Igbaria and Chakrabarti 1990, Joyce and

Kirakowski 2015, Nickell and Pinto 1986, Wixom and Todd 2005, Yang and Yoo 2004) often cover a specific domain or technology – e.g., General Internet Attitude (Joyce and Kirakowski 2015) – or may be classified as insufficient or inadequate when regarding the phenomenon of self-tracking (see Section 2.2, p. 14, for a detailed discussion). To that end, the following detailed research question is proposed:

*RQ4: How can self-tracking attitudes be measured?*

In order to investigate this research question, a specific construct is generated that can measure self-tracking attitudes. According to construct-development guidelines (Churchill 1979, Lewis et al. 2005, MacKenzie et al. 2011, Smith et al. 2014), the construct is specified, and a first version of the instrument is validated in the form of a self-reported survey instrument. Understanding attitudes toward self-tracking should help in predicting the self-tracking behavior of individuals and consequently identifying potential users or customers. An in-depth understanding of attitudes toward self-tracking is also a natural step toward improving self-tracking IS, toward fostering their adoption and allowing users to reap the benefits of IS usage.

Overall, the dissertation follows Bhattacherjee et al. (2018) and Vodanovich et al. (2010) and challenges existing theories, trying to propose alternatives for further investigation in the IS community. The research results contribute to the literature as they enlarge qualitative and quantitative empirical knowledge about the self-tracking phenomenon.

Having derived the detailed research questions, the final subsection combines them all together into one research framework that serves as an integrated view of the coverage of this dissertation.

### 2.5.3 Research Framework

Summarizing the theoretical foundations and the status quo presented in the sections above, Figure 9 establishes the research model. First, the dissertation investigates the private and the professional contexts of IS research to finally quantify the extent of IS research in the private context. RQ1a and RQ1b will investigate this issue in the next chapter, Chapter 3 (p. 33).

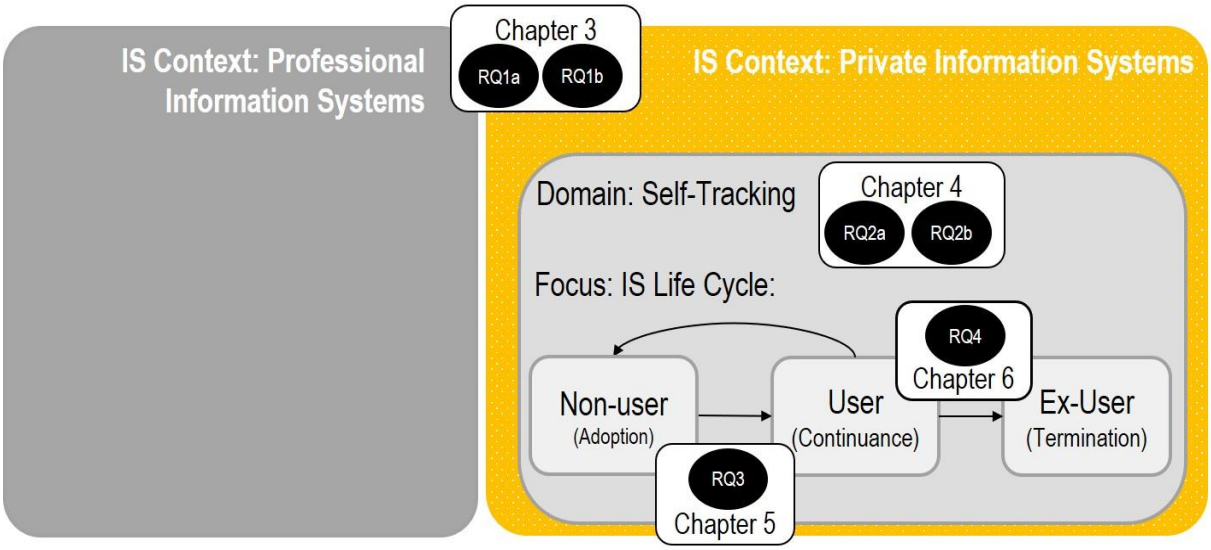



**Figure 9.** Research Framework of the Dissertation Amended from Maier et al. (2015, p. 278) and Middleton et al. (2014, p. 509)

In order to increase IS research on PIS, the dissertation continues by concentrating on a specific domain of PIS that covers various systems available to private users, and predicted to be one major trend in the next years: self-tracking. For better understanding of the phenomenon of self-tracking, a literature research is conducted within the IS discipline and related disciplines (psychology and human-computer-interaction) to answer RQ2a and RQ2b in Chapter 4 (p. 67).

To understand the usage as a main concern of IS research, which lays the foundation for other research interests, an empirical investigation of the adoption and continuance of PIS (RQ3 in Chapter 5, p. 95) and the concept of self-tracking attitudes (RQ4 in Chapter 6, p. 111) are proposed.

The next chapter starts with the status quo analysis and aims at answering the two detailed research questions regarding the extent of PIS within IS research.

# 3 Bibliometric Study on the Private Context of IS Use in IS Literature

In light of the increased usage and importance of Information Systems in the private context, the following chapter focuses on the research efforts within the IS community toward a better understanding of IS use in the private context (see Figure 10).

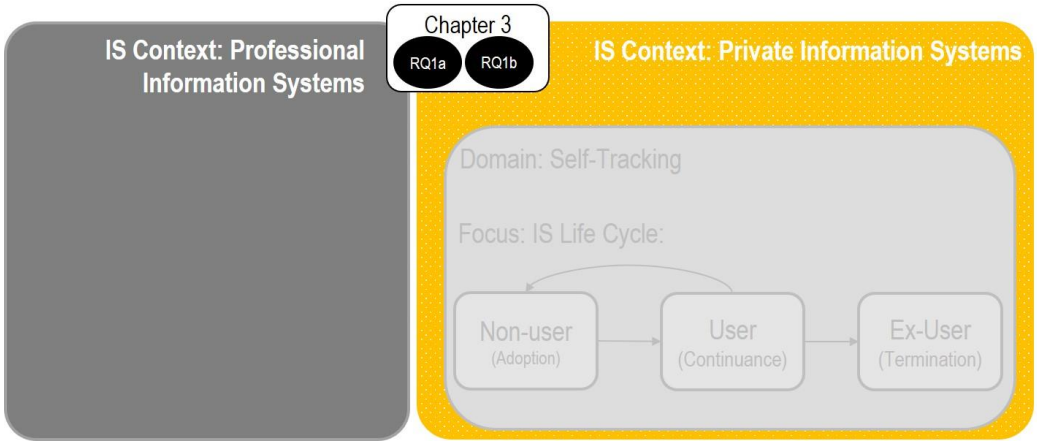



**Figure 10.** Research Focus for Chapter 3: Examination of Articles and their Context

Hence, this chapter represents a self-examination of the IS community, to stimulate an informed discussion of the discipline facing the relevancy of the private context, which has gained importance in practice. Yet, it seems that the IS discipline is not sufficiently concerned with research on the private use of IS. Sørensen and Landau (2015) have already identified such a gap between practice and the literature in a specific research field within the IS discipline that actually drives much IS usage in the private context: mobile ICT. They investigate the extent of that research and find out that the IS discipline lags behind the development in practice, as only around 3% of all articles treat mobile ICTs.

Furthermore, as discussed in the Introduction (p. 1) and in Section 2.1 (p. 5), there is unanimity about whether the IS discipline has already started to sufficiently engage in research on PIS use. To that end, the chapter aims first at answering the following detailed research question:

*RQ1a: To what extent do top IS outlets reflect the trend in practice toward the private use of IS currently and over the last two decades?*

To answer the question, this chapter investigates the state of IS research with the help of a literature analysis that establishes the state-of-the-art of a science, also called the science of a science or research on research (Hood and Wilson 2001, Straub 2006). Arnott and Pervan (2012) distinguish two types of literature analysis: literature reviews (vom Brocke et al. 2009, Fettke 2006, Webster and Watson 2002) and bibliometric studies (Cocosila et al. 2009, Osareh 1996, Vessey et al. 2002, Weber 1990). Literature reviews cover thematic analyses that classify and analyze "articles according to themes that are relevant to the theory and practice goals of a research project" (Arnott and Pervan 2012, p. 926). In this sense, literature reviews rather emphasize qualitative aspects and "describe the key concepts" of articles, or develop "a model to guide future research" (Webster and Watson 2002, p. xxi). In contrast, bibliometric studies use quantitative methods (i.e., mathematical and statistical) to determine how many articles fall into a specific category (e.g., articles that investigate aspects of IT value) or include a certain aspect (e.g., use quantitative research methods). Furthermore, bibliometric studies also "provide insight into the history of science" (Hood and Wilson 2001, p. 292) by analyzing multiple years or longer time periods. In the IS discipline, bibliometric studies[11] are a well-established quantitative instrument to investigate core topics (Alavi et al. 1989, Cocosila et al. 2009, Culnan 1986, 1987, Sidorova et al. 2008), diversity and research methods (Chen and Hirschheim 2004, Glass et al. 2004, Grover et al. 1993, Vessey

[11] According to Siluo and Quingli (2017) and Hood and Wilson (2001), in the research stream of Information Science, several types of quantitative analysis of any aspects or information from the literature exist. The field distinguishes bibliometrics (the oldest term, that started with concentrating on books), scientometrics (a more modern term that focuses on a larger set of documents), or informetrics (that includes bibliometrics and scientometrics and non-scholarly work). Yet, the authors agree that this distinction is rather fuzzy and other definitions exist that just lead to random usage of the terms by other scholars (not engaged in Information Science). Some even use the different terms interchangeably. For that reason, this study follows Cheon et al. (1993), Culnan (1986, 1987), Culnan and Swanson (1986), Sørensen and Landau (2015), using the classical term "bibliometrics."

et al. 2002), the evolution of IS research (Baskerville and Myers 2009, DeSanctis 2003), or cumulative research tradition (Farhoomand and Drury 1999, Grover and Lyytinen 2015, Hamilton and Ives 1982b). All these efforts of taking a "step back periodically and think[ing] about the research which constitutes a field" (Culnan 1987, p. 341) represent a critical self-evaluation of the discipline that follows an overarching goal. For example, the results try to legitimize the existence of the young IS discipline and shape its identity (Agarwal and Lucas 2005, Benbasat and Zmud 2003, Lyytinen and King 2004, Wu and Saunders 2003) and help to increase innovativeness by summarizing the existing knowledge, which helps scholars to better build on prior insights and follow new and challenging research questions, thus determining the maturity of the relatively young IS discipline or a specific research field (e.g., mobile ICT).

With the aim of research question RQ1a to investigate the extent of research on PIS use within the IS discipline, the dissertation employs a quantitative literature analysis. Better called a bibliometric study, it counts articles that investigate IS topics in a private or a professional context. The results of the bibliometric study help researchers to "direct their efforts in the most productive manner" (Alavi et al. 1989, p. 372) and clearly show that issues from the private context are a vivid, growing field of IS research. Another step to support future research efforts is identifying more information about typical characteristics of the articles that investigate private use of IS. This helps other scholars to extend previous literature in a systematic way. Following other scholars who previously undertook bibliometric studies, this chapter also intends to provide more insights into typical characteristics of research on PIS. Such characteristics are defined as intellectual structure (definition please see Chapter 2, footnote 1, p. 5) and may encompass, for example, employed research methods and research designs (Alavi et al. 1989, Williams et al. 2009); nationality and most cited articles (Bernroider et al. 2013, Córdoba et al. 2012); publications and authors most cited, and cooperation between authors (Cocosila et al. 2009). In order to enlarge this study toward insights on the extent of PIS within IS research, the following research question is established to give a more detailed overview of PIS research:

*RQ1b: How does the intellectual structure of research in the private context of IS use look like and how has it evolved?*

To answer the research question, the bibliometric study focusing on the usage context of IS from the first research question is enlarged to investigate a selected set of characteristics of the intellectual structure of typical IS articles. Again, articles that employ a certain characteristic or fall into a specific category are counted. Then, the results provide further insights about current and previous ways to undertake research (e.g., research method, citations). This analysis supports conclusions on the maturity and diversity of the research stream of PIS and the private context. In turn, this improves orientation of other scholars and streamlines future work.

The chapter is structured as follows: The first subsection explains the methodology for analyzing the context and the characteristics of the intellectual structure of PIS. Then, the complete database and quality criteria of the research are described. Subsequently, the results as well as limitations on their interpretation are presented. Finally, the results are summarized and discussed in the last section.

## 3.1 Overall Method for Bibliometric Study

As described above, bibliometric studies analyze the state-of-the-art of a science and quantify the output, or citations (Chen et al. 2012, Sørensen and Landau 2015). On the one hand, such aspects may encompass explicit and easy-to-access data from articles: metadata (e.g., co-authors and authors, publication details, keywords, university affiliations) or secondary data (citations). On the other hand, a key interest consists of implicit data. Such data can be indirectly derived from the title, abstract, or full text. For that reason, many bibliometric studies consist of two major steps: (1) extraction and generation of data, followed by (2) a quantitative descriptive analysis (counting number of appearances of a certain aspect). Before quantifying the number of articles according to different article characteristics, data collection and preparation play a significant role, especially for implicit data, because it takes interpretation to derive information from text.

The section at hand describes the data collection and preparation method for the characteristics investigated in the bibliometric study. Table 4 shows an overview of the different characteristics that help to answer the research questions of this chapter. For the first research question ("To what extent do top IS outlets reflect the trend in practice toward the private use of IS currently and over

the last two decades?"), an article's research context is assessed. Then, the remaining four characteristics offer insights into the intellectual structure of previously identified articles that only concern the private context.

As mentioned before, there are implicit and explicit characteristics. The latter are easily captured because they can be directly copied from meta-data or objectively assessed (such as the authors, Google Scholar citations, or number of references). In contrast, implicit characteristics cannot be easily determined (e.g., the research context of an article). To do so, the content of an article needs to be analyzed in more detail. Such a content analysis "uses a set of procedures to make valid inferences from text" (Weber 1990). The major steps of a content analysis encompass document selection (e.g., newspapers, transcripts), encoding/categorization, interpretation, and quantitative/qualitative analysis. Successful selection of the sources for a content analysis requires coding as a focal step. Coding represents a systematic analysis according to formulated rules (Holsti 1968). This approach ensures a certain level of objectivity. Coding helps to structure massive text (passages) in order to interpret the content by allocating a specific code to each (text) passage considered relevant as defined within the coding rules. Finally, the combination of different attributes of the content establishes generalizability of the findings, which can be reported in a qualitative and quantitative form.

Overall, Table 4 shows which type of data collection or preparation is needed for each characteristic. The first two characteristics (context and research method) are rather implicit information that requires the application of a content analysis. The remaining three characteristics (nationality, thematic content, and knowledge utilization) represent explicit data that can be captured more easily.

The final step consists of counting the number of articles for each characteristic and calculating shares for the articles that belong to one specific type of a characteristic (e.g., how many articles are concerned with research on the private context or the professional context).

**Table 4.** Major Characteristics of the Bibliometric Study of PIS

| | Research Question 1 | Research Question 2 | | | |
|---|---|---|---|---|---|
| Characteristics | 1. Context | 2. Research method | 3. Nationality | 4. Thematic Content | 5. Knowledge Utilization |
| Indicators | Sample composition & IS under investigation | Research method (according to method section) | Nationality of the affiliation of the leading author | Author given keywords | Authors, references, Google Scholar citations (showing how knowledge is being reused) |
| Data Collection & Preparation | Content analysis of articles in the form of coding | Content analysis of articles in the form of coding | Extraction of metadata from articles and transformation | Extraction of metadata from articles and grouping | Extraction of meta and secondary data (Google Scholar) |

The next subsection starts with the first characteristic and research question. It describes in detail the assessment of the context of an article for further descriptive analyses.

### 3.1.1 Research Context of an Article

Subsection 2.1.2 (p. 9) defines in detail the goal and relevancy of the first research question ("To what extent do top IS outlets reflect the trend in practice toward the private use of IS currently and over the last two decades?") and characteristic. The assessment of the context of an article represents the data adequately to answer this question. The subsection at hand describes precisely the overall data collection and analysis approach and the detailed information about the categorization. Determining the research context of articles is a difficult task, as it is always implicitly named within an article. Furthermore, articles are often framed as being within a professional context, but upon a closer look, the full text reveals that the sample or the studied technology rather covers a private context. Therefore, special focus is applied to the identification of the correct research context in the subsection at hand which is separated in two parts. The first part describes the bibliometric study and the second part explains the categorization scheme to differentiate private and professional contexts in articles.

Bibliometric Study of IS Usage Context

The first characteristic of interest concerns the context of IS within research articles. The characteristic relates to one major interest of this investigation, as it answers the first research

question ("To what extent do top IS outlets reflect the trend in practice toward the private use of IS currently and over the last two decades?") aimed at determining the extent of PIS within IS. For that reason, the approach of the bibliometric study is much more sophisticated in comparison to those confined to explicit characteristics.

Figure 11 shows the general approach of the bibliometric study, which follows Vessey et al. (2002, p. 145), Alavi et al. (1989, p. 364), Sørensen and Landau (2015, p. 162), Grover and Lyytinen (2015, p. 276), Swanson and Ramiller (1993, p. 301), Farhoomand and Drury (1999, p. 4). The recommendations and insights of those six articles guided this study, with the goal of ensuring a qualitative and highly objective categorization of the articles. First, a database containing the metadata (including source, title, authors, abstract, and keywords) was created (1) and a preliminary version of coding rules (defining the categories and explaining the process in an explorative way as discovered from literature) was established (2). Each of three raters categorized the complete data, which was organized in three iteration cycles (3). Between the first (3) and second (5), as well as between the second and third (7) round of categorization, the raters and scholars discussed the categorization, based on a validation subsample of articles (steps 4 and 6; see Subsection 3.2.2, p. 45). The subsample was selected based on the criterion that it should contain the same number of articles from each year and each outlet, and randomly selected articles that met those diversity criteria to cover a wide spectrum. This validation step was used to update the coding rules in order to converge on a standardized understanding and process. The validation subsample also served as a training set for the reviewers of the second and third round, to ensure data quality. After the completion of the final round of coding, the three categorizations of an article were compared (8) and in the case that opinions differed, the researchers would review the opinions and follow a strict set of rules or open a discussion to reach consensus.

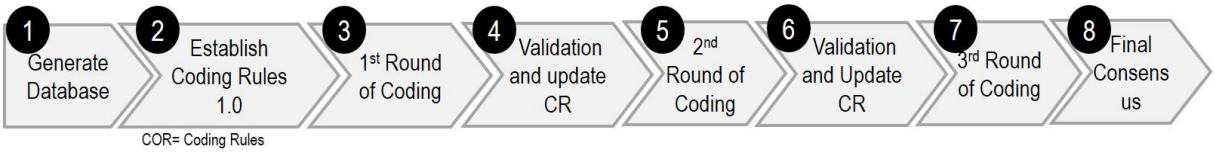



**Figure 11.** General Categorization Approach for the IS Usage Context of Articles

The final consensus consisted of subcategories allocated to one of four superior categories (private; professional; both, multiple; other; see Figure 12). Succeeding to this step, the data is ready for quantitative analysis in the form of counting the articles per category, IS outlet, outlet type, and year. For better understanding of the final results, the following part of the subsection explains in detail the coding procedure for all three coding rounds (step 3, 5, and 7), which leads to the final subcategories and superior category (context) of each article.

Categorization Scheme for the IS Usage Context

The basic step of determining the context of an article consists of studying the content of the article (title, abstract, keywords, full text where necessary). Then, according to the content, the article is classified into a certain context of IS use. Finally, the share of articles that fall into each category (context) by year and by outlet can be assessed.

The classification process in each round of coding consists of two or three steps. First, the rater skims through the metadata (especially title and keywords) to get a first impression of the adequate context and category (step a). This impression may be corroborated or refuted by reading the abstract (step b). In some cases, it is possible to make the categorization based on the metadata and the information in the abstract. In other cases, that information is not enough to determine the category with high confidence. In those cases, it is necessary to include the full text, as recommended by Vessey et al. (2002). In more than 50% of the cases, it was necessary to skim at least parts of the full text of the article (step c). Over time, the methodology section was identified as the most informative part of the full text for the categorization.

As outlined above, the main goal of this bibliometric study was to assess the share of IS articles that focus on the private and/or professional use of IS. The category of **professional use** encompasses articles that analyze IS within companies and governments or between those organizations (business-to-business or government-to-business transactions). For example, the category includes articles concentrating on the design of business-related IS or technology acceptance by employees. By contrast, the category of **private use** of IS includes articles that

focus on nonprofessional contexts – for instance, the adoption of fitness trackers to monitor workout performance. Throughout the processes of categorization and consensus building, various articles could not be attributed exclusively to a single category. For example, articles examining interactions or activities on platforms such as eBay or crowdfunding may not give enough information if the research focus pays particular attention to private buyers but also includes commercial buyers. Both types of buyers (or sellers) can interact with each other on eBay. Additionally, for articles covering social-networking sites, precisely allocating the article to one category is difficult when it is unclear if the social-networking site is used privately or implemented for organizational networking or marketing. When it was obvious that an IS could be used in both contexts and the article lacked information on the sample composition or the type of artifact, the article was allocated to the ambiguous context category (**professional and private use** of IS). The fourth category **other** contains general articles such as instrument development, editorial, or obituary/epitaph (in 2005, a whole issue in the European Journal of Information Systems was dedicated to the deceased scholar Claudio Ciborra). Figure 12 displays all four categories, and Appendix 9.3.1 (p. 189) explains the detailed classification scheme with its subcategories derived from literature.

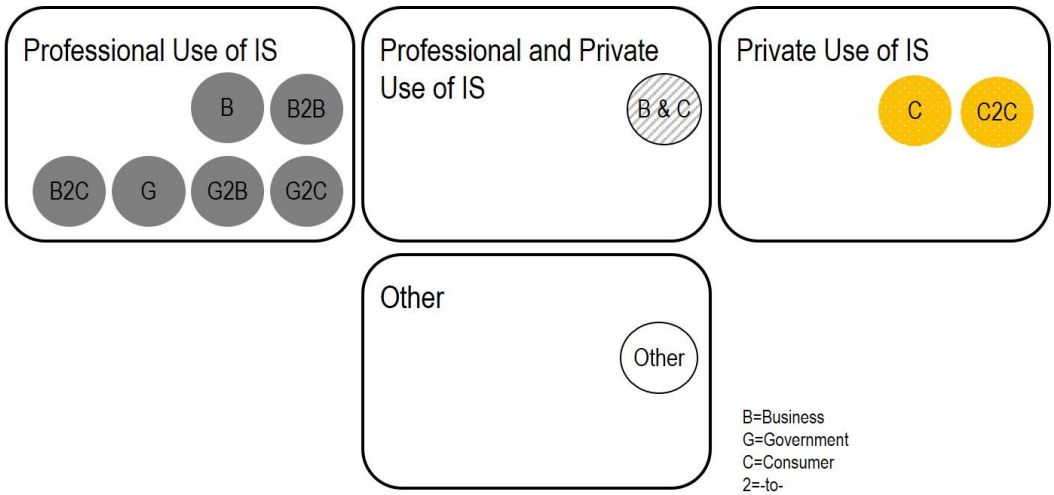



**Figure 12.** The Four Categories for the Final Analysis and their Subcategories

The next subsections concentrate on the second research question of this chapter ("How does the intellectual structure of research in the private context of IS use look and how has it evolved?") and present data collection, preparation, and data analysis of four additional characteristics forming the intellectual structure of the private context of IS use. The first characteristic that sheds light on the intellectual structure is the employment of research methods. A detailed account of the assessment process follows.

### 3.1.2 Research Methods and Meta-Categories

A large stream of research is engaged in studying the employed research methods to debate the identity of the discipline, to influence identity formation (Riedl and Rueckel 2011), or to ensure diversity (French and Shim 2011). In this sense, various discussions since the 1980s over the previous decades concerned positivist vs. interpretivist paradigms, rigor vs. relevance, the core of IS, and more recently since 2011, behavioral vs. design science (French and Shim 2011). Riedl and Rueckel (2011) analyzed 20 different studies that investigated the employed research methods from 1968 until 2006, and give a comprehensive overview of the most prominent evolutions of these almost 40 decades.

First, it is vital to discern the exact role of a research method within the research process (Jenkins 1985). A research method helps the researcher to gather data. After the data collection itself, data analysis starts. The results of data analysis answer a specific research question.
According to this process description, a research method represents the first part of a methodology chosen by a researcher to engage in scientific work. The article from Riedl and Rueckel (2011) reveals 50 different research methods that have been applied in IS research. Additionally, when studying various frequently cited and discussed articles in IS research, a broad array of research methods and their meta categories, as well as data collection methods can be catalogued.

However, each author uses another framework and or adapts existing ones. So, one challenge lies in selecting an adequate framework that properly reflects the employment of research methods.

In fact, Riedl and Rueckel (2011) analyze 20 research-method studies and identify four that IS research uses most frequently: surveys, case studies, laboratory experiments, and field experiments. Yet, the remaining 45 research methods the authors identify are less often or even rarely used (e.g., protocol analysis, game playing, hermeneutics, secondary data usage). In addition, differently named research methods often describe very similar ways of collecting data. For example, methods like data analytics or secondary data usage all use already "existing" (Chen and Hirschheim 2004, p. 206) "large, diverse, and dynamic data sets of user-generated content" (Müller et al. 2016, p. 289). This represents a challenge to detecting essential changes within the usage of research methods and the discussion of challenges and trends. The unanimity and plethora of named research methods by scholars might hinder the goal of recognizing the intellectual structure and changes in the employment of IS research methods in the private context of IS use. First, the data is not easily comparable, as each author has a different framework with only small overlaps. Second, assessing the research method of articles is not as easy as expected, because of the unanimity of distinguishing research methods and missing details in a large number of articles. For that reason, this analysis combines multiple but similar frameworks provided by IS scholars with typical, all-encompassing categories. So, this subsection describes in the first part in detail the overall data collection and analysis approach, and in the second part the detailed article categorization scheme to assess their employed research method, research design, and research approach. Following other scholars, the analysis includes the meta-categories of the research design and the research approach, in order to provide a much richer dataset for interpretation. As a result, this subsection especially focuses on the identification of the correct research method, research design, and research approach.

Bibliometric Study of Research Methods and Meta-Categories

Analyzing the employed research methods and meta-categories in the context of a bibliometric study requires a content analysis with a categorization approach, because of three issues. First, the research method and meta-categories are often only named in the full text. Second, the characteristics are not often explicitly named at all. Third, each author uses another definition or concept for his or her work, and no uniform categorization exists in IS literature.

On this account, the employed research method and meta-categories represent implicit data, the analysis of which calls for a categorization approach. The categorization approach for the research methods and meta-categories largely follows the approach from the previous section (Subsection 3.1.1, p. 35). However, the approach is slightly adapted because the research method and meta-categories are easier to detect than the research context of an article. Moreover, the employed research method and meta-categories are one out of four captured characteristics, which also limits the scope of effort and time for capturing each characteristic. Figure 13 explains the complete approach of the general categorization of the employed research method and meta-categories.

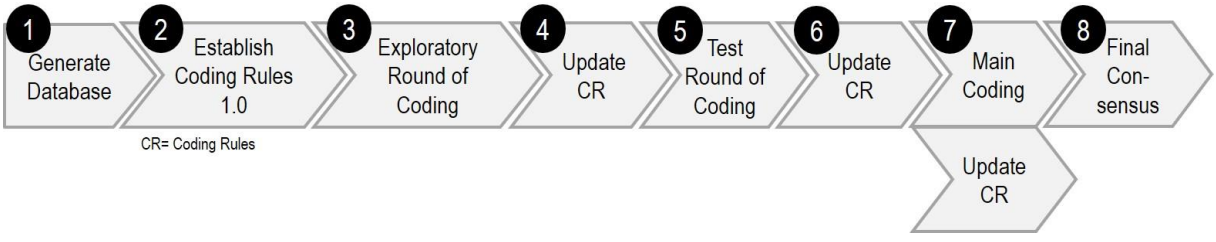



**Figure 13.** General Categorization Approach for the Employed Research Method of Articles

First, the database containing the metadata of articles (including source, title, authors, abstract, and keywords) from Subsection 3.1.1 (p. 35) was reused (1). Then, departing from the exemplary categorization framework from Chen and Hirschheim (2004), a preliminary and exploratory round of coding (3) of a subsample of the complete data set (over 50% of the selected articles, over 1,000 articles) was conducted. Observations and experiences from this exploratory round led to an in-depth update of the coding rules based on a more profound literature analysis (Alavi et al. 1989, Ayanso et al. 2007, Backlund 2005, Cheon et al. 1993, Ebeling et al. 2012, Galliers and Land 1987, Glass et al. 2004, Hamilton and Ives 1982b, Harrison and Wells 2001, Holz et al. 2006, Jenkins 1985, Orlikowski and Baroudi 1991, Palvia et al. 2004, Riedl and Rueckel 2011, Venkatesh et al.

2013, Vessey et al. 2002). The insights engender an update of the coding rules (4) with a much more diversified and adapted categorization scheme for the complete data sample. According to Palvia et al. (2004), as a next step, a randomly selected subsample serves to train coders and test the application of the coding rules (5). The testing round provides the basis for validity and reliability testing (see Subsection 3.2.2, p. 45). The resulting experiences and uncertainties were resolved and included in the next update of the coding rules (6). These coding rules lead to the main coding (7) and were subject to some minor modifications. The modifications were also applied to the full sample; even previously processed articles were coded again. Then, to ensure validity, the coders undertook a final round of test coding. To that end, another subsample was chosen and categorized by the coders and researchers to test the degree of accordance. Finally, (8) final consensus was reached among the coders.

As a consequence, data can be used for the quantification of articles per research method (and meta-categories), research context, IS outlet – as in Sarker et al. (2013) – outlet type, and/or year. For better understanding the results, the following part explains in detail the coding procedure, which leads to the assessment of research methods (and meta-categories). More specifications about the categorization scheme follow in the next part.

Categorization Scheme for the Research Methods and Meta-Categories

The classification process in each round of coding consists of two steps. First, the rater skims through the metadata (especially title and abstract) to identify the employed research method (step a). In most cases, it is impossible to make the categorization based on the metadata or the information in the abstract. In those cases, it is necessary to include the full text, as recommended by Vessey et al. (2002). For that reason, in 50% of the cases, it was necessary to skim at least parts of the full text of the article (step b). Over time, the introduction, the general structure of the article, and methodology section became the parts of the full text most informative for the categorization. As already mentioned, in accordance to Sarker et al. (2013), the identification of the employed research method can be quite challenging. Some authors do not explicitly name a research method, or they use overly generic or unrecognizable designations for research methods.

In 674 articles, the explicitly named research methods were extracted and correspond to the categories named above. Because 145 articles did not mention a precise research method, the coder categorized them according to the framework. For 204 articles, at least one research method required renaming because the named research method did not fit the categorization scheme).

Figure 13 shows the framework for classifying research designs, approaches, and methods (see Figure 14). It was developed based on the literature and experiences from a first exploratory round of categorization that only considered the framework from Chen and Hirschheim (2004). By means of such a rather inductive approach, it became clear that the employed categories do not properly represent all currently employed research methods.

On this account, the categorization framework was reworked by taking into consideration the categorizations from Alavi et al. (1989), Hamilton and Ives (1982b), Harrison and Wells (2001), and Venkatesh et al. (2013). All four articles were used because they either are quite similar or cover a broad spectrum of research methods. Additionally, they are from different time periods, which should have covered a broad variety of research methods that might appear within the chosen timespan for this study. Following most authors (Alavi et al. 1989, Chen and Hirschheim 2004, Farhoomand and Drury 1999, Harrison and Wells 2001, Holz et al. 2006, Venkatesh et al. 2013), this framework essentially differentiates **empirical** (based on observations, describing an object) from **non-empirical** (based on ideas, frameworks) and **qualitative** (narrative data collection) from **quantitative** (numerical/statistical data collection) research. Non-empirical research mainly consists of a qualitative approach containing research methods such as **conceptual, opinion**, **other**, or **literature review** with only a qualitative analysis goal. Empirical research designs (e.g., **field study**, **literature analysis**, **action research**) follow a quantitative and/or qualitative approach. Finally, the framework also accounts for mixed strategies and approaches and combinations of different multiple research methods.

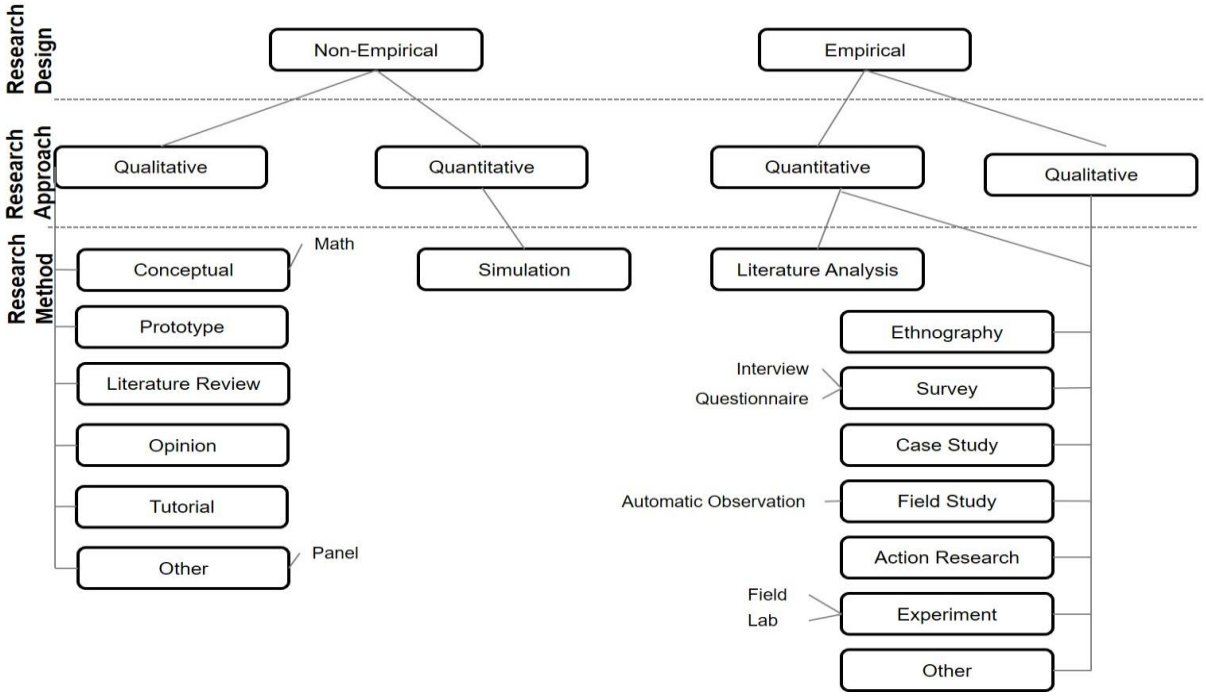



**Figure 14.** Categorization Scheme for Classifying Research Methods

Further information and detailed definitions of each research method can be found in Appendix 9.3.2, p. 190. After clarifying the data collection, preparation, and data analysis for the research methods, the next subsections focus on more factual and objective data that does not require content analysis (categorization). To start, the following subsection describes the method for determining the geographical origin of articles engaged in research in the private context of IS use.

### 3.1.3 Nationality

IS scholars investigate geographical aspects of articles because they draw conclusions on the amount of research activities in a specific country by a research stream (Gallivan and Ahuja 2015, Williams et al. 2009). Galliers et al. (2007) recognize different profiles for different regions in IS research and even distinguish a “European style of research” (Galliers et al. 2007, p. 20). This is in line with conferences that concentrates on specific regions (e.g., European and Americas Conference on Information Systems). Such differences imply potential opportunities for additional research or funding that might help to diversify and extend global knowledge (Williams et al. 2009). In order to account for such differences within the private context, this indicator was added to the analysis of the intellectual structure of IS research in the private context. This section describes in detail the overall data collection and analysis approach of explicit data in IS articles. Assessing the nationality of an article is a far simpler task than determining an article’s context or the employed research method. To that end, this subsection is shorter than the previous ones.

In order to analyze the nationality of an article in the context of a bibliometric study (for more information see Subsection 3.1.1, p. 35), the already existing database from Subsection 3.1.1 was reused and extended. Following Córdoba et al. (2012), for each article, the country of origin of the affiliated institution of the first author was identified and captured. It is usually named at the beginning of an article and, in most cases, the city of origin and country are also provided. In the case that only a city of origin or only the name of the institution was provided, a quick Google search helped to complete the information in the database.

As the number of articles from the private context of IS use is expected to be rather small, resulting in scattered results, another meta-level was used for the analysis of nationality: the continent. This is also in line with prior bibliometric studies, where the share of articles is compared on country and continent levels. From the country of origin of the leading author, the geographical continent was derived to determine the final nationality of an article (Table 37 in Appendix 9.3.4, p. 193, shows the exact allocation).

Following the description of the methodology of the third characteristic of interest, the next subsection treats the fourth characteristic, the thematic content.

### 3.1.4 Thematic Content

As already described, in IS research the investigation of the focal themes that scholars study represents the most prominent bibliometric characteristic (Alavi et al. 1989, Cocosila et al. 2009, Culnan 1987, Glass et al. 2004, Sidorova et al. 2008). Scholars denote this type of study as the intellectual core of the discipline, and sophisticated methods exist. With the identification of the most prominent research themes, scholars draw conclusions on the maturity, innovativeness, diversity, or identity of either the discipline or a specific research stream. On this account, they study from a couple of hundred articles to more than 2,000 articles with either cumbersome manual work or complex text-mining methods. So, a bibliometric study that does not take into consideration the thematic content of articles seems inevitable. For this reason, the thematic content is included in the overall list of characteristics here. However, as the primary goal of this study already encompasses the tedious work of classifying the context of each article, the determination of the thematic content was simplified, and an analysis of the thematic content is realized with the already captured metadata: the keywords authors select for storing their article on scientific platforms. As a result, this section describes in detail the overall data collection and transformation approach of the keywords of an article, used to find key themes for PIS. Again, the data-capturing process is easier because it involves explicit data. This is why the subsection is shorter than 3.1.1 and 3.1.2.

In order to analyze the thematic content of an article in the context of a bibliometric study (see Subsection 3.1.1, p. 35), the already existing Excel database from Subsection 3.1.1 was reused and extended. For each article, scientific platforms or the header information of the article provides on average five keywords that shortly describe the content of an article, often determined by the author. This information was captured within the database and separated in various columns (depending on the number of keywords). The last step of the separation of keywords was often cumbersome due to heterogeneous separators that exist when data from different platforms or archives is captured (commas, semicolons, or dashes were used).

For further analysis of the keywords, a quick overview of the data with a pivot table made clear that the data needed even more homogenization. For example, platforms or archives use different spellings or notations (e.g., eHealth, e-Health). To homogenize the spelling of the keywords to better analyze the data, as a first step all keywords were transformed into lower-case to increase comparability. As a result, the database consists of 3,814 keywords.

The large number of keywords still requires condensing to enable meaningful data analysis. Another database was created containing from one to multiple entries per article with the main metadata and context category, as categorized in Subsection 3.1.1. With a pivot table summarizing the articles per uniquely given keyword, it becomes apparent that out of the 3,814 keywords, 3,165 keywords are only named once. This represents over 80% of all available keywords, so not even 20% of all keywords were used more than once (the maximum number times used was 33). One reason lies in an issue of data heterogeneity that hinders analysis. Some keywords are not really unique keywords. Due to the liberty of keyword selection by authors, they use the same keyword but in many variations: singular, plural, abbreviated, different order, or combined with other words (“business alignment”, “business it alignment”, “it business alignment”, “business information technology alignment”). Yet, in the pivot table, each variation is shown as a distinct keyword. Another reason for the high number of unique keywords relies on the fact that a research theme can be described with various keywords. For example, technology adoption can be described with “technology adoption,” “IS adoption,” “TAM,” “IS acceptance,” and other keywords. Accordingly, generally speaking, the total number of keywords could be reduced by grouping similar keywords or aligning the spelling variations. As a result of both issues, data analysis would require a data harmonization to determine exactly unique keywords, and some complex text mining or cluster analysis for determining typical IS themes.

All in all, this procedure is outside the scope of this dissertation (especially the clustering would represent the effort of a second dissertation). Thus, following Williams et al. (2015), most focus is on frequently used keywords. In this sense, homogenization and clustering were only considered for keywords used five or more times. This resulted in 112 keywords under consideration for homogenization. A pivot table was checked for any similar keywords that could be merged (e.g., articles use “business analysis,” “business analyst,” and “business analytics”) to one keyword (e.g.,

"business analytics"). After having identified 29[12] possible merges (see Table 5), the raw data was adjusted accordingly and reanalyzed with a pivot table. As a result, another 13 keywords were included because they matched the clustered keywords. This led to 125 keywords used five or more times and thus considered for thematic analysis and clustering.

**Table 5.** All 29 New Keywords with the Merged Old Keywords (for Five or More Occurrences)

| new keyword | merged keywords | new keyword (continued) | merged keywords (continued) | new keyword (continued) | merged keywords (continued) |
|---|---|---|---|---|---|
| **business analytics** | business analysis | **electronic commerce** | e commerce | **interorganizational systems** | inter organisational systems |
| | business analyst | | electronic commerce | | inter organizational systems |
| | business analytics | **enterprise architecture** | enterprise architecture | | interorganizational systems |
| **business it alignment** | business alignment | | enterprise architecture (ea) | **it infrastructure** | it infrastructure |
| | business it alignment | **enterprise resource planning system** | erp | | it infrastructure |
| | it business alignment | | erp best practices | **longitudinal research** | longitudinal analysis |
| **business model** | business model | | erp ii | | longitudinal perspective |
| | business models | | erp implementation | | longitudinal research |
| **business value of information technology** | business value of information technology | | erp projects | | longitudinal study |
| | business value of it | | erp system scope | | longitudinal survey |
| **data analytics** | data analysis | | erp systems | **online reviews** | online review |
| | data analytics | **grounded theory** | classic grounded theory | | online reviews |
| **decision support systems** | decision support system | | grounded theory | **ontology** | ontologies |
| | decision support systems | | grounded theory methodology | | ontology |
| | decision support systems (dss) | | grounded theory study | **organizational change** | organisational change |
| | decision support systems (dsss) | | quantitative grounded theory | | organizational change |
| **digital platforms** | digital platform | **human computer interaction** | human computer interaction | **partial least squares** | partial least squares |
| | digital platforms | | human computer interaction (hci) | | partial least squares (pls) |
| **econometric analysis** | econometric analyses | | humanñcomputer interaction | **social networking sites** | social network sites |
| | econometric analysis | **information systems management** | information systems management | | social networking sites |
| **economics of information systems** | economics and value of is | | is management | **systematic literature review** | systematic literature review |
| | economics of information systems | **information systems planning** | information systems planning | | systematic literature review (slr) |
| | economics of is | | is planning | **technology acceptance model (tam)** | tam |
| **ecosystems** | ecosystem | **Online communities** | online community | | technology acceptance model |
| | ecosystems | | online communities | | technology adoption model |
| **Social influences** | social influence | | | | |
| | social influences | | | | |

Due to the fact that the homogenization described above always considered all articles from all contexts, a closer look at the keywords solely used for articles in the private context induced some further changes. Articles in the private context employed the most frequently employed keyword for six articles. This is far beyond the articles of all contexts, where the most frequently employed keyword was used for 33 articles. On this account, a new cut-off level of two was established for the keywords belonging to articles in the private context (see the result in Table 7). This decision also included checking for similar keywords with a close word stem (e.g., only distinguished by plural vs. singular), and some close keywords were merged to make the analysis simpler and clearer.

[12] For the detailed analysis of the private context of IS use, three merges were only detected when analyzing the top 33 keywords in this context. They were not detected before because the total number of mentions of the keywords did not amount to five. They encompass online communities, technology acceptance model (tam), and social influences.

The acquired data serves as input for the detection of relevant topics within the research stream of the private context of IS use. As a next step, the final characteristic that will shed light on the intellectual structure of this research stream builds on the knowledge utilization by scholars. The following section presents the data collection, preparation, and analysis in more detail.

### 3.1.5 Knowledge Utilization

The term "knowledge utilization" stems from Hamilton and Ives (1982a, p. 61) and refers to "the dissemination and use of research results by researchers in subsequent investigations." In this context, scholars investigate the most productive authors, references, or co-citations in articles to make inferences about the cumulative tradition (the reuse of knowledge) within a research stream. For example, Cocosila et al. (2009) investigate co-authorship and the most productive authors in their dataset (three IS conferences). To that end, they identify the number of publications per author and calculate a ratio called cooperativity index, a value that relates the total number of authors and the total number of papers and measures cooperation intensity. This can reveal insights about the quality of a paper or the author's willingness to cooperate. Culnan (1986) focuses on the analysis of co-citation of authors in the bibliographies of an article. This represents a cumbersome task, as the reference list of each article must be analyzed. According to Culnan (1986) and Hamilton and Ives (1982b), co-authorship analysis also helps inform about the cumulative tradition of referring to previous work and to uncover informal networks between authors. Motivated by the latter goal, Bernroider et al. (2013) combine the analysis of bibliographic co-citations and citations for network analysis, and they reveal that citation analysis uncovers articles that have "a greater influence on a subject than those less frequently referenced" (Bernroider et al. 2013, p. 78). This helps them to investigate the effects of cooperation between researchers. Finally, a rather simple approach is followed by Williams et al. (2015), who count the number of authors per article in order to analyze relevant articles for a specific research stream.

This subsection describes in detail the overall data collection and analysis approach of the metadata, enriched with secondary data of IS articles. An assessment of the extent of knowledge utilization is captured with three indicators: the number of articles per authors, the Basket of Eight[13] (BoE) references per article, and the Google Scholar citations per article. The selection of the indicators is derived from the availability and high accessibility of the (meta)data as well as from aspects that have been investigated in prior literature.

In order to analyze the thematic content of an article in the context of a bibliometric study (for more information see Subsection 3.1.1, p. 35), the already existing Excel database from Subsection 3.1.1 was reused and extended. For each article, only the number of BoE references and the Google Scholar citations needed to be searched. To begin, citations from Google Scholar (http://scholar.google.com) for each article were collected twice – at first, manually in 2016,[14] and later automatically with the help of software in 2018.[15] Both counts of Google citations were stored in the database. Then, the data-capture process for the references included manually counting the number of all references of the opened PDF file of an article and the number of references published within the BoE. Both results of the counting process were entered into the database.

The data transformation for the indicators of knowledge utilization required some extra tasks that are described next.

First, in order to analyze the **authors**, a quick overview of the data with a pivot table made clear that the data had to be homogenized in more detail. Platforms or archives use different sequences of first and family name (inverted sequence, e.g., Robert Gallier or Gallier Robert), middle names inconsistently (either written out or only initials given, e.g., Susan A. Brown or Susan Brown), or sometimes first or family names changed (due to marriage or abbreviated first name, e.g., Robert Gallier is also named Bob Gallier). Most inconsistencies were identified manually and adapted to proceed with the data analysis (counting and calculation of shares).

Second, for analyzing the **references**, a ratio (called BoE ratio in the following) was calculated representing the share of references from the Senior Scholars' Basket of Eight within the total

[13] Refers to top IS outlets according to the Senior Scholars' Basket of Eight (AIS 2011) which encompasses typical IS knowledge.
[14] Gathered by two different researchers at two different moments in time: the Google Scholar citations for the conference articles were collected in May 2016. The Google Scholar citations for the journal articles were collected in November 2016.
[15] Automatically gathered with the software Publish and Perish (https://harzing.com/resources/publish-or-perish) in 2018 and merged with the database at hand.

number of references in the references section of an article. All in all, for 112 articles, no references section existed as those articles prevailingly represent, for example, editorials, panels, or errata which do not always refer to previous literature. For the remaining 1,654 articles, the BoE ratio was calculated.

In 2016, for 1,759 articles **Google Scholar citations** were gathered because at the time of the final database update in August 2017, seven articles were found to be missing in the database (mostly editorials). On this account, for the second round of the Google Scholar citation assessment in 2018, Google Scholar citations were gathered for the full sample (1,766 articles).

After having explained in detail the data collection and preparation, the next section presents the complete scope of the data. Furthermore, it describes the choice of measures that ensure high quality of the research at hand, also called validation.

## 3.2 Database and Validation

Turning now to the actual data employed for the study, this section describes and explains the extent of the database gathered in the context of the bibliometric study and elaborates on quality criteria of the bibliometric study at hand.

### 3.2.1 Data Description

The first goal is to quantify to what extent articles published in leading IS outlets investigate the private use of IS, as opposed to the traditional focus domain of IS research, i.e., the professional use of IS in settings that involve organizations. Given the blurry boundary between the two contexts described above, the share of articles that fall into both categories is also analyzed. The second goal consists in examining the intellectual structure (characteristics) of articles that investigate research questions related to the private context of IS usage. To that end, all articles published in a defined set of top IS journals and conferences in the exemplary years 1995, 2005, and 2015 (amounting to a total of 1,766 articles) were analyzed.

The center of interest was on “top IS publication outlets” (Bernroider et al. 2013, Sørensen and Landau 2015, Vessey et al. 2002, p. 136), namely the conference proceedings (VHB 2017) of ICIS (International Conference on Information Systems) and ECIS (European Conference on Information Systems) and the AIS (Association of Information Systems) Senior Scholars’ Basket of Journals (AIS 2011): EJIS (European Journal of Information Systems), ISJ (Information Systems Journal), ISR (Information Systems Research), JAIS (Journal of the Association of Information Systems), JIT (Journal of Information Technology), JMIS (Journal of Management Information Systems), JSIS (Journal of Strategic Information Systems), and MISQ (Management Information Systems Quarterly). Following the example of Cocosila et al. (2009) who exclusively focused on the study of conference papers, two top IS conferences were selected to complete the journal articles because (1) the database is large; (2) the data is more recent (due to the missing delay for the review process that exists for journal articles, see Sørensen and Landau (2015); (3) in many cases, the articles represent a first version of highly qualitative journal articles anyway; and (4) most previous studies rely only on journal publications to which enlarging the sample and perspective could contribute.

Given the goal of including the full range of articles published in those outlets in a predefined time period, the effort involved in the classification process and the number of articles that appear every year in these outlets, it was necessary to restrict the period of observation. Rather than analyzing two or three consecutive years, three isolated years were selected as exemplary units of analysis for different periods in time. The year 2015 was chosen due to the goal of having the most recent completed year of publications (from the perspective of the categorization project launch in 2016); the year 1995 was chosen due to the comparability with Vessey et al. (2002), whose analysis starts in that year. The year 2005 was added to augment the scope of analysis by an interim observation period that makes it possible to evaluate the center of interest of the leading IS outlets at ten-year intervals. Additionally, it is interesting to compare the two years of 1995 and 2005 with the vision of Kolbe and Brenner (1995), which dates from 1995 and includes a scenario of PIS applications for 2005. Table 6 displays the number of articles per year and per journal or conference proceeding.

**Table 6.** Overview on the Number of Articles Analyzed - The Analysis Covers the Entire Set of Articles Published in these 10 Outlets in 1995, 2005, and 2015

| Proceedings / Journals | Number of all Publications in | | | | Proceedings / Journals (continued) | Number of all Publications in | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2005 | 2015 | Total | | 1995 | 2005 | 2015 | Total |
| ECIS | 104 | 160 | 286 | 550 | JMIS | 41 | 49 | 57 | 147 |
| ICIS | 44 | 85 | 344 | 473 | JSIS | 30 | 22 | 21 | 73 |
| EJIS | 21 | 66 | 41 | 128 | JAIS | * | 14 | 31 | 45 |
| ISJ | 22 | 22 | 29 | 73 | MISQ | 24 | 28 | 43 | 95 |
| ISR | 18 | 29 | 48 | 95 | JIT | 32 | 21 | 34 | 87 |
| Total for all: | 336 | 496 | 934 | 1,766 | * = founded in 2000 | | | | |

For the data analysis, three Excel files exist with various data. The first Excel file focuses on analyzing the research context and the employed research methods per article. For that reason, each data entry/row represents an article. All in all, per article the following information exists:

a. Type of Outlet: Conference proceedings or journal;
b. Year of publication (1995, 2005, 2015);
c. Author(s) (3,514 unique authors);
d. Abstract;
e. Keywords (3,814 unique keywords);
f. Accessed full text for assessing the research context;
g. Meta-Category for the research context of the article;
h. Detailed-Category for the context/focus of the article;
i. Categorization-tuple[16] of the three iterations;
j. Origin Country, i.e., Country of home university of leading author;
k. Origin Continent, i.e., Continent of home university of leading author;
l. Absolute number of citations on Google Scholar in 2016 and 2018;
m. All reference, i.e., the total number of references;
n. IS references, i.e., the number of references from the Senior Scholars' Basket of Eight;
o. The ratio of IS references in comparison to all references;
p. Research design;
q. Research approach;
r. One up to five research methods.

Then, for analyzing the authors and the keywords two additional Excel files were created: one for analyzing the authors and another one for the keywords. Depending on the number of authors and keywords, multiple rows/entries for each article exist: one row per author or keyword. Additionally, the context, type of outlet, year of publication, authors, abstracts, and keywords are included.

As described above, besides the transfer of meta or secondary data to the database, the identification of the research context and the research methods implies the more complex process of content analysis. This process included various researchers who categorized articles based on their content completely on their own, guided by coding rules. In order to ensure high quality and objectivity of this categorization process, several quality criteria can be applied. The following section explains their foundation and assessment.

### 3.2.2 Quality Criteria for Classifications

Notably in empirical research, data collection is required to respond to specific quality criteria. They represent a relevant aspect of research in social sciences and other disciplines and refer to "quality and rigor" (Venkatesh et al. 2013, p. 31) achieved in the course of validation of scholarly work. In the following subsections, the main quality criteria are presented and specify the extent to which they were integrated within this research is specified.

In general, validation refers to the "degree of confidence that ... methods being selected are useful in the quest for scientific truth" (Straub, Boudreau, et al. 2004, p. 383). Validation is relevant in all three phases of scholarly work depicted in Figure 15 (Bortz and Döring 2006, Venkatesh et al. 2013):

(1) the design of a study (called data collection in qualitative approaches, which encompasses study design and data collection),

[16] This refers to an ordered list that contains the results of each categorization iteration, e.g., (B; (B, B2B); B2B).

(2) the data measurement (called analytics in qualitative approaches, which deals with processing data), and
(3) the accuracy of interpretation (also called inference or statistical conclusion).

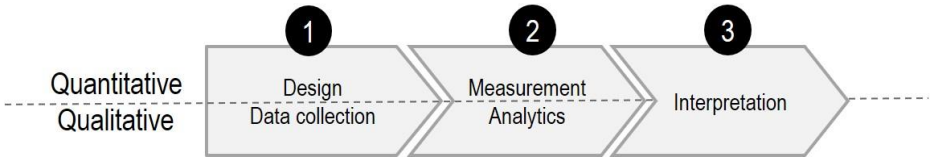



**Figure 15.** Phases of Scholarly Work in which Quality Criteria Ensure Shared Understanding and Accuracy

Validation has a long tradition and there is little agreement among scholars on the exact application of different validation measures. Each research approach (especially qualitative and quantitative ones) may require another set of validation measures. For quantitative research, IS scholars (Boudreau et al. 2001, Gefen et al. 2000, Straub, Boudreau, et al. 2004) provide some useful guidelines, helping with exact recommendations for adequate validation measures. They mainly suggest common requirements for testing **objectivity, reliability, and validity** of quantitative measures (Bortz and Döring 2006). For qualitative research, strong unanimity exists about the types of quality criteria that are applied to qualitative research (Bortz and Döring 2006, Venkatesh et al. 2013). Some scholars just adapt the validation procedures of quantitative methods for qualitative methods. Others completely refute the application of quantitative criteria for qualitative methods and call for fully new criteria. Overall, notably for qualitative methods, most scholars focus on "providing rich descriptions of their engagement, high quality data collection efforts, and rigorous data analysis and reporting" (Venkatesh et al. 2013, p. 34). The dissertation at hand mostly follows Venkatesh et al. (2013) and Bortz and Döring (2006), who try to define validation methods for qualitative studies comparable to validation methods of quantitative studies. This allows better comparability and a more consistent validation of different results in the increasing number of mixed and multi methods that exist within the IS discipline (Bortz and Döring 2006, Venkatesh et al. 2013). Due to the fact that this dissertation also uses both approaches (qualitative and quantitative), its center of interest is on providing in depth explanations and descriptions of the qualitative work as whole.

To begin, **objective** results are produced independently of a researcher (Rack and Christophersen 2006). In the case that only one scholar (e.g., due to expert knowledge) can generate certain results or interpretations, the results are not objective. In general, a scholar already strongly impacts the generation of results in the data-collection phase (e.g., the selection of test participants). Additionally, a scholar also affects the phases of data analysis and interpretation (Bortz and Döring 2006). So, to ensure objectivity over all phases, at first, standards, guidelines/rules, and trainings help to decrease individual differences within the data-collection phase. Then, in the course of data analysis, a sign of high objectivity lies in the fact that different data analysts always get to the same result. Again, standards and guidelines help to achieve more objective analyses. Finally, to ensure objective interpretations, a scholar's influence can be decreased by comparisons and norms (e.g., representative results for age, gender, and education).

Notably for qualitative research approaches, transparency is vital (Bortz and Döring 2006), as "the researcher is the instrument for collecting and analyzing data" (Kaplan and Maxwell 2005, p. 45). In contrast, in some cases, qualitative approaches require especially open and flexible test measures of the scholar, as they need to be responsive to the individual needs of their participants. The scholar's need for such a high level of subjectivity provides a better understanding of a research problem or question. Especially for data analysis and interpretation, the quantification of agreement between various rounds and/or scholars engaged in the qualitative research approach ensures objectivity. The higher the accordance, the lower is the influence of subjectivity. When a consensus between subjects cannot be assessed within qualitative approaches, the quality criteria for reproduction is rather a problem of validity (Bortz and Döring 2006).

For the Bibliometric Study at Hand:

Concerning the data collection and design phase, objectivity is only an issue for the choice of operationalization or measurement of the characteristics (context, research method, nationality, topics, knowledge utilization). The selection of the operationalization has been described and justified in depth in the methodology section above (Section 3.1, p. 34) with the help of examples or citing the work of other IS scholars followed here. So, the choices

of the operationalization are not subject to present author's interpretation, but rather they originate from a shared understanding with other scholars. This provides an indicator for a sufficient level of objectivity.

Concerning the measurement (preparation) or analytics phase, objectivity is predominantly an issue for the qualitative part of the research, namely, the categorization of articles to determine the adequate research context and employed research method(s). In order to delimit subjectivity, an extensive set of coding rules (see Figure 11, p. 36 and Figure 13, p. 38) allows homogenizing the understanding of each research context and each research method. The coding rules serve as training material and standards for coders and aim at delimiting rather subjective categorizations. Additionally, they give orientation to the coders for their categorization task. The coding rules help the coders to identify insightful sections of an article that provide information for either identifying the context of an article or the research method employed. The coding rules also define each context and research method in detail. The high level of clarification increases the chance of a uniform allocation of the article to a specific context or identification of research method(s). It also increases transparency for other scholars. For the measurement (preparation) of the explicit characteristics (metadata and secondary data), no subjectivity exists; they only represent factual data.

The interpretation phase described in the next subsection focuses on comparisons of the results with other studies and samples to ensure objectivity.

Second, **reliability** ensures the repeatability or reproducibility of research results (Rack and Christophersen 2006). Scholars' success in generating the same results over and over ensures reliability, a precondition for quantitative research related to the accuracy of the measurement (Venkatesh et al. 2013). Only if the results are repeatedly in close proximity to each other or the same do they represent the "true score" (Straub, Boudreau, et al. 2004, p. 400). Retests or splitting the sample in two halves are typical ways to test reliability in quantitative research approaches. Other methods rely on calculating ratios, such as indicator reliability (please see Subsection 5.3.2, p. 102, for more details and typical measures for psychometric constructs).

In turn, for qualitative research approaches, specific ratios such as inter-rater reliability[17] might even be rejected by some scholars who argue that a particular situation or individuality is of key interest in the qualitative approach. For that reason, the qualitative results cannot and should not be repeatable (Bortz and Döring 2006). In contrast to this view, other scholars (Leung 2015) propose that for qualitative methods, reliability rather concentrates on consistency. For example, approaches that ensure reliability for qualitative work encompass "constant data comparison, comprehensive data use, inclusive of the deviant case, … use of tables" (Leung 2015, p. 3–4), argumentative defenses for any decision (also called refutational analysis), and the integration of quantitative methods (Leung 2015). Finally, the most often applied method to ensure reproducibility consists of extensive documentation (e.g., for interviews, this includes recordings and transcriptions).

For the Bibliometric Study at Hand:

Data collection and analytics/measurement: As explained above, even though some scholars might refute reliability, this study integrates the quality criteria especially in the analytics phase; i.e., content analyses that identify the context and research methods of an article. The reproducibility of the results of a content analysis (categorization) is of importance for further interpretations of the quantified results. Without showing that other scholars categorize an article to the same context and research method, current results are not resilient and representative for further interpretation. Reliability is also relevant for possible extensions of the categorization in the future, e.g., to other years or outlets. Detailed coding rules and high transparency of the categorization process helped to control agreement with the categorization. Especially for the research methods, a detailed tracking process provides information about any action taken by the coders (e.g., when a research method explicitly named in the article did not fit the framework and was renamed).

[17] Statistical analysis of the agreement of different rounds of data analysis in qualitative procedures (e.g., categorizations).

Overall, for the categorization characteristics (context and research method), reliability was ensured to a different extent. For the major focus of the dissertation, the private context of IS use, extensive reliability measures were used. The author organized three rounds of categorization by independent coders and calculated the inter-rater reliability between each categorization round (see the description of the application of the validity criterion which is introduced below in the last part of this subsection). Because the research methods represent a secondary concern of the study and are much easier to extract from an article, inter-rater reliability was only calculated for a subsample of articles before and after the main categorization step. This much more simplified approach follows Palvia et al. (2004).

The interpretation phase described in the next subsection takes care to compare the results to other studies.

Finally, as the most important criterion (Bortz and Döring 2006), **validity** describes how "accurately the findings represent the truth in the objective world" (Venkatesh et al. 2013, p. 32). So, for example, an intelligence test should really measure intelligence and not anxiety. This quality criterion is rather complex and much more difficult to test than objectivity or reliability. For the measurement and inference phase of quantitative methods, three main types of validity exist: content, criterion, and construct validity. Other aspects of validity (e.g., internal and external) are rather relevant within the design phase of quantitative methods.

- Content validity (sometimes also called or related to face validity) refers to the momentum with which the content of the test encompasses all relevant aspects of the phenomenon that should be measured (Bortz and Döring 2006). For example, in a test about basic arithmetic operations that does not include a question on division, it is quickly evident to anyone who can name the operations that the content validity is limited. No further analysis is needed to reach this decision (Bortz and Döring 2006). This type of validity is often useful for questionnaires that try to grasp latent constructs. For more information, see Subsection 6.1.3, p. 117.
- Criterion validity relates to predicting (DeVellis 2012). It implies the causality (empirical association) between a test and a certain criterion. For example, intelligence shows high correlation with a students' performance (Himme 2006).
- Construct validity confirms the theoretical relationship between constructs (DeVellis 2012). For example, as described in the model of technology acceptance (see Appendix 9.1.2, p. 175), attitude toward usage is expected to increase when the perceived usefulness and ease of use increase.
- Internal and external validity ensure that either the explanation for causality is unequivocal (i.e., there is only one plausible explanation because other effects are highly controlled), or the results are highly generalizable due to the high representability of the sample and the real-world setting (Venkatesh et al. 2013).

The validity of qualitative research approaches refers to the "extent to which data are plausible, credible, and trustworthy" (Venkatesh et al. 2013, p. 34). It is much harder to evaluate qualitative and nonfactual data than quantitative data according to these requirements. Depending on the phase of scholarly work (see Figure 15), different measures and criteria exist to ensure validity:

- Data collection: Rigor in the phase of data collection implies decisions about operationalizations and a first selection of methods (Venkatesh et al. 2013). Driven by theory, a scholar selects a research focus, an operationalization, and a sample (Sarker et al. 2013). Given the decision regarding the selection of the sample, the chosen exemplary case that is typical for a certain phenomenon determines representability. The challenge is to explain and defend the selection of a sample. Another possibility is to integrate quantitative methods. Additionally, background information from literature or experts may enrich validation in the data-collection phase.
- Analytics: Analytics helps to relate the results of the operationalization to theory for further interpretation (Burton-Jones and Lee 2017, p. 455). To this end, a shared meaning is crucial. The resulting findings must be dependable (i.e., researchers need to explain if changes occurred in the setting and how they affect the work); consistent (verified by a process that examines raw data, transcripts, or data reduction/grouping such as is obtained from coding); and plausible (i.e., findings should fit the data) (Venkatesh et al. 2013). For analytics, scholars often use rule-based approaches and systematic inspection of the material at hand.
- Interpretation: In this phase, credibility and transferability of the interpretations are crucial aspects. This corresponds to the internal and external validity of quantitative data. To this end,

others may verify and reinforce the interpretations (Venkatesh et al. 2013). Consensus among the interpretations of the main scholar and others ensures validity, increasing credibility and ruling out other explanations. Another possibility describes the presentation of other potential explanatory models with an argumentative description of the chosen model. Scholars may also use theory building from qualitative data (Sarker et al. 2013).

For the Bibliometric Study at Hand:

Data collection/Design: Rigor in the design and data-collection phase concerns the operationalization of the characteristics. Departing from IS literature, resulted in a shared understanding of the different contexts (see Section 2.1, p. 5) and research methods (see Subsection 3.1.1, p. 39). Additionally, the acquired insights from literature were formalized in form of detailed coding rules for both characteristics. The operationalization of the other characteristics is also derived from literature and other scholars, and thus also based on a shared understanding.

Analytics: This phase ensures dependability, consistency, and plausibility, especially for the assessment of implicit data within a qualitative approach (i.e., identification of context of articles and employed research method). For both characteristics, inter-rater reliability ratios were calculated. For the focal characteristic of an article, the context, categorization took place with the help of three iteration cycles of the complete dataset. At the end, the three decisions were harmonized with a systematic rule-set and consensus finding. This was especially necessary, as the context of an article represents a rather new aspect that has not been explicitly considered in research to this extent. Following completion of the three coding iterations, final comparisons were undertaken to ensure inter-rater reliability by calculating Mezzich's Kappa (Ahn and Mezzich 1989, Eccleston et al. 2001, Mezzich et al. 1981). Mezzich's Kappa has evolved from the Cohen Kappa and Fleiss Kappa, to evaluate qualitative data analysis with multiple coders and overlapping categories where coders could assign more than one category to an article. The Mezzich's Kappa for the present three rounds of categorizations calculated at the detailed categorization level is 0.6, considered strong agreement (Kolb 2004) and highly significant. This confirms that the agreements were not random, and that the categorization is reliable and valid. In turn, research methods represent a well-established research focus and are often easier to detect within an article than the research context. For that reason, only one categorization round was implemented. In order to ensure rigor, inter-rater reliability was calculated before and after the categorization. For a randomly selected sample of 23 and 24 articles, the inter-rater reliability of the categorized research methods according to the Mezzich's Kappa increases from 0.5 to 0.6 from the pre- to the post-categorization validation. As explained above, this represents good agreement and shows that the categorization is reliable and valid. The agreement on the level of the research design and research approach is even higher.

The interpretation of the research results, which follows in the next subsection, is compared to other studies and samples.

After having explained the selected validation measures, the next section describes the results of the data analysis for each indicator.

## 3.3 Results of the Descriptive Analysis

This section provides insights into the research from the private context of IS use. First of all, the results reveal generally increasing attention between 1995 and 2015 of the IS community toward PIS and the private context; yet, in comparison to the total output of the discipline, the share is still sparse. Second, concerning the intellectual structure of IS research on the private context, the analysis reveals an increasing diversity, especially comparing 1995 to 2015. Mostly authors from North America, Europe, or Asia use a set of four research methods to discover research results primarily on topics such as social-networking sites, online/virtual communities, and technology acceptance. Additionally, a set of 355 authors engaged in research on the private context of IS use (which amounts to approximately 3 authors per article) in 1995, 2005, and especially 2015. They publish between one and three articles in diverse journals or at conferences. It is not surprising that conference papers are less frequently cited as journal articles.

Finally, authors tend to reuse IS knowledge on average in 15% of their overall sources for an article in the private context. This is slightly higher than for all contexts together.

More findings and details are presented in the following subsection.

### 3.3.1 Analysis of Research Contexts

The data gathered in the process explained in Section 3.1 (p. 34) enables presentation of the share of articles from the private context of IS use as a percentage of the overall sample (with all contexts), per year, and for each outlet.

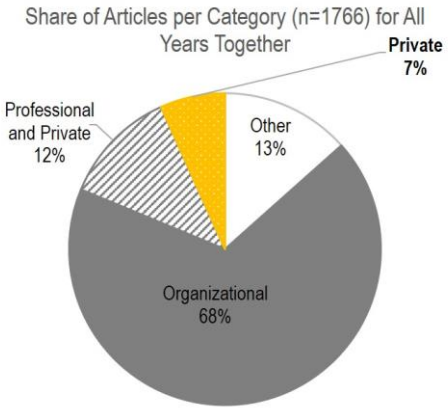



**Figure 16.** Share of Articles on the Private Use of IS (Yellow Section) for the Full Sample of 1,766 Articles

The results suggest that despite the vast expansion of IS into private lives in practice, only a small share (average of 7% across all three years) of articles published in top IS outlets is dedicated to the private context of IS use (Figure 16). Overall, 68% of the articles analyzed cover purely professional contexts. Across all three years, 13% of the articles are classified as “other” (meta-reviews, editorials), and 12% of the articles concern both contexts (private and professional).

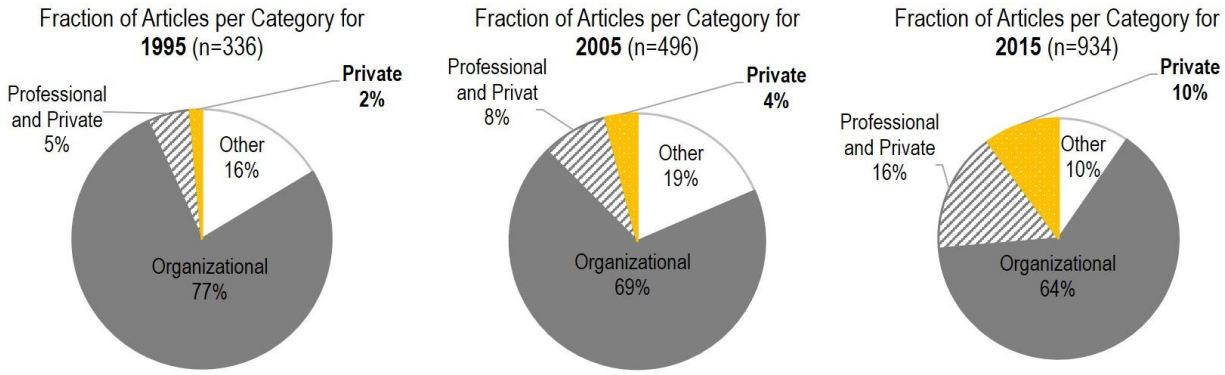



**Figure 17.** Share of Articles on Private Use of IS (Yellow Section of the Diagram) for the Years 1995, 2005, 2015

With respect to evolution over the selected time period of over 20 years, the data depicted in Figure 17 suggest that the share of private use of IS articles has considerably changed in the three years under study, increasing almost tenfold from 2% to 10%. Additionally, the share of articles that fall into both categories has also increased from 5% to 16%. In contrast, the share of articles from the professional context of IS use has decreased in the interval from 1995 to 2015, from 77% to 64%.

As Figure 18 shows, research on the private context of IS use exists in almost all IS outlets – except for JIT. JMIS and JSIS (for 2005 and 2015) show a small but stable mean share of articles from the private context of 5%. Comparing 1995 with 2015, the share of articles from the private context steadily increases in ISJ (10 percentage points, to 10%), ECIS (7 percentage points to 8%), and ICIS (12 percentage points to 12%).

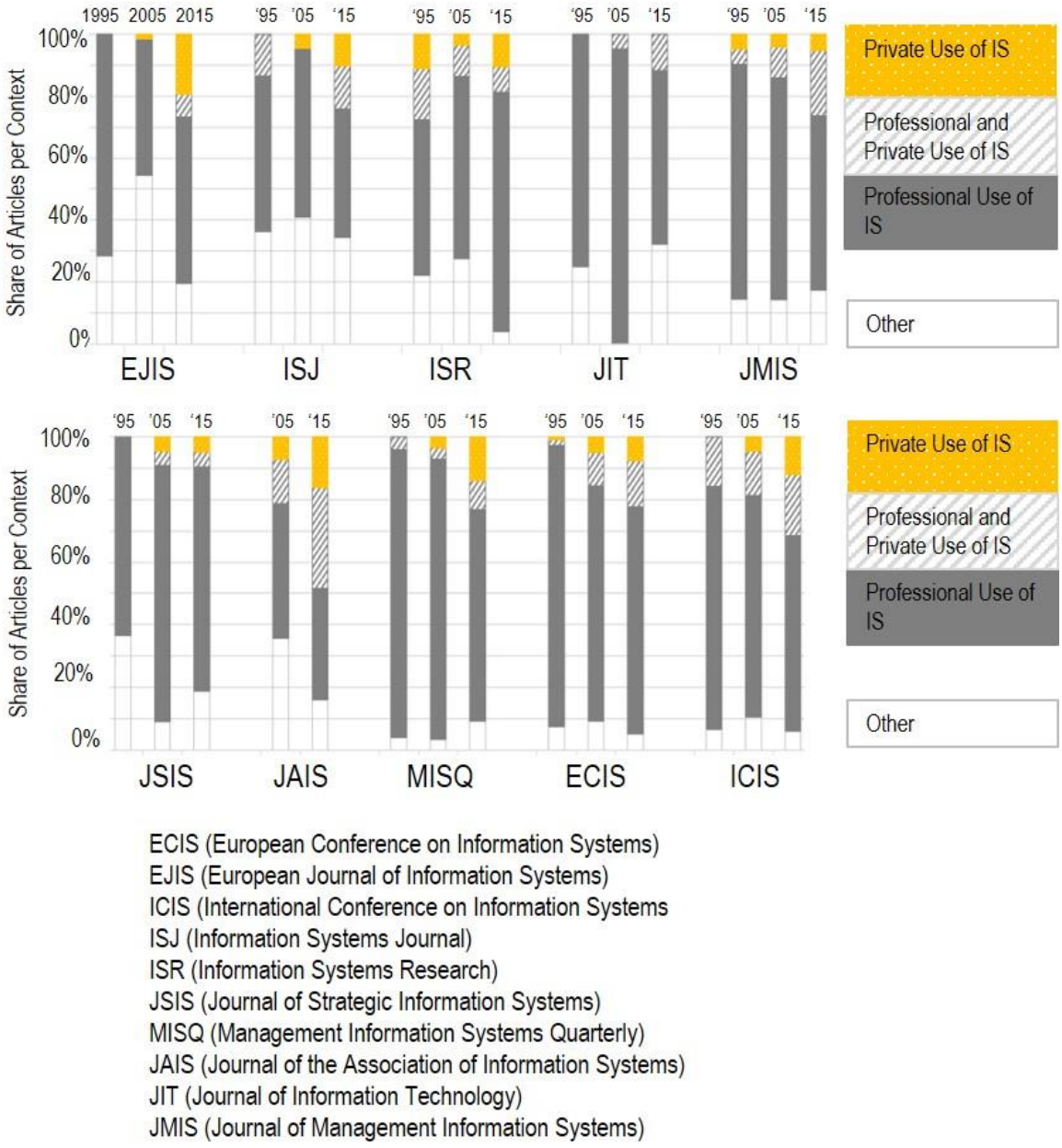



**Figure 18.** Share of Articles on Private and/or Professional Use of IS (n=1,766) Corresponding to the Final Consensus after Three Rounds of Coding

EJIS (20%), JAIS (16%), and MISQ (14%) each had a particularly high share of articles on the private use of IS in 2015, which reflects a remarkable increase in comparison to the share in 2005 (EJIS: 18 percentage points, JAIS: 9 percentage points, MISQ: 10 percentage points). In contrast to JAIS (founded in 2000), EJIS and other outlets (ISJ, JSIS, MISQ, ICIS) only contain articles on the private use of IS in the years 2005 and 2015. Yet, for ISR, JMIS, and ICIS, articles on the private use of IS belong to the sample since 1995. Appendix 9.3.4 (p. 193) shows an overview of all shares.

The results show the extent of research on the private context of IS use nowadays (2015) and over time (including 1995 and 2005). The following analysis pays particular attention to the articles from the private context of IS use, which amount to 119 articles (representing 6% of the total sample described in Subsection 3.2.1, p. 44). Appendix 9.3.4 (p. 193) shows the absolute number of articles per year and outlet. Research on this context is still sparse, but it strongly increases in 2014 and for most IS journals. In order to elaborate further on research on the private context of IS use, the following sections describe more aspects of the intellectual structure. To that end, the following subsection focuses on the employment of research methods.

### 3.3.2 Analysis of Research Methods and Meta-Categories

This subsection represents more information about the intellectual structure of the research on private context IS. It presents information on the employed research method and meta-categories (research design: empirical vs. non-empirical; research approach: qualitative vs. quantitative).

First, for **research design** employed in articles from the private context, taking all selected years together, Figure 19 (bar chart at the top) shows that a combination of both empirical and non-empirical designs dominates (almost 60% of all articles). Then, representing one-third, purely empirical research designs follow. Finally, almost 10% of the articles use only non-empirical research designs. In contrast, the shares for all articles of all contexts together (n=1,766, bar chart on the bottom Figure 19) are almost equally split around one-third for all three research designs (both, empirical, non-empirical).

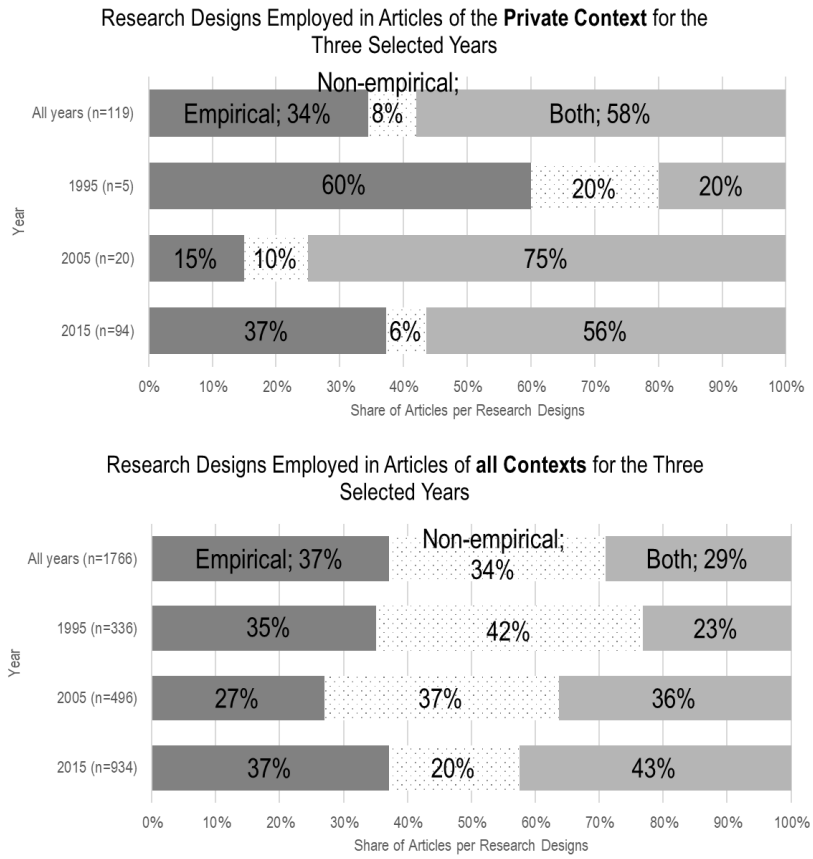



**Figure 19.** Share of Research Designs (Empirical vs. Non-Empirical) Employed in the Articles for the Private Context and all Contexts

Again, focusing on the research designs employed in the private context (see bar chart at the top of Figure 19), comparisons between the years 1995 and 2015 show that the shares of articles using purely empirical or non-empirical research have decreased within that time. In 1995, empirical articles comprised 60% of all articles, compared to 40% in 2015. Non-empirical articles show a decrease of 14%. Articles combining both research designs have largely increased between 1995 and 2005, from 20% to 65%. In turn, considering the evolution of the share of articles using both research designs at the same time, the bar chart shows a decrease between 2005 and 2015. All in all, this category still represents a dominant share compared with the purely empirical or non-empirical research. The results should be interpreted with caution, due to the strongly differing number of articles for each year (1995: 5; 2005: 20; 2015: 94).

Second, the **research approaches** employed in articles from the private context show a quite similar picture compared with the development of the research designs. Figure 20 (bar chart at the top) shows that articles combining both research approaches (qualitative and quantitative) represent 55%. Then, purely quantitative approaches are employed in almost one-third of all articles. Finally, almost 18% of the private-context articles use purely qualitative approaches. In contrast, for articles from all contexts (bar chart on the bottom), the share of articles that employ

purely qualitative approaches amounts to over 50%, and purely quantitative articles represent only 15%. Both research approaches are employed together in over a third of all 1,766 articles.

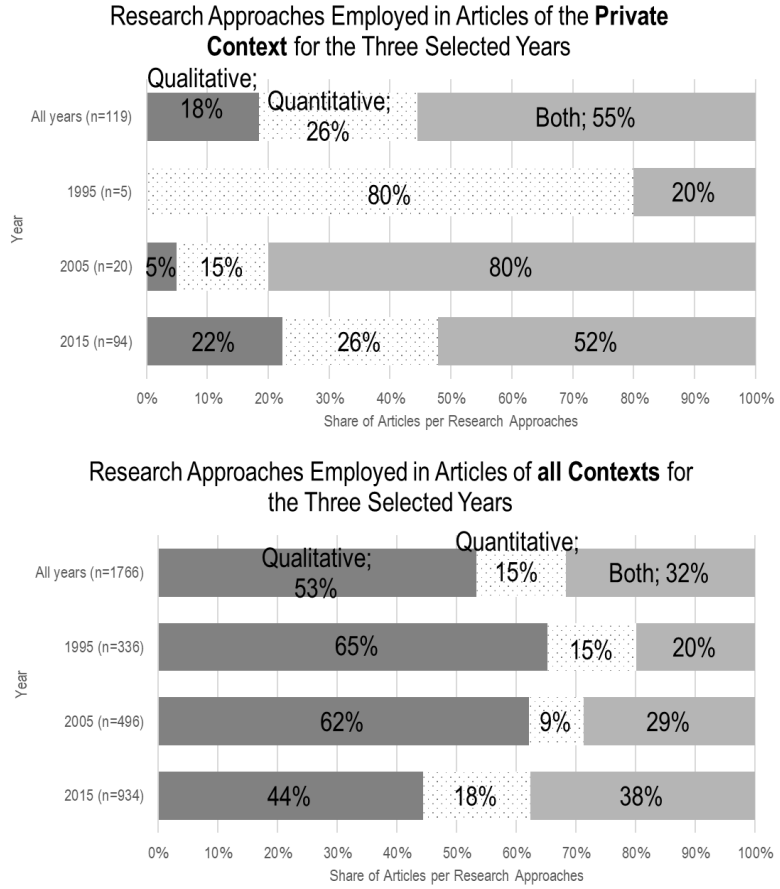



**Figure 20.** Total Shares of Research Approaches (Qualitative vs. Quantitative) for the Private Context and all Contexts

Considering the evolution over time for articles from the private context (see bar chart at the top of Figure 20), the share of articles combining both research approaches increased from 1995 to 2015, with a peak in 2005 of 80% of all articles. Surprisingly, in 1995, no purely qualitative articles were found, and purely quantitative research dominated. In turn, the share of purely quantitative research methods decreased in 2005 and went back to the same level in 2015. Purely qualitative approaches increased notably between 2005 and 2015 (from 5% to 22%).

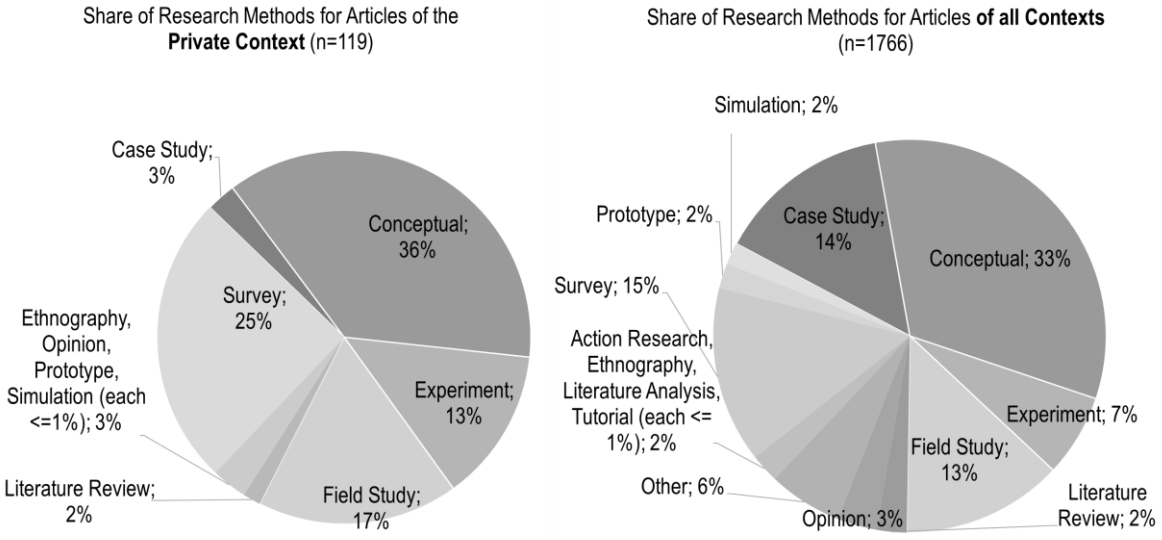



**Figure 21.** Share of Research Methods Employed in the Articles for the Private Context and all Contexts

Third, concerning the **research methods**, articles from the private context of IS employ fewer types of research methods than articles from all contexts together (see the pie charts from Figure 21). Considering all contexts, articles generally used from one up to four research methods: 37% of all articles use one research method, 58% use two research methods, 3% use two or four research methods. This leads to a greater number of research methods (n=2,578) than the number of articles analyzed (n=1,766).
In the same sense, for the private context, the number of employed research methods (n=198) exceeds the number of articles (n=119). Almost 60% of the articles on private use of IS employ conceptual methods as the primary research method and combine it with a secondary research method. The remaining 40% the articles prevailingly use only one research method (survey, case study, experiment, field study, literature review, opinion, or ethnography).

All in all, comparing the composition of employed research methods for all contexts with the sample of the private context (see pie charts of Figure 21), similarities can be detected (Figure 21). To begin, conceptual research methods represent the most employed method for articles of all contexts (33%) and for the ones purely concerned with the private context (36%). Additionally, the following research methods reveal similar shares for articles on all contexts and on the private context: field studies (around 15%), literature reviews (2%), ethnographies (less than 1%), simulations (2% or less than 1%), opinions (3% or less than 1%). In contrast, the share of surveys and case studies is quite different. The share of surveys is much higher in articles on the private context than in articles on all contexts (25% compared to 13%), and the share of case studies is much lower in articles on the private context than in articles on all contexts (3% compared to 14%). Also, the share of experiments is quite different. In articles on the private context, the share is almost twice as much as for articles on all contexts (13% compared to 7%).

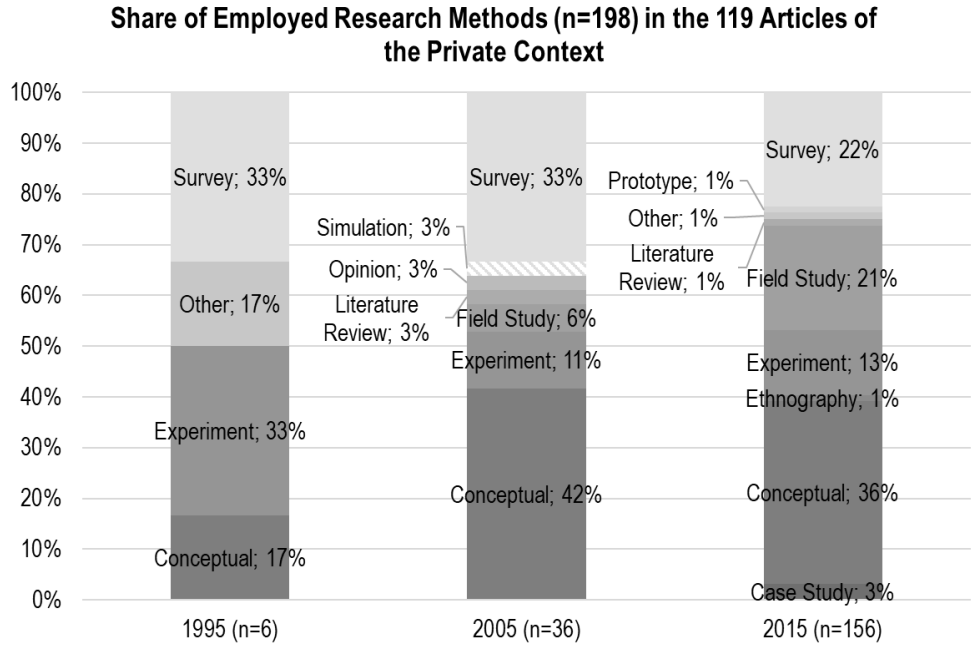



**Figure 22.** Share of Employed Research Methods in Articles on Private Use of IS

Figure 22 compares the selected years 1995, 2005, and 2015 for the articles on the private context, and shows that the number of types of employed research methods increases. The development ranges from three major research methods (survey, experiment, and conceptual) in 1995, over seven different research methods (survey, simulation, opinion, literature review, field study, experiment, and conceptual) in 2005, to eight (survey, prototype, literature review, field study, experiment, ethnography, conceptual, and case study) in 2015. Since 2005, conceptual methods have become increasingly important, and in 2015, a more pluralistic composition of empirical research methods is employed (survey, field study, experiment, ethnography, case study). The share of empirical research methods stays stable from 1995 to 2015 at 50% to 60%. In contrast, in 2015, authors chose to use a more diversified composition of empirical research methods besides surveys and experiments.

Moreover, considering the research methods used per outlet type in articles on the private context, conference papers offer a much larger variety of research methods. Taking together all years, conference papers employ 10 different methods, compared to journal articles that only employ four different research methods. Journals rather publish articles including conceptual methods, experiments, and surveys. Field studies and case studies are also of interest in the ISR, JSIS, JAIS, and MISQ. Only MISQ published a literature review. For full disclosure on the absolute numbers, please see Table 40, p. 195 and Appendix 9.3.4, S.193.

With these differences in mind, the next subsection focuses on the nationality of leading authors of the articles on the private context.

### 3.3.3 Analysis of Nationality

In order to detect aspects of the most active continents and countries engaged in research on the private context of IS use, the nationality of articles was analyzed based on the location of the institute of the leading author of each article. The following subsection reports on results for the nationalities of articles on the private context per continent and per outlet and breaks the continent level down to the country level. A comparison to the articles of all contexts finalizes the analysis.

Overall, the dominant nationality for each of the selected years is North American. The second and third most productive nationalities of IS research in the private context are European and Asian, respectively. Then, far behind, Australian authors follow on the list of productive authors. The smallest share of articles comes from South America (only 1% in 2015). Comparing the development of the shares of all nationalities over time (see Figure 23), research on the private context was mostly published by European (20%) and North American (80%) scholars. Then, in 2005, the share of North American articles decreased to 50%, and European articles gained five percentage points. Furthermore, in 2005, Asian authors engaged in research in the field to the same extent as European scholars. In 2015, the composition becomes even more diversified: Australian and South American authors also engage in IS research on the private context. Moreover, the share of articles from North American authors diminishes again from 2005 to 2015, from 50% to 36%.

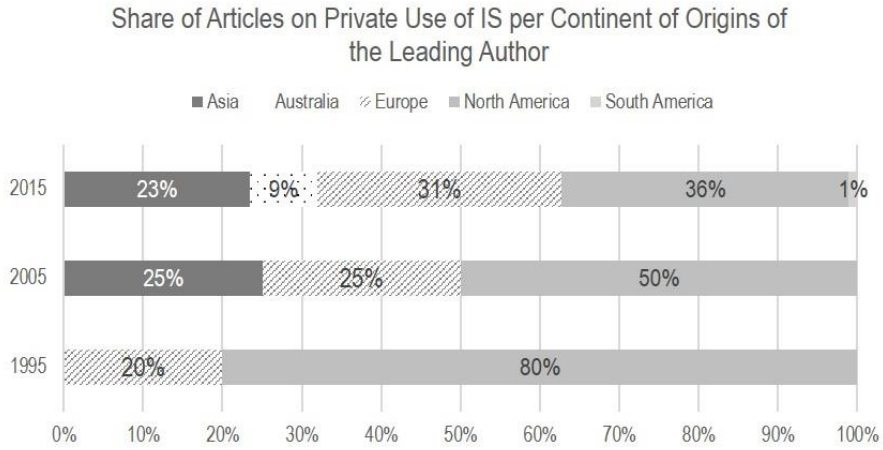



**Figure 23.** Share of Articles on Private Use of IS per Continent of Origin and Year of the Leading Author

Moreover, comparing most productive nationalities per outlet for the private context, Figure 24 shows that especially in MISQ, JAIS, and JSIS, articles fully originate from one sole continent. Principally, this arises from the fact that the sample size only encompasses one article. MISQ has a strong North American focus. JAIS shows the same dominance of North America in 2005, but for 2015, all five articles originate in Asia. The same applies for JSIS, yet the article from 2015 originates from Europe. For EJIS, ISJ, ISR, JMIS, and ECIS, at least the year 1995 (and partially 2005) is also dominated by one nationality:

- Asia for EJIS in 1995;
- North America for ISJ in 1995 and for ISR, and JMIS in 1995 and 2005;
- Europe for ECIS in 1995.

Then, the following years show a more diversified field, as well as an increasing absolute number of articles. Articles originate from up to five different continents, and especially EJIS and ICIS reflect this development. ECIS shows a strong European dominance over all three years, and ISR and JMIS mostly publish North American articles over all three years.

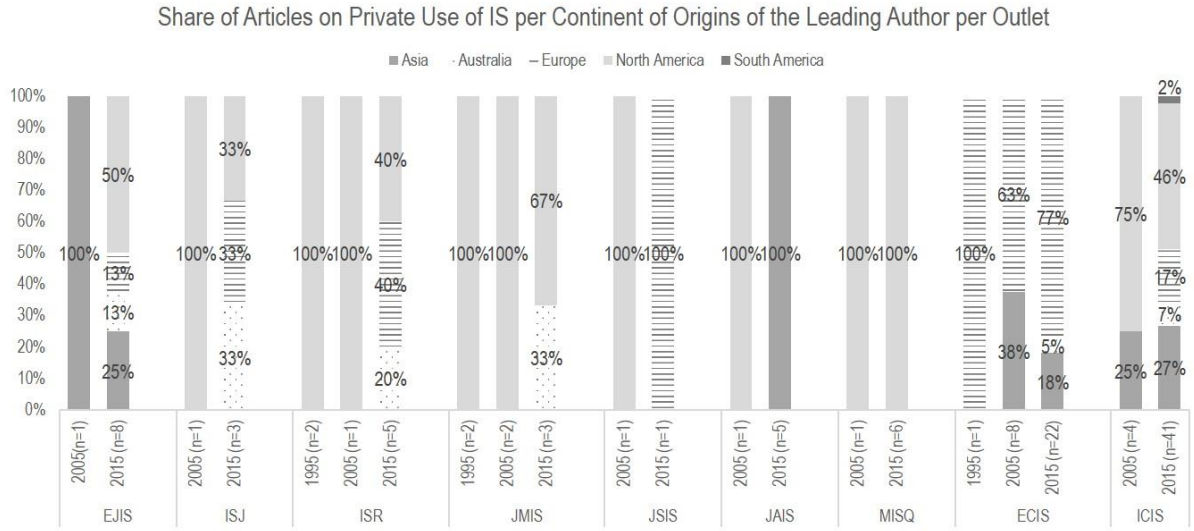



**Figure 24.** Share of Articles per Continent of Origin from Articles on the Private Context of IS Use per Outlet

Breaking down the results for all continents to the country level (for detailed data, see Appendix 9.3.4, S.193), the most productive country in Europe is Germany (especially in 2015) with 16 articles published, followed by Switzerland and Finland. Only two or three articles originate from Denmark, Ireland, the Netherlands, and the United Kingdom. For North America, the United States of America outnumbers Canada by far. Concerning the Asian articles, predominantly authors from Singapore contribute to IS research on the private context. Behind Singapore, China is the second largest contributor. Less than three contributions each follow from Hong Kong, Malaysia, Republic of Korea, Saudi Arabia, South Korea, and Taiwan.

In comparison to these results for articles on the private context, articles on all contexts (see Figure 25) show a dominance of both North American and European articles throughout all selected years. Additionally, the shares of articles from Asia, Australia, South America, and Africa stay more or less stable or (for Asia and Australia) slightly increase over the years.

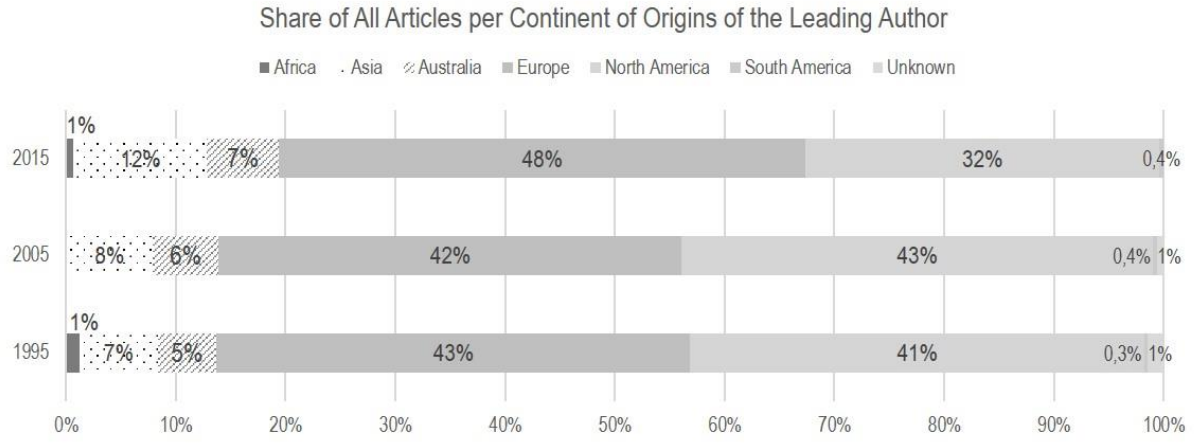



**Figure 25.** Share of All Articles per Continent of Origin and Year of the Leading Author (Unknown Origins come from Editorials and other Articles with no Given Author)

After having investigated the nationality of articles on the private context of IS use, the next subsection turns to the thematic content of the research stream.

### 3.3.4 Analysis of Thematic Content

Analysis of the thematic content of the articles on the private context focuses on another type of metadata: the keywords related to each article. As explained in Subsection 3.1.4 (p. 41), this indicator analysis only concentrates on the most frequently employed keywords.

The following table shows the top 33 keywords employed in at least two articles. At the head of the list, the following keywords appear: “social networking sites,” “online communities,” “technology acceptance (tam),” “social media,” and “virtual community.” Then, the keywords “satisfaction,” “continuance intention,” and “online reviews” follow with three occurrences.

Most of the keywords were employed for articles originating in 2015, with the following exceptions. The keywords “online communities,” “virtual community,” “social influences,” “habit,” “experiment,” and “ease of use” were also employed for articles published in 2005. Just two keywords – “electronic brainstorming” and “group support systems” – appeared only in 1995. Two additional keywords were employed only for articles in two different years: The “theory of planned behavior” was mentioned in 1995 and 2015 and “technology acceptance model (tam)” in 1995 and 2005.

**Table 7.** Top 33 Topics of the Private Context with Number (#) of Occurrences (Employed More than Twice)

| Topics – Keywords | # of Articles | Topics – Keywords (continued) | # of Articles | Topics – Keywords (continued) | # of Articles |
|---|---|---|---|---|---|
| social networking sites | 6 | sharing economy | 2 | affective commitment | 2 |
| online communities | 6 | **is discontinuance** | 2 | social networks | 2 |
| technology acceptance model (tam) | 5 | group support systems | 2 | **ease of use** | 2 |
| social media | 5 | knowledge management | 2 | **online social networks** | 2 |
| **virtual community** | 5 | technology adoption | 2 | technostress | 2 |
| satisfaction | 3 | **mobile applications** | 2 | privacy | 2 |
| **continuance intention** | 3 | user generated content | 2 | trust | 2 |
| online reviews | 3 | network analysis | 2 | **electronic brainstorming** | 2 |
| social influences | 2 | **antecedents** | 2 | habit | 2 |
| **theory of planned behavior** | 2 | **behavioral economics** | 2 | **self-disclosure** | 2 |
| **homophily** | 2 | experiment | 2 | word of mouth | 2 |

Table 8 compares the top 10 keywords of articles of all contexts with the top 10 keywords of the private context, and reveal some overlaps. Two keywords enter the top 10 of both samples: “technology acceptance model” and “social media.” In turn, the remaining keywords differ. The top 10 keywords of articles of all contexts concentrate on business-related aspects (“electronic commerce,” “outsourcing,” “knowledge sharing/management,” “interorganizational systems”) whereas articles on the private context focus on social and usage aspects.

**Table 8.** Top 10 Topics for the Full Sample and the Professional Use of IS Articles

| Top 10 Themes Of Articles of the Private Context | frequency | Top 10 Themes of Articles of all Contexts | frequency |
|---|---|---|---|
| social networking sites | 6 | electronic commerce | 33 |
| online communities | 6 | social media | 32 |
| technology acceptance model | 5 | case study | 27 |
| social media | 5 | knowledge management | 24 |
| virtual community | 5 | information systems | 24 |
| continuance intention | 3 | technology acceptance model | 19 |
| satisfaction | 3 | outsourcing | 15 |
| online reviews | 3 | knowledge sharing | 15 |
| social influences | 2 | interorganizational systems | 15 |
| theory of planned behavior | 2 | adoption | 15 |

The findings on the top 10 keywords resulted from an analysis that took into consideration keywords employed in one or more contexts (private, professional, both, other). As a next step, considering only keywords uniquely employed in the private context reduced the number of keywords from 359 to 255 keywords. The most frequently employed keywords marked in bold in Table 7 amount to 12 keywords that mainly cover aspects of social or virtual networks (“virtual community,” “homophily,” “online social networks,” “self-disclosure,” “antecedents”), IT usage (“continuance,” “discontinuance,” “ease of use,” “theory of planned behavior”), and decision making (“behavioral economics,” “electronic brainstorming,” “mobile applications”).

Breaking down the results of the keywords uniquely employed in articles on the private context to the three selected years shows that in 1995, only “electronic brainstorming” was uniquely used. For 2015, the following were employed: “continuance intention,” “self-disclosure,” “online social

networks," "mobile application," "homophily," "is discontinuance," "antecedents," and "behavioral economics."

Subsequent to the analysis of the thematic content on the private context, as a final step, the next subsection presents the results for knowledge utilization.

### 3.3.5 Analysis of Knowledge Utilization

As described in the methodology section, knowledge utilization is analyzed with the help of three indicators: the authors, references, and number of Google Scholar citations per article. For that reason, the subsection at hand presents the results for each indicator individually.

In total, 3,154 **authors** have (co-)authored the articles on all contexts. Of these, almost 80% of all authors (2,518) have (co-)authored only one article. To simplify the data analysis, only on the most productive authors were chosen; thus, for all articles on all contexts, the most productive authors count 10 or more articles.

In contrast, for the private context, overall, 355 authors have (co-)authored an article on the private context and 289 authors have contributed to only one article (again around 80%). Of these, 30 authors have (co-)authored two publications, and two authors have (co-)authored three publications on the private context. These two most productive authors are Susan A. Brown and Viswanath Venkatesh. So, the most productive authors have (co-)authored two or more articles. The complete list can be found in the appendix (Table 41, p. 195).

**Table 9.** Most Productive Authors and Number of Articles in the Sample: (A) 208 out of 255 Authors who uniquely contributed to the Private Context; (B) 3,154 Authors who contributed to All Contexts

A

| Most Productive Authors of Articles on the Private Context | # of (Co-)Authored Articles |
|---|---|
| Viswanath Venkatesh | 3 |
| Sabine Matook | 2 |
| Tawfiq Alashoor | 2 |
| Lee Xian Yap | 2 |
| Mikko Rajanen | 2 |
| Morgan M. Shepherd | 2 |
| Hanna Krasnova | 2 |
| Jeffrey V. Nickerson | 2 |
| Hans van der Heijden | 2 |
| Hartmut Hoehle | 2 |
| Jenine Beekhuyzen | 2 |
| Jerome Yen | 2 |
| Bruce A Reinig | 2 |
| Chao-Min Chiu | 2 |
| Arto Lanamäki | 2 |

B

| Most Productive Authors of Articles on all Contexts | # of (Co-)Authored Articles |
|---|---|
| Robert D. Galliers | 18 |
| Vladimir Zwass | 15 |
| Sirkka L. Jarvenpaa | 14 |
| Alexander Benlian | 13 |
| **Richard L. Baskerville** | 12 |
| H. Raghav Rao | 12 |
| Philip Powell | 11 |
| Leslie P. Willcocks | 11 |
| **Izak Benbasat** | 11 |
| Kalle Lyytinen | 11 |
| **Varun Grover** | 10 |
| **Paul Benjamin Lowry** | 10 |

Table 9 displays the most productive authors of articles on the private context and on all contexts. The right table shows the most productive authors of articles on all contexts. Overall, Robert D. Galliers has (co-)authored 18 articles in the full sample. He is the most productive author with the most articles on all contexts. The left side of Table 9 distinguishes the authors who have uniquely contributed to publishing on the private context, i.e., who did not (co-)author an article in other contexts. They amount to 208 authors, and the most productive ones have (co-)authored up to three articles. The small share of articles on the private context (10% of the articles of all contexts) explain the smaller number of authors who have (co-)authored articles on the private context. This leads to only a few overlaps between the most productive authors. For example, in articles on the private context, Viswanath Venkatesh has published the largest number of articles (three articles). However, this is not even enough to count as one of the most productive authors of the articles on all contexts. On this account, he does not appear in the ranking of most productive authors of articles on all contexts (B, Table 9), as the lowest number of articles per author there amounts to ten. In turn, some who are the most productive authors of articles on all contexts (highlighted in bold in B) have (co-)authored only one article on the private context, so they do not appear in the left table: Richard L. Baskerville, Izak Benbasat, Varun Grover, and Paul Benjamin Lowry.

Additionally, from the data at hand, it is possible to establish the willingness to cooperate for an author with two ratios: First, the number of authors per article is examined to reveal how many authors generally cooperate to publish an article. Comparing the authors of articles on the private context with those from articles on all contexts, on average, private-context articles have been written by slightly more authors (3 vs. 2.5). Especially articles from ICIS, JAIS, JMIS, ISR, and ISJ

are rather author intensive with an average of three to four authors per article. Second, calculating the cooperativity index[18] (see Table 44, p. 197) reveals information about the individual willingness of an author to cooperate. It shows that between 1995, 2005, and 2015, on average there are fewer authors per publication for EJIS, JMIS, JSIS, and ICIS. But, ISJ, ISR, JAIS, and MISQ show an increasing number of authors per publication. Only ECIS shows an unstable cooperativity index for the selected years.

Second, concerning the cumulative tradition, the extent to which the articles use the knowledge of the IS domain is analyzed (see Table 10). To this end, the share of **references from BoE journals** is analyzed. First, articles on the private context reveal a mean of 67 references in total (higher than for articles on all contexts). From the 67 references, on average, 11 references represent articles from the BoE, which equals around 15% for each article on the private context (left table). The analysis of the ratio for articles on all contexts delivers the same result (right table).

**Table 10.** Mean Number of References and BoE References and Mean Share of BoE References from All References in an Article for the Private Context (A) and for All Contexts (B)

| | A | | | | B | | | |
|---|---|---|---|---|---|---|---|---|
| Year | # of Articles | Mean #References per Article | Mean #BoE references per Article | Mean BoE-Share | # of Articles | Mean #References per Article | Mean #BoE references per Article | Mean BoE-Share |
| 1995 | 5 | 35 | 4 | 12% | 336 | 30 | 3 | 10% |
| 2005 | 20 | 48 | 9 | 17% | 496 | 41 | 6 | 13% |
| 2015 | 94 | 73 | 12 | 15% | 934 | 62 | 11 | 17% |
| **Total** | **119** | **67** | **11** | **15%** | **1,766** | **50** | **8** | **15%** |

Breaking down the results for the three selected years, Table 10 shows that the ratio of BoE references to all references of an article on the private context was higher in 2005 than in 2015 (left table). In turn, for articles on all contexts, the left side of Table 10 reveals a unique upward tendency from 1995 in comparison to 2005 and 2015 (from 10% to 16%). Overall, for both tables, the absolute mean sum of references and BoE references has increased.

Examining the references and BoE references for articles on the private context for each outlet shows that the mean numbers of references and BoE references for journals are quite different, compared to conferences (see Table 11). Whereas journal articles show that a share of 18% of all references are BoE references, conference articles only show BoE references in 13% of all their references. The same issue exists for the articles on all contexts. For the private context, especially EJIS, ISJ, and JAIS show a strong tradition of citing more BoE articles in relation to all references. For articles on all contexts, a quite similar phenomenon can be observed.

**Table 11.** Mean Number of References and BoE References per IS Outlet for the Private Context (A) and All Contexts (B)

| | A | | | B | | |
|---|---|---|---|---|---|---|
| Journals | Mean # of References per Article | Mean # of BoE references per Article | Mean BoE Share | Mean # of References per Article | Mean # of BoE references per Article | Mean BoE Share |
| European Journal of Information Systems | 101 | 21 | 21% | 47 | 9 | 20% |
| Information Systems Journal | 91 | 27 | 29% | 43 | 9 | 25% |
| Information Systems Research | 79 | 9 | 13% | 53 | 8 | 15% |
| Journal of Information Technology | none | none | none | 48 | 8 | 17% |
| Journal of Management Information Systems | 69 | 11 | 16% | 57 | 11 | 17% |
| Journal of Strategic Information Systems | 85 | 16 | 18% | 43 | 8 | 22% |
| Journal of the Association for Information Systems | 134 | 28 | 19% | 96 | 18 | 20% |
| MIS Quarterly | 98 | 20 | 17% | 81 | 15 | 18% |
| Proceedings of the European Conference on Information Systems | 45 | 6 | 13% | 40 | 5 | 11% |
| Proceedings of the International Conference on Information Systems | 57 | 8 | 13% | 51 | 8 | 15% |
| Total | 67 | 11 | 15% | 50 | 8 | 15% |

Third, in order to establish the influence of articles on the literature and to identify the most influential articles, **Google Scholar citations** for each article are analyzed, for which the data collection from 2018 is taken into consideration, as it is more reliable than the data from 2016 (available in the appendix, Table 45, p. 198).

For articles on the private context, the left side of Table 12 reveals that articles from 1995 have many more citations than articles from 2005 and 2015, as they have been available to other

[18] Publications per author

scholars for much longer. In total, articles on the private context are cited on average 124 times in 2018. In comparison to the results for 2016 (Table 45, p. 198), the average citations per article have increased considerably. Citations for articles published in 1995 have increased on average by over 200 citations, whereas articles published in 2005 only show an average increase of 40 citations. The evolution is still the smallest for articles published in 2015. In turn, articles on all contexts count an average 84 citations in 2018 (see Table 12, right table). Looking at the development of the average number citations per article development between 2016 and 2018, it becomes apparent that articles published in 1995 or 2005 show a mean increase of around 30 citations. In contrast, more recently published articles from 2015 only show an increase of 12 citations between 2016 and 2018. Overall, the most often cited article of all contexts is from Taylor and Todd (1995a). It shows an increase in citations of 20% in two years (from 6,975 citations in 2016 to 8,377 in 2018).

**Table 12.** Google Scholar Citations for Articles on the Private Use of IS Context (A) and for the Full Sample (B) – Collected in 2018

| A | | | |
|---|---|---|---|
| **Year** | **# of Articles** | **Mean # of Citations per Article** | **Max # of Citations** |
| 1995 | 5 | 1795 | 8,377 |
| 2005 | 20 | 197 | 1045 |
| 2015 | 94 | 20 | 160 |
| **Total** | **119** | **124** | **8,377** |

| B | | | |
|---|---|---|---|
| **Year** | **# of Articles** | **Mean # of Citations per Article** | **Max # of Citations** |
| 1995 | 336 | 205 | 8,377 |
| 2005 | 496 | 132 | 4,795 |
| 2015 | 934 | 15 | 585 |
| **Total** | **1,766** | **84** | **8,377** |

Table 13 illustrates the citation results per outlet[19] for articles on the private context only. Comparing the outlet type, journal articles from the private context are cited more often than conference articles (on average, 328 citations compared to 9 citations for conference articles). Concerning the minimum values of citations, conference articles may also show no citations at all, whereas journal articles are cited at least seven times. In detail, ISR shows the highest mean of citations per article (as the article with the most citations of articles on all contexts belongs to ISR). Then, with a significant gap, JSIS, MISQ, and JSIS follow. All other journal outlets contain articles with an average of 57 or less citations. Especially conference articles show five or less mean citations per article.

**Table 13.** Google Scholar Citations of Articles on the Private Use of IS Context per IS Outlet and Year

| Journal/ Year | # of Articles | Mean # of Citations per Article | Min # of Citations /Article | Max # of Citations/ Article |
|---|---|---|---|---|
| EJIS | 9 | 63 | 20 | 160 |
| 2005 | 1 | 135 | 135 | 135 |
| 2015 | 8 | 54 | 20 | 160 |
| ISJ | 4 | 100 | 11 | 224 |
| 2005 | 1 | 224 | 224 | 224 |
| 2015 | 3 | 58 | 11 | 119 |
| ISR | 8 | 1,144 | 20 | 8,377 |
| 1995 | 2 | 4,316 | 254 | 8,377 |
| 2005 | 1 | 307 | 307 | 307 |
| 2015 | 5 | 43 | 20 | 76 |
| JMIS | 7 | 134 | 9 | 387 |
| 1995 | 2 | 173 | 97 | 248 |
| 2005 | 2 | 261 | 135 | 387 |
| 2015 | 3 | 24 | 9 | 37 |
| JSIS | 2 | 567 | 89 | 1,045 |
| 2005 | 1 | 1045 | 1045 | 1,045 |
| 2015 | 1 | 89 | 89 | 89 |

| Journal/ Year | # of Articles | Mean # of Citations per Article | Min # of Citations /Article | Max # of Citations/ Article |
|---|---|---|---|---|
| JAIS | 6 | 77 | 7 | 349 |
| 2005 | 1 | 349 | 349 | 349 |
| 2015 | 5 | 23 | 7 | 52 |
| MISQ | 7 | 207 | 57 | 916 |
| 2005 | 1 | 916 | 916 | 916 |
| 2015 | 6 | 89 | 57 | 144 |
| ECIS | 31 | 11 | 0 | 55 |
| 1995 | 1 | 0 | 0 | 0 |
| 2005 | 8 | 23 | 6 | 55 |
| 2015 | 22 | 7 | 0 | 26 |
| ICIS | 45 | 8 | 0 | 234 |
| 2005 | 4 | 64 | 0 | 234 |
| 2015 | 41 | 3 | 0 | 13 |

Following Hamilton and Ives (1982b), the most often cited articles on the private context are identified and displayed in Table 14. All of them originate from 1995 and 2005, and their long availability accounts in part for that result. Accordingly, the top four articles from 2015 (with more than 100 citations in 2018) are included. It is striking that IS usage (especially adoption) is one main topic. This supports the results from Subsection 3.3.4 (p. 57), which also identifies IS usage as one major topic when analyzing the keywords of the articles on the private context of IS use.

[19] According to the context categorization, JIT does not contain any articles within the private context. For that reason, it is not included in Table 13. This issue explains a lack of results for selected years within the table (e.g., 1995 of EJIS and ICIS).

**Table 14.** Articles on the Private Use of IS with More Than 200 Google Scholar Citations

| Journal/ Conference Proceedings | Year | Authors | Title | # of citations (2018) |
|---|---|---|---|---|
| Information Systems Research | 1995 | Shirley Taylor, Peter A. Todd | Understanding Information Technology Usage: A Test of Competing Models | 8,377 |
| Information Systems Research | 1995 | William J. Doll, T. S. Raghunathan, Jeen-Su Lim, Yash P. Gupta | Research Report – A Confirmatory Factor Analysis of the User Information Satisfaction Instrument | 254 |
| Journal of Management Information Systems | 1995 | Shepherd, Morgan M, Briggs, Robert O, Reinig, Bruce A, Yen, Jerome, Nunamaker Jr, Jay F | Invoking Social Comparison to Improve Electronic Brainstorming: Beyond Anonymity | 248 |
| Journal of Management Information Systems | 2005 | Fang Xiaoweng, Susy Chang, Jacek Brzezinski, Xu Shuang | Moderating Effects of Task Type on Wireless Technology Acceptance. | 387 |
| Journal of Strategic Information Systems | 2005 | June Lu; James E. Yao; Chun-Sheng Yu | Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology | 1,045 |
| MIS Quarterly | 2005 | Susan A. Brown, Viswanath Venkatesh | Model of Adoption and Technology in Households: A Baseline Model Test and Extension Incorporating Household Life Cycle | 916 |
| Journal of the Association for Information Systems | 2005 | Hao Lou, Patrick Y.K. Chau, Dahui Li | Understanding Individual Adoption of Instant Messaging: An Empirical Investigation | 349 |
| Information Systems Research | 2005 | Sung S. Kim, Naresh K. Malhotra, Sridhar Narasimhan | Two Competing Perspectives on Automatic Use: A Theoretical and Empirical Comparison | 307 |
| Proceedings of the International Conference on Information Systems | 2005 | I. M. Y. Woon, G. W. Tan, and R. T. Low | A Protection Motivation Theory Approach to Home Wireless Security | 234 |
| MIS Quarterly | 2015 | Hartmut Hoehle, Viswanath Venkatesh | Mobile Application Usability: Conceptualization and Instrument Development | 130 |
| Information Systems Journal | 2015 | Christian Maier; Sven Laumer; Christoph Weinert; Tim Weitzel | The effects of technostress and switching stress on discontinued use of social networking services: a study of Facebook use | 119 |
| MIS Quarterly | 2015 | De Liu, Daniel J. Brass, Yong Lu, Dongyu Chen | Friendship in Online Peer-to-Peer Lending: Pipes, Prisms, and Relational Herding | 144 |
| European Journal of Information Systems | 2015 | Christian Maier, Sven Laumer, Andreas Eckhardt, Tim Weitzel | Giving too much social support: social overload on social networking sites | 160 |

Analysis of the knowledge utilization in the sample leads to the next section, comments on the limitations of the methodology before summarizing and discussing the results in the final section.

## 3.4 Limitations

Depending on the characteristics of the articles, different limitations apply to data collection, analysis, and interpretation. Overall, there is one aspect that applies for all characteristics: the focus on a subset of leading IS journals and conferences. The possibility that the results for other IS outlets are different cannot be ruled out. The center of interest on top IS outlets for bibliometric studies is not unusual and follows the reasoning of other scholars (Bernroider et al. 2013, Sørensen and Landau 2015, Vessey et al. 2002). Finally, whether the three years selected for the analysis (1995, 2005, and 2015) are representative for the years in between is uncertain. Special issues or specific conference themes may have affected the results of the particular years under investigation. However, notable for the context, the results are quite similar for conferences and journal articles. Given the longer lead-time for journal publications, it is unlikely that the results are biased by a topic trending in a particular year at a particular conference, which suggests that the chosen years are a good indicator for that period in time. The selection of three years represents a limitation of the study design, but also a trade-off concerning the sample size in favor of including a variety of outlets (Basket of Eight and conferences). Other studies' samples range between 96 and 2,098 articles and only cover one year or a shorter period of time than this study, and fewer outlets (Ayanso et al. 2007, p. 20, Chen and Hirschheim 2004, Farhoomand and Drury 1999, Vessey et al. 2002).

Concerning the **research context,** the results of these bibliometric studies are subject to the choice and definition of the categorization scheme used and the categorization process itself (coder subjectivity). Following an iterative process was meant to increase objectivity. First, a categorization scheme derived from literature was applied. Second, minimizing the risk of coder subjectivity was attempted by carrying out three rounds of categorization (also applied by Alavi et al. (1989)). Third, consensus was sought through discussion of the cases where the categorization results of different coders did not match. Fourth, coding rules (explanations and exemplary articles for the categorization scheme) were established based on the discussions in early stages of the process, where efforts were made to systematically reduce the uncertainty concerning the context

of an article. The methodology section is identified as the most reliable part from which to infer the context of an article. In the introduction, discussion, and conclusion sections, many authors tend to place their research results (often originating from a specific issue or field of application) within a larger picture or to generalize them. This implies that these sections contain many aspects and keywords that are potentially misleading. Thus, the categorization here is based on the methodology section, especially the level of analysis (sample composition, artifact). The level of analysis describes the exact context of the research results, making understanding the scope of analysis much easier and increasing inter-rater reliability.

To the same extent, subjectivity represents one major limitation on the analysis of the **research methods** as well. As this indicator is only of secondary interest and easier to assess, the process to ensure a high level of objectivity is less intensive than that concerning the research context. On this account, only one round of coding was conducted. To ensure objectivity, the coder carefully read the articles and re-used (if possible) the research method indicated by the authors. Moreover, when difficulties appeared, the coders and researchers discussed them and found a solution together. This solution was then integrated in the coding rules and applied to all corresponding cases. Then, in order to ensure objectivity of the categorization scheme, they were derived in two ways: deductively from the literature, as well as inductively from an exploratory round of coding. Moreover, the categorization scheme led to coding rules that were adapted and refined continuously.

For the remaining indicators, which mostly consist of external or metadata, other limitations exist. The **nationality** of an article may not cover the true nationality of the first author, because it rather represents the nationality of his or her research institute. However, identifying the true nationality would be rather cumbersome or even impossible, as it would require finding the C.V.s or contacting over 3,000 authors. Additionally, this kind of operationalization was already used by IS scholars to analyze geographical aspects. Then, the **thematic context** of articles on the private context might not cover all existing themes because the analysis is not based on the full text, but on the keywords of an article. Context analysis or text mining represent alternative methods that might reveal more precisely the theme of an article. Yet, they are outside the scope of this dissertation. Moreover, the analyzed articles only take into consideration the most frequent keywords. Those that were only employed less than four times were not included in the harmonization and analysis. Finally, the limitations of the analysis of **knowledge utilization**, require considering mainly two characteristics: BoE references and Google Scholar citations. The interpretability of the BoE references as an indicator for the cumulative tradition of utilizing IS knowledge is limited, as the BoE references do not contain other IS outlets, such as conferences or other journals. Additionally, when comparing results for articles on the private context with articles on all contexts, the reader should keep in mind that outliers play a much larger role with the sample size of 119 articles on the private context than that of 1,766 articles on all contexts.

Considering all the limitations identified above, the next section discusses the results of the bibliometric study in detail.

## 3.5 Discussion

The final section of this chapter discusses the findings, contributions to literature, and implications for practice.

The primary goal of this chapter was to quantify the extent to which the IS discipline follows the trend in practice reflecting the increasing relevancy of IS in the private context. Additionally, a secondary goal consisted of increasing knowledge of the current state of the IS research in the private context. To that end, 1,766 articles from top IS outlets (journals and conferences) were analyzed. The content and other characteristics of an article served as a basis for reaching the goals stated above. Table 15 summarizes the most relevant results from Section 3.3 (p. 49).

The bibliometrics study in this chapter created a comprehensive analysis by outlet and year of the share of articles on research on different contexts (private, professional, both, and other).

**Table 15.** Summary of the Research Results for Each Research Question and Indicator

| | Research Question 1 | Research Question 2 | | | |
|---|---|---|---|---|---|
| **Character-istics** | 1. Context | 2. Research method and meta-categories | 3. Nationality | 4. Thematic Content | 5. Knowledge Utilization |
| **Main Insights** | - Only 7% of IS articles belong to the private context<br>- The percentage has more than doubled in 2015 (10%) compared to previous years (1995: 1% and 2005: 4%)<br>- JIT did not publish an article in the private context of IS use – JSIS and JMIS seem to be rather reluctant towards the private context<br>- EJIS, JAIS, MISQ and ICIS show the largest share of articles of the private context in 2015 | - Most articles of the private context employ a combination of empirical and non-empirical designs (then purely empirical and lastly non-empirical designs)<br>-In contrast, for articles of all contexts, all three research designs are almost equally distributed<br>- Most articles of the private context employ mixed research approaches (qualitative and quantitative) in contrast to articles of all contexts, where purely qualitative approaches dominate<br>- The most often employed research methods in articles of the private context are: conceptual (36%), survey (25%), field study (17%), experiment (13%)<br>- The number of employed research methods of articles of the private context increased from four to 10 different research methods from 1995 to 2015<br>- Journal articles of the private context predominantly focus on four research methods (conceptual, survey, experiment, field/case study), but conference articles are more pluralistic | - Research on the private context originated mostly from North America and Europe<br>- Since 2005 the North American dominance slowly shrunk, and Asia contributed to almost one third of all articles of the private context<br>- ISR and ICIS showed a very diversified picture of different nationalities of articles of the private context<br>- ECIS published predominantly European articles of the private context<br>- JMIS, ISR, and MISQ publish predominantly North American articles of the private context | - Most frequent themes of articles in the private context: social networking sites, online communities, virtual community, social media, and technology acceptance (tam)<br>- Keywords that were uniquely employed in the private context encompass the following three themes: Social and virtual networks, IT usage, decision making<br>- The number of themes in articles of the private context was more pluralistic in 2015 than in 1995 or 2005 | - Most productive authors of articles in the private context: Susan A. Brown and Viswanath Venkatesh have each three publications<br>- The number of authors per article of the private context is slightly higher than for articles of all contexts (three vs. 2.5 per article)<br>- BoE: the average number of references in the private context amounts to 67 references with 15% of references originating from the BoE (slightly higher than for all contexts) – yet, the share is rather unstable over time<br>- Conference articles of the private context use less BoE references and notably the journals ISJ, EJIS and JAIS the most BoE references<br>- Google Scholar citations: 124 cites per article of the private context on average – ISR and JSIS show the highest number of mean citations per article (in general, journal articles are far more often cited than conference articles) |

Overall, the findings for the **first research question** ("To what extent do top IS outlets reflect the trend in practice toward the private use of IS currently and over the last two decades?") provide quantitative support for the observations of senior IS scholars concerning the limited research on IS in the private context (Baskerville 2011a, b, Crowston et al. 2010, Gaß et al. 2015, Glass et al. 2004, Liang and Tanniru 2007). Several scholars have actively called for more IS research, for instance, on new challenges associated with Web 2.0, ubiquitous computing, and social networks, in order to support the mission of IS "to improve our individual and collective lives by making the best possible use of available technologies" (Stahl 2012, p. 209). At the same time, the results of the study suggest that their calls may have borne fruit. From 1995 to 2015, strong growth in the share of articles from private context is evident. The mean share of articles covering private use of IS in 1995 is almost nonexistent at 1%, but it grew to 10% in 2015. Still, this modest share does not seem to properly reflect the high rate of diffusion of IS in the private context (e.g., PC and smartphone usage). As a comparison, the IT infiltration in German companies and households provides insightful information. In Germany, 94% of all companies with more than nine employees had computers in 2017 (Statistisches-Bundesamt 2018b). Taking into consideration the number of employees (Reuters 2016, Statistisches-Bundesamt 2016), a rough calculation for 2015 reveals that almost 31 million employees are surrounded with IS for nine hours a day. In contrast, with an IS infiltration (even considered without smartphone use) of 88% of all households (Statistisches-Bundesamt 2018a), around 11 million individuals (Statista 2018a, b) are surrounded with IS also for at least nine hours a day. This would result in a ratio of private to professional IS usage of 1:3. Yet, this study's results are far beyond this practice phenomenon. Remarkably, JIT did not publish a single article concentrating on the private context in the three years analyzed. Journals with a very low share of articles on the private use of IS are JSIS and JMIS – a finding that is not surprising

given the professional-related focus of JSIS (Gable 2010) and JMIS. Yet, for other top IS outlets, the share rather increases. EJIS, JAIS, MISQ, and ICIS show the largest share of articles on the private context. Thus, even prominent journals and conferences on the discipline show great support and interest in the research stream of the PIS and the private context.

The share of articles from the purely professional context decreased from 77% in 1995 to 64% in 2015, putting the stability of the professional core of IS (Sidorova et al. 2008) into question. These results also highlight that more than one-tenth of the articles analyzed ambiguously affect both professional and private contexts. This number also increases over the years studied. Interestingly, the ambiguous category notably increases for JIT, JMIS, ECIS, EJIS, and JAIS, but decreases for ISJ and ISR. Especially JAIS and ICIS published a large share of articles that belong to ambiguous contexts (over one-third in 2015 for JAIS). This result may suggest that the private context is already deeply rooted within IS research, yet unacknowledged. Certainly, topics such as work-home conflict or bring-your-own-device represent potential candidates for articles that indirectly treat the private context. They also acknowledge the increasing relevancy of IS use in the private context, which even interferes with the professional context.

The present results extend, complement, and update previous studies on the status quo of IS research (Gaß et al. 2015, Glass et al. 2004, Sidorova et al. 2008) by investigating private contexts as a distinct category and by exploring the ambiguous context of many articles. The database serves as quantified basis information for the discussion about the boundaries or the identity (Agarwal and Lucas 2005, Benbasat and Zmud 2003) of the discipline and offers a new perspective on structuring IS research. Until now, the private user was only considered within the level of analysis of an article (e.g., individual or group). Yet, this does not adequately acknowledge the role of IS use in the private context – notably, the future relevancy due to the increasing digitalization in our everyday lives. The results also help other researchers to better direct their submissions related to the private context to journals that are more open to this context. Furthermore, editors of journals that have shown reluctance toward the private context might consider extending their orientation in that direction. Moreover, emphasizing research in the private context of IS also has implications for practice. Hence, academia can offer more insights for practitioners which are relevant for business models (value propositions), business processes, innovation (Maglio 2015, Medina-Borja 2015), IT management, or performance within the firm (Baskerville 2011b).

The **second research question** (“How does the intellectual structure of research in the private context of IS use look like and how has it evolved?”) concerns the intellectual structure and its evolvement over time. Addressing the question began with quantifying and describing several characteristics of the scientific pursuit by IS scholars of the private context. Overall, 119 articles belong to the private context. Mostly external and metadata served as input for this analysis. Thus, the results give an impression of the maturity and diversity of the research stream.

First, investigation of the current composition of **research methods and meta-categories** employed in the private context demonstrated changes in time that may reflect trends or specificities of the private context. Concerning the current composition (2015), mixed research designs (empirical and non-empirical) and approaches (qualitative and quantitative) clearly dominate. This shows that authors pay attention to theorizing as well as empirical validation, and some calls of scholars (Venkatesh et al. 2013) have been answered by obtaining rich insights into various phenomena. Furthermore, the research design is a good indicator of maturity of a field, according to Cheon et al. (1993): Non-empirical research that focuses on structuring and describing is evaluated as less mature than empirical research that includes inferences and generalizations. Over 90% of all employed research methods in 2015 comprise only four research methods: conceptual (36%), survey (22%), field study (21%), and experiments (13%). Overall, the evolution over time of the employment of research methods for studying the private context is becoming increasingly diversified, and scholars tend increasingly to use empirical research methods. That is a clear sign of the evolvement of the research stream in terms of research methods. Compared to conferences, journals are much more restricted, and their published articles on the private context show small variety in employed research methods. This rather reveals an aspect that should be addressed in future endeavors to increase maturity and offer richer results on these phenomena. In contrast, for articles on all contexts, the results differ for research designs, approaches, and methods. Articles on all contexts are much more empirical and qualitative. Moreover, other research methods dominate. As a result, the research for articles on the private context differs from

that for articles on all contexts, proving that the research behavior is different from the typical professional context.

Second, concerning **nationality**, authors from North American and European institutions still dominate research on the private context of IS. Thus, the research stream has not been sufficiently considered yet by researchers in other countries/continents. There is still potential to gain more diversified insights with more participation from different nationalities. At the same time, considering the evolution over time, the nationalities of authors have become more and more pluralistic, showing an increasing interest in self-tracking from one or two countries independently. Furthermore, as the data from 2015 shows, currently Asian authors contribute as much as European authors to IS research on the private context. Considering more detailed data broken down to the outlet, it is interesting to see that some IS outlets seem to be dominated by one nationality in their publications on the private context. This may help other scholars to choose a potential outlet for their publication.

Third, the analysis of the **keywords** (and the results for the most cited articles) give a first hint of main themes relevant to the private context. These themes encompass social or virtual networks, IT usage, and individual decision making. They are rather focused on an individual that uses IS beyond organizational boundaries. Hence, the results of this work join prior articles with the aspiration to structure the essence of IS research – or the intellectual core, as Sidorova et al. (2008) frame it. In contrast to Sidorova et al. (2008), the method of the analysis is rather limited and only encompasses a small part of the total number of keywords. On this account, the indicator of thematic content is only seen as a condensed preview of the global thematic structure of the private context. A structured study might offer more insights into the private context, which would be comparable with previous work (Alavi et al. 1989, Palvia et al. 2004, Sidorova et al. 2008, Vessey et al. 2002).

Finally, concerning knowledge utilization, the bibliometric study revealed rather divergent insights into the structure and the maturity of IS research on the private context. Similar to the example from Cocosila et al. (2009), the analysis of the most productive **authors** reveal familiar names of senior IS scholars. Viswanath Venkatesh and Susan A. Brown represent such senior IS researchers who have contributed much to IS literature in general. Yet, the maximum number of publications per author is still only three publications. The small number of articles for the most productive authors makes it difficult to discern the most productive authors addressing the private context. IS research of the private context seems rather to be more of a by-product of research from the professional context. Moreover, there is no specific outlet that only publishes articles on the private context (co-)authored by senior IS scholars (see Table 41, p. 195). This shows that the outlets seem to be open for various authors engaged with the private context, or else they just do not consider the context at all and the result is random. For articles on the private context, 9 out of the 30 most productive authors are loyal to one outlet. The remaining 21 authors chose up to three different outlets for their research. The highest diversity of authors (authors in relation to articles on the private context) reveals ISJ, with only four articles but 15 authors. The instability of the cooperativity index for different outlets implies that the private context of IS use is still in a forming phase, and there is no monotonous publication pattern concerning authors. Additionally, similar to Cocosila et al. (2009), the number of articles is growing, and for most outlets the cooperativity index is also increasing.

Hamilton and Ives (1982b) note that articles with a high number of **references** provide information about the intensity of interaction with prior research. On this account, articles with 15 to 20 references are evaluated as articles with a high degree of interaction. In comparison to the number of references at that time (early 1990s), this classification is not adequate any more. In this bibliometric study, for articles of all contexts, the mean number of references per article amounts up to 50 references per article (with 8 BoE references). For the private context, the interaction with prior IS and other literature is even higher at 67 references per article (with 11 BoE references). So, the threshold for a high intensity of interaction with prior research should be higher. Furthermore, Hamilton and Ives (1982b) also distinguish the number of references for different types of research methods (e.g., survey and tutorial articles have more than 20 references) in order to identify relevant research methods. In contrast, the data at hand only allows a comparison of the mean number of references on the level of the research design and the research approach (see Table 46, p. 198 and Table 47, p. 198). It shows that articles on the private context with a mixed empirical design and approach have the strongest cumulative tradition. In second position are non-

empirical and qualitative articles. In contrast, for articles on all contexts, mixed designs and non-empirical designs have the strongest cumulative tradition. For the research approach, mixed approaches also show the largest mean BoE ratio. In general, the BoE ratio is slightly higher in the private context than in all contexts. Thus, the interaction with prior literature differs not only between contexts, but also between research designs and approaches. The stronger interaction with prior literature for non-empirical and qualitative research in the private context allows conclusions concerning the high level of maturity of the discipline.

Finally, concerning the **Google Scholar citations**, articles on the private context do not show many differences compared to articles on all contexts. In turn, the analysis helps to identify most frequently cited articles on the private context. They can be considered key articles for the private context. The themes they cover confirm in part the identified themes from the keyword analysis above.

The results **contribute** in various ways to the literature. First, this is one of the first quantified overviews of the intellectual structure of IS research on the private context. These insights inform the areas of employment of research methods, nationality, thematic content, and knowledge utilization. According to Cheon et al. (1993), aspects such as research methods, topics, or comments about a field determine its maturity and state of evolution. For example, they state that mature fields show high diversity in topics or research methods, reflecting that no focal point exists at one specific topic, paradigm, or research method. For most characteristics investigated in the bibliometric study at hand, the data shows an increase in number of employed research methods, nationalities, themes, authors, authors per article, BoE references, total number of references, and citations. Thus, the research stream shows an increasing level of maturity with much potential, given the most current data from 2015. Second, with the sample of all articles from the BoE and two major IS conferences, previous but outdated studies on the intellectual structure of IS (Backlund 2005, Chen and Hirschheim 2004, Ebeling et al. 2012, Farhoomand and Drury 1999, Glass et al. 2004) are updated. Finally, the results show that the IS research on the private context evolves and even depicts first signs of maturity. They can also be interpreted as an openness of the discipline to future research. Aligning with previous researchers, this study aims to “motivate a more reasoned, reflective adoption of approaches from the diverse perspectives available” (Orlikowski and Baroudi 1991, p. 1). These insights should direct not only authors but also reviewers or track chairs who can manage the plurality and heterogeneity of research in the private context in the first place.

In summary, the results show that the research stream of the private context belongs to the IS discipline and has been progressing in the last 20 years. The bibliometric study serves as a first indicator of an increasing number of articles with growing diversity and maturity. Overall, the investigation shows a certain dynamic within research, especially over the years studied, which still lags far behind the development in practice. To that end, the research stream still offers a large field for future scholars and investigations. As a start, other scholars can use the insights generated by the dissertation at hand to direct their research efforts at more diverse results. Furthermore, other scholars can better make strategic decisions, such as finding an adequate publication outlet.

In that sense, the remaining part of this dissertation reinforces the relevancy of the private context and focuses on contributing to the research stream with further insights. On this account, the following chapter of the dissertation concentrate on a specific technology of the private context: self-tracking technologies. The following chapter gives a structured overview on the literature of IS and related disciplines on self-tracking, in the form of a literature review that illuminates this domain of PIS.

# 4 Literature Review on Self-Tracking Research

As the previous chapter shows research on use of IS in the private context still in its infancy, this dissertation aims at enlarging IS knowledge on PIS. On this account, a specific application domain was chosen to contribute to the research with a specific private-use IS: self-tracking appliances (see Figure 26). Two main reasons led to this decision. On the one hand, self-tracking mostly concentrates on the private individual and private activities. To this end, the domain covers a wide range of IS use in a private context and perfectly illustrates the differences between private and professional IS. On the other hand, self-tracking appliances have gained increasing attention from mass markets. For example, over 70% of the adults in the US engage in health tracking with pedometers (Fox and Duggan 2013). Beyond specialized devices such as wristbands or shower meters, smartphone applications represent a typical self-tracking appliance. So, the exponential increase in smartphone ownership in industrialized countries (over 50% in 2016) makes self-tracking easily accessible for everyone (Poushter 2016).

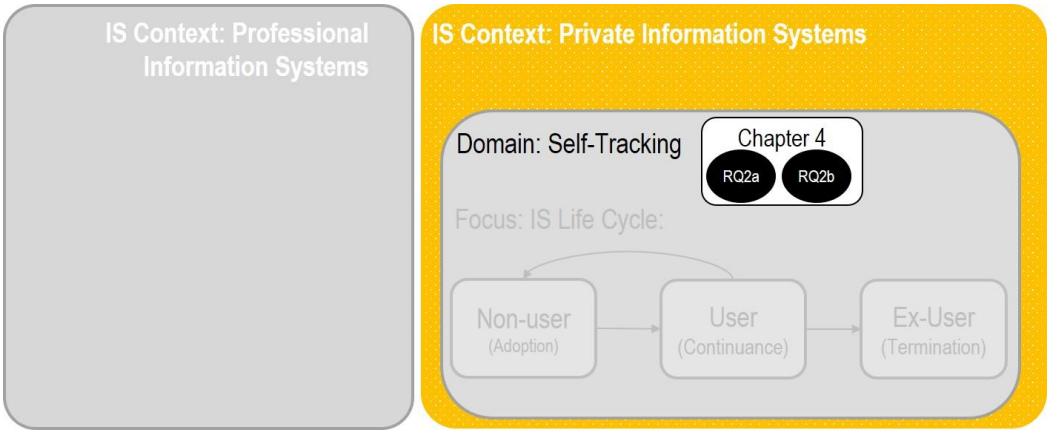



**Figure 26.** Research Focus for Chapter 4: Status-Quo of Self-Tracking Research in IS

Like the state of PIS, self-tracking research is still sparse. First interesting insights on self-tracking exist (Kersten-van Dijk et al. 2017, de Moya and Pallud 2017); however, the knowledge is still scattered in various disciplines and areas. As a first example, the HCI discipline yields findings from two specific research streams called personal informatics (see footnote 2, p. 7) and lived informatics (see footnote 5, p. 20). As shown in Subsection 2.3.2, p. 20, HCI research pays particular attention to understanding self-tracking-device usage. Moreover, IS research also covers usage behavior, but large parts of the research that mentions self-tracking considers it rather as a by-product of other themes (e.g., IoT or wearables). Then, psychology provides general theories that help explain the phenomenon of self-tracking, with widely recognized concepts such as goal-setting, self-efficacy, or self-monitoring. On this account, psychology shows that self-tracking can help to manage various situations, e.g., bad moods and depression (Thayer et al. 1994). In addition, areas such as health care and insurance acknowledge the potential of self-tracking for delivering preventive and personalized health services that emancipate the patient or keep him or her healthy (Paluch and Tuzovic 2017, Paton et al. 2012). Furthermore, tech companies (e.g., Google, Apple, Facebook) are interested in self-tracking because it generates massive data (Crawford et al. 2015, Klauser and Albrechtslund 2014). Finally, sociology is also interested in self-tracking, as it organizes the modern trend of self-improvement (e.g., losing weight, eating more healthy, spending less money, conceiving children more easily), which motivates numerous individuals to optimize their private lives (Lupton 2014).

As shown above, self-tracking implies multiple promises for individuals and organizations to improve some aspect of an individual's life or provide more information. However, studies have shown that such promises might not hold, due to lack of knowledge about the real impact of self-tracking on individual behavior (Kersten-van Dijk et al. 2017). Additionally, studies and market research show contradictory results about usage behavior or appreciation by individuals of self-tracking appliances. So, in the case that system usage cannot be ensured, all positive aspects of the application of self-tracking are left unleveraged. Moreover, different disciplines consider multiple explanations and theories. Yet, the application of such explanations and theories is not structured and does not adequately take into consideration previous literature of other disciplines.

For example, Chung et al. (2017), Epstein et al. (2015), Rockman and Gewald (2017), Sjöklint et al. (2015), and Zhou et al. (2016) take into consideration the concept of goal setting, but the authors hardly cite each other. This implies a lack of a cumulative tradition. On this account, self-tracking research appears to be uninformed and unstructured.

In order to streamline the scattered research and better inform scholars, this study follows Ayobi et al. (2016), De Moya and Pallud (2017), and Kersten-van Dijk et al. (2017) by deriving the following research questions:

*RQ2a: What research insights currently exist about the phenomenon of self-tracking?*

*RQ2b: What research gaps and future research directions can guide IS researchers?*

A systematic literature review (vom Brocke et al. 2009, Fettke 2006, Webster and Watson 2002) helps answer both research questions. To that end, a systematic literature review structures research on self-tracking in IS and related disciplines, identifying articles concerned with self-tracking, depending on their focus and insights. On this account, 114 articles are analyzed in depth to establish the status quo of self-tracking research from 1994 until 2018. The status quo aids in deriving a research agenda that helps other scholars to direct their research. Furthermore, the literature review also serves as a foundation for the dissertation

So, this chapter is structured as follows. The first section presents the methodology of the literature review corresponding to guidelines from the literature. The next section depicts databases and discusses data quality. Then, the results are described and illustrated in a quantitative and qualitative way. The limitations and the discussion sections finalize the chapter.

## 4.1 Overall Method for Literature Review

According to Rowe (2012, p. 243), “a literature review synthesizes past knowledge on a topic or domain of interest, identifies important biases and knowledge gaps in the literature and proposes corresponding future research directions”. With the goal of summarizing and structuring the research on self-tracking, a literature review was conducted according to typical IS guidelines (vom Brocke et al. 2009, Fettke 2006, Webster and Watson 2002) and current practice (Bengtsson et al. 2011, Webster and Watson 2002). Adhering to the guidelines ensures transparency and helps to meet all validity and reliability requirements.

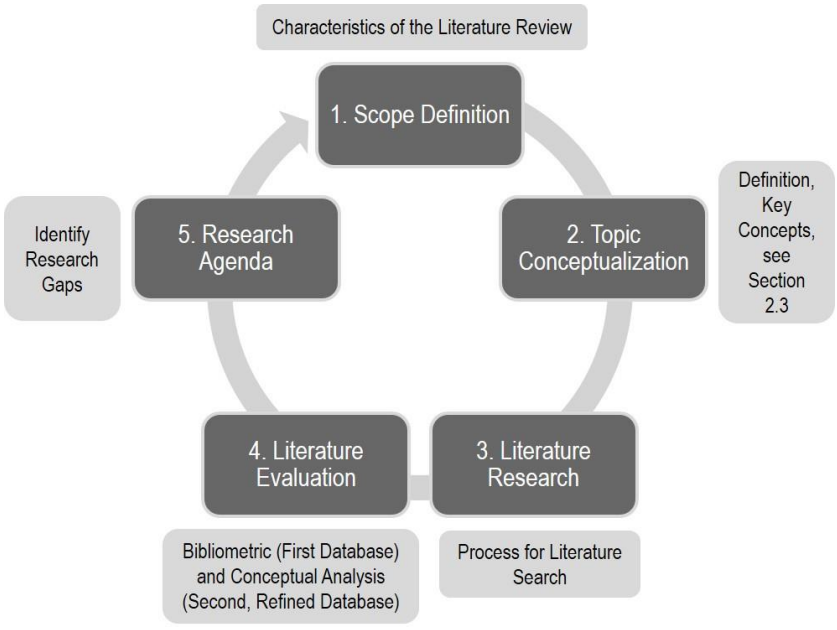



**Figure 27.** Literature Review Process Amended from vom Brocke et al. (2009, p. 8)

Figure 27 depicts the overall methodology, structured according to the process steps of vom Brocke et al. (2009). First, the scope (1) of the literature review is defined. This incorporates decisions such as the time period or journal and conference outlets. The conceptualization of the topic (2) follows. For the dissertation at hand, self-tracking is conceptualized in Section 2.3 (p. 17). The definition of the scope and the conceptualization lead to determining parameters for the literature search (3). Thereby, identified articles serve as input for the literature evaluation (4). The dissertation at hand

conducts a quantitative and a qualitative analysis. The quantitative analysis presents results in the form of a bibliometric study. The qualitative analysis is content-related and includes a mapping of concepts derived from the articles. The results lead to the identification of research gaps that are summarized in a research agenda (5) to help streamline future research.

The following subsections present more details about each step of the literature review process. The first subsection starts with the definition of the scope, which also includes a description of search parameters.

### 4.1.1 Definition of Scope

This subsection specifies the scope of the literature review using a framework consisting of several characteristics from Fettke (2006), Cooper (1988), and vom Brocke et al. (2009). Table 16 summarizes the specific characteristics of this literature review, following Fettke (2006).

**Table 16.** Characteristics of the Literature Review Amended from Fettke (2006, p. 259)

| Characteristics | | Categories | | | |
|---|---|---|---|---|---|
| a. Type | | Mathematical-Statistical | | Natural Language | |
| b. Focus | | Research results | Research Method | Theory | Application / Experience |
| c. Aim | Formulation | Not Explained | | Explained | |
| | Content | Integration | | Critic | Central topics |
| d. Perspective | | Neutral | | (Espousal of) Position | |
| e. Literature | Selection | Not Explained | | Explained | |
| | Scope | Key Work | Representative | Selective | Exhaustive |
| f. Structure | | Historic | | Thematic | Methodic |
| g. Target Audience | | General public | Practice | General researchers | Specialized researchers |
| h. Future Research | | Not Explained | | Explained | |

The type (a) of this literature review is described in mathematical-statistical terms and in natural language. The first type, a bibliometric study (for a definition and explanations see Section 3.1, p. 34), underlines the evolution over time and the status quo of research efforts in the domain of self-tracking. It implies a quantitative descriptive analysis of the first database. The second type conducts a content-analysis (for a definition and explanations see Section 3.1, p. 34) of articles that concentrate exclusively on self-tracking and do not mention self-tracking as a by-product. The qualitative analysis consists of a literature review in natural language.

The focus (b) of the literature review covers all aspects extracted mainly through the content-analysis in order to establish a status quo of the research stream – e.g., the research results or employed theories. The aim (c and d) of the analysis has been explained in the previous sections and pays particular attention to identifying central topics. Overall, the goal is a comprehensive overview of self-tracking that helps to detect research gaps that this dissertation addresses.

The perspective on the literature is neutral (d) and no specific theoretical position is taken. Theoretical concepts only serve as a means of structuring the analysis. To that end, two models support the systematic procedure of the content analysis.

Concerning the literature (e) reviewed within the content analysis, Subsection 4.1.3 (p. 70) explicitly explains which articles were selected. In addition, the subsection also explains the results of the selected scope of the literature search and pays particular attention on relevant disciplines and academic outlets. The selection of articles originates, on the one hand, from the conceptualization of the topic; on the other hand, the availability of the journals or conference articles influences the selection of the articles as well.

The structure (f) is divided into two parts. The first part of the literature review is historical, i.e., a bibliometric study to investigate the interest in self-tracking over time. To this end, the bibliometric study analyzes the hits for each keyword, year, and outlet. The second part is a thematic analysis that works out central topics in a refined database of the search hits for selected keywords. The thematic analysis leads to an identification of research gaps to guide future research. To that end, a research agenda is drawn (h).

As a result, the primary target audience (g) consists of specialized researchers who are interested in engaging in research on self-tracking. Additionally, as a second target audience, the literature review also addresses practitioners and general researchers who need an overview of previous achievements or some specific key facts about the topic.

The next section briefly defines the conceptualization of self-tracking, which has already been described in depth in the theoretical background Section 2.3 (p. 17).

### 4.1.2 Conceptualization of Topic

Self-tracking refers to actions implying one or more of the following self-tracking components: self-measurement, data collection/storage, analysis, reflection, and behavioral change concerning private activities. The private activities range from self-tracking every step to every financial expenditure. One of the most prominent models from Li et al. (2010) distinguishes the following phases, also called stages of self-tracking: preparation, data collection, integration, reflection, and action. Detailed information on self-tracking and associated concepts is depicted in Section 2.3 (p. 17).

Following the conceptualization of self-tracking, the literature search process is described in the next subsection.

### 4.1.3 Literature Search

Consistent with the suggestions from vom Brocke et al. (2009), this subsection presents the literature-search process that identifies and selects literature for the bibliometric study and the content/thematic analysis. Figure 28 presents each step of the literature search.

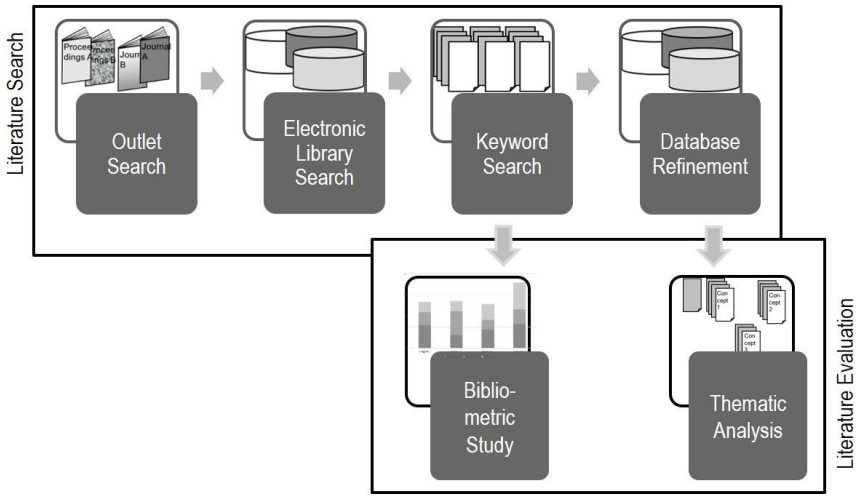



**Figure 28.** Literature Search and Evaluation Process Amended from vom Brocke et al. (2009, p. 9)

To begin, appropriate outlets were searched and selected that (1) have already been engaged with self-tracking, (2) contribute relevant insights on self-tracking, (3) are representative of a discipline, and (4) publish high-quality papers (e.g., ensured with a double-blind review process). Due to the interdisciplinary nature of the IS discipline (Currie and Galliers 2003), two additional research disciplines were considered: HCI and psychology. HCI has already coined two research streams that concentrate on self-tracking, called personal informatics and lived informatics. Moreover, psychology offers a body of knowledge on human behavior, decision making, or reflection, associated with self-tracking and especially behavioral change. Furthermore, this study follows the examples of other scholars (Bernroider et al. 2013, Sørensen and Landau 2015, Vessey et al. 2002) by using currently top-ranked journals and conference proceedings (AIS 2011, APA 2017, Thomas Reuters 2009, Thomson Reuters 2009, SJR 2015b, a, VHB 2017) to fulfill qualitative requirements. Notably, conference proceedings were included because the first round of literature search in the IS discipline did not produce many hits for self-tracking research, which result is rooted in the novelty of the phenomenon of technologically enabled self-tracking.

Second, as scientific articles are published in different electronic libraries, the next step explains the search and selection of those electronic libraries. The availability of journals and conference proceedings according to the license subscription of the University of Bamberg (more information on http://ezb.uni-regensburg.de) led both the electronic library search and electronic library selection. All in all, prominent electronic libraries were taken into consideration (e.g., AIS Electronic Library, EBSCO, IEEE, TandFonline, Springer Link, Sciencedirect). Additionally, in order to analyze an historical trend, no limitation of the search period was imposed, following Rowe (2012) who

suggests considering larger time periods for phenomena that have not been investigated or reviewed much.

Third, the conceptualization in Section 2.3 (p. 17) led to a number of keywords related to the concept of self-tracking for the literature search. The most apparent originate from a first exploratory study using Google Scholar; they are defined in Subsection 2.3.2 (p. 20):

- "self-tracking;"
- "quantified self;"
- "self-monitoring;"
- "self-experimentation;"
- "self-management;"
- "self-optimization;"
- "personal information system;"
- "self-measurement."

For the keyword search, the keywords were entered in the search field in quotes. To that end, the search concentrated on finding the exact combination of the terms and avoided hits that only fit one part of the hyphenated keywords. Additionally, further deviant spelling was considered: search terms encompassed keywords with and without hyphen and the American and British spelling of "self-optimization." The search within the database included the abstract, title, and keywords. Depending on the platform, sometimes the full text was entailed also.

Fourth, all hits for the keywords were collected in a large Excel sheet (referred to here as the database of the results), including typical meta-data such as author names, publication information, abstract, and keywords. Several thousand articles at hand required a refinement of the search. A quick overview revealed that many articles only mention self-tracking once and focus on other aspects. For this reason, the results were refined according to a specific rule set outlined in Subsection 4.2.1 (p. 73).

The next step describes the literature evaluation of the identified articles with the help of the outlet, electronic library, and keyword search.

### 4.1.4 Literature Evaluation

The analysis and evaluation of the results requires two databases. The first database contains all articles found with the defined parameters (i.e., outlets, electronic library, and keywords). The second database of the results represents a refinement of the first and only includes articles that mainly pays particular attention to self-tracking. For each database of results, a specific type of analysis and evaluation was conducted.

The first analysis offers a descriptive analysis of quantitative aspects of self-tracking research. These aspects provide an overall view of the development and evolvement of self-tracking research. According to methods and goals of bibliometric studies (see Section 3.1, p. 34) descriptive methods create an overview of the development of research on self-tracking, identified with the selected keywords. Following other scholars, such as Cocosila et al. (2009), this study reports the overall research output and the research output per research stream, per publication type, and per keyword.

The second analysis focuses on identifying current topics and issues within IS research on self-tracking. Following the suggestions from Webster and Watson (2002) and vom Brocke et al. (2009), current topics and issues within the research are extracted with a content analysis of research articles. The systematic analysis of the content of articles can be structured with concept mapping. It supports the detection of defined concepts (topics and issues) and establishes a matrix (also called a concept matrix) that relates the identified concepts with each article. Concept mapping contributes to synthesizing results and identifying research gaps. A selection of characteristics of an article served to detect relevant concepts (e.g., the research question and the overall theme of an article define the concept of research themes and interests of an article). Applying a systematic approach, the concept identification is aligned with insights from other scholars, comprising prior literature reviews and models or frameworks. The approach represents a deductive exploration driven by theory. Besides the examples of other literature reviews on the topic (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017), two theoretical models from the self-

tracking domain served as input: the self-tracking stage from Li et al. (2010) and typical IS themes from Sidorova et al. (2008). Both models were chosen due to their prominence and reusability.

On this account, the following characteristics (with specifications) were extracted from each article:

1) The main research themes and interests concerning self-tracking research were captured.
    - The overall IS research theme of an article was assigned in relation to the five main IS themes defined by Sidorova et al. (2008) (for more details, see Appendix 9.4.2, p. 200).
    - The research question of each article was captured.
2) The research results according to the different stages of self-tracking were captured.
    - Research results of an article were captured.
    - The general aim of the article was assigned to one or more stages of self-tracking (following Li et al. (2010); see Subsection 2.3.2, p. 20).
3) Employed concepts from prior literature (e.g., theories, models) were captured.
4) Methodological aspects of research on self-tracking were captured.
    - Employed research method(s) from an article were assigned according to the model from Subsection 3.1.2, p. 37.
    - The sample size of empirical research articles was captured.
5) The context of the articles (see Subsection 3.1.1, p. 35), the level of analysis of the self-tracking activity, and the self-tracking domain were captured.

In combination with such a deductive approach using predefined models, an inductive approach allows establishment of a framework directly from the data. It visualizes research streams within self-tracking research in the IS discipline, with the help of mapping procedures. The results of both analyses (deductive and inductive) provide the necessary information to identify research gaps for further research on self-tracking appliances. They represent the basis for the final step, the derivation of a research agenda, described in the following subsection.

### 4.1.5 Research Agenda

According to Mueller-Bloch and Kranz (2015, p. 4), a research agenda represents “a set of questions for further research” which can be drawn from literature gaps. They define research gaps as a lack of “information that is derived from a literature synthesis and requires further research to be solved” (Mueller-Bloch and Kranz 2015, p. 4).

Research gaps (also called problems) can be classified by five different types (Mueller-Bloch and Kranz 2015, p. 11):

- A methodological conflict that results from homogenic use of research methods;
- Contradictory evidence that originates from conflicting results on a phenomenon;
- A knowledge void in a related field of research, or to explain surprising results;
- An action-knowledge conflict that appears when actual behavior differs from expected behavior;
- Evaluation void results from missing empirical evaluation/validation of research findings and propositions;
- A theoretical conflict that describes the competition of different theories to explain a phenomenon.

As seen in Subsection 4.1.4 (p. 71), the concept mapping from Webster and Watson (2002) and vom Brocke et al. (2009) serves as an instrument to identify research gaps. It easily shows how often a certain concept is employed in a set of articles. This information reveals concepts that are rarely or never used. On this account, the concept mapping presented in Section 4.3 (p. 76) serves as basis for deriving the research agenda and research gaps in Section 4.5 (p. 89).

Before presenting the results of the literature review, the next section describes the database of the results and quality criteria.

## 4.2 Database and Validation

The bibliometric study and the content analysis conducted in this chapter require two different databases. The next subsection explains in detail the data collection, and elaborates on the quality criteria of the literature review at hand.

### 4.2.1 Data Description

The definition of the scope of the literature search described in the previous section (Subsection 4.1.3, p. 70) resulted in a database of 2,096 articles (see Figure 29). Some keywords generated duplicates within the database when an article was found with several keywords, so the database needed refining for further analysis. After deleting these duplicates (250), the database consisted of 1,846 articles (representing on average 2% of all articles published in the selected outlets for all years). Except for the MKWI (Multikonferenz Wirtschaftsinformatik), all proceedings were accessible through electronic libraries such as AIS Electronic Library, Springer Link, or American Psychological Association. In contrast, digitization has not yet affected the discipline of psychology to the same extent as it has IS or HCI, such that conference proceedings are not available electronically.

So, the first database contains all hits found for the selected keywords, electronic libraries, and outlets (see Table 17). For each hit, the following data was stored to an Excel database: ID, search date, outlet name, discipline type, outlet type, database, search keyword, abstract, title, authors, publication year, volume number, issue number, abstract, name of the proceedings, author-chosen keywords.


**Figure 29.** Database Selection and Different Samples of the Literature Review

Overall, the search field encompasses 30 outlets (8 conference proceedings, 22 journals), a time period of 174 years (earliest journal availability from 1844), 11 electronic libraries, and three disciplines. On average, this leads to 60 hits per outlet, without duplicates (minimum 5, maximum 260). The complete overview of the number of hits for the database with and without duplicates is summarized in Table 17.

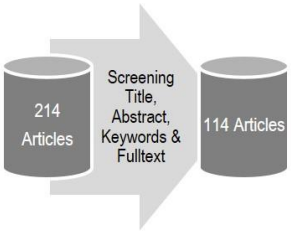
**Table 17.** Sample Overview (Disciplines, Outlets, Electronic Libraries, # of Hits for All Keywords, Covered Search Period, Share of Hits of All Articles of an Outlet)

| Discipline | Outlet Type | Journal/ Conference Proceedings | Electronic Library | # of Hits for All Keywords (incl. Duplicates) | Share of Hits of Total # of Articles | Available Period per Electronic Library | # of Hits for All Keywords (without Duplicates) |
|---|---|---|---|---|---|---|---|
| IS (818/ 707) | Conference (681/ 576) | AMCIS | AIS Electronic Library | 302 | 3% | 1995-2018 | 260 |
| | | ECIS | AIS Electronic Library | 134 | 3% | 2000-2018 | 108 |
| | | ICIS | AIS Electronic Library | 209 | 4% | 1980-2017 | 181 |
| | | MKWI | PDF Proceedings | 14 | 1% | 2008-2018 | 9 |
| | | WI | AIS Electronic Library | 22 | 2% | 1999-2018 | 18 |
| | Journal (137/ 131) | EJIS | Springer Link | 14 | 1% | 1991-2018 | 14 |
| | | ISJ | Wiley Online Library | 9 | 1% | 1990-2018 | 9 |
| | | ISR | pubsonline | 16 | 2% | 1990-2018 | 14 |
| | | JAIS | AIS Electronic Library | 21 | 4% | 2000-2018 | 21 |
| | | JIT | Springer Link | 11 | 1% | 1986-2018 | 11 |
| | | JMIS | Taylor & Francis | 25 | 2% | 1984-2018 | 23 |
| | | JSIS | Sciencedirect | 7 | 1% | 1991-2018 | 7 |
| | | MISQ | AIS Electronic Library | 34 | 2% | 1977-2018 | 32 |
| Psycho (512/ 499) | Journal | AJP | AJP | 189 | 1% | 1844-2018 | 181 |
| | | ARP | Ebsco | 113 | 10% | 1950-2018 | 108 |
| | | AGP | PubMed | 6 | 0% | 1966-2012 | 6 |
| | | JAP | APA | 40 | 0% | 1917-2018 | 40 |
| | | JPSP | APA | 114 | 1% | 1965-2018 | 114 |
| | | Psych Bul | APA | 15 | 0% | 1904-2018 | 15 |
| | | PsychRev | Ebsco | 5 | 0% | 1894-2018 | 5 |
| | | TCS | Sciencedirect | 30 | 1% | 1997-2018 | 30 |
| HCI (766/ 640) | Conference (274/ 227) | CHI | ACM Digital Library | 148 | 1% | 1981-2018 | 118 |
| | | Mobile/BCS-HCI | ACM Digital Library | 24 | 1% | 2005-2018 | 22 |
| | | UbiComp | ACM Digital Library | 102 | 3% | 2001-2018 | 87 |
| | Journal (492/ 413) | CHB | Sciencedirect | 267 | 4% | 1985-2018 | 248 |
| | | HCI | Taylor & Francis | 47 | 10% | 1985-2018 | 24 |
| | | TMC | IEEE Xplore | 5 | 0% | 2002-2018 | 5 |
| | | IJHC | Sciencedirect | 51 | 2% | 1994-2018 | 41 |
| | | PUC | Springer Link | 85 | 6% | 1997-2018 | 62 |

| Discipline | Outlet Type | Journal/ Conference Proceedings | Electronic Library | # of Hits for All Keywords (incl. Duplicates) | Share of Hits of Total # of Articles | Available Period per Electronic Library | # of Hits for All Keywords (without Duplicates) |
|---|---|---|---|---|---|---|---|
| | | PMC | Sciencedirect | 32 | 3% | 2005-2018 | 28 |
| | | TOCHI | ACM Digital Library | 5 | 1% | 1994-2018 | 5 |

(# of Total Hits per Discipline or Outlet Type with Duplicates / without Duplicates)
# = Number

AJP = American Journal of Psychiatry
ACM = Association for Computing Machinery
AMCIS = Americas Conference on Information Systems
ARP = Annual Review of Psychology
BSC-HCI = British Computer Society Human Computer Interaction Conference
CHB = Computers in Human Behaviour
CHI = Conference on Human Factors in Computer Systems
HCI = Human-Computer Interaction (Journal)
IEEE TMC= Institute of Electrical and Electronic Engineers Transactions on Mobile Computing
IJHC = International Journal of Human-Computer Studies (former International Journal of Man-Machine Studies)
JGP = Archive of General Psychiatry
JAP = Journal of Applied Psychology
JPSP = Journal of Personality and Social Psychology
MobileHCI = International Conference on Human-Computer and Interaction with Mobile Devices and Services
PMC = Pervasive and Mobile Computing
PsychBul = Psychological Bulletin
PsychRev = Psychological Review
PUC = Personal and Ubiquitous Computing
TCS = Trends in Cognitive Sciences
TOCHI = Transactions on Human-Computer Interaction
UbiComp = Ubiquitous Computing
WI = Wirtschaftsinformatik (German Information Systems Conference)




**Exclusion Criteria:**

- PhD project presentation (8);
- Workshop/panel descriptions (15);
- Main focus of the paper on other things, e.g., media flow, addiction, goal-setting, social networks, gamification, behavior change systems, city design (30);
- Completely other topic, e.g., sleep quality prediction, remembering with mobile applications, includes personal counseling, 3D printing (30);
- Quantification of something other than private activities, e.g., behavior, cognitive process, communication, economic value (5);
- Literature Reviews (3);
- Video Showcase/Demonstration (2);
- The same content as another paper (2);
- Self-tracking of others/groups (4);
- In Korean (1).

**Figure 30.** Exclusion Criteria for the Final Screening to Obtain the Sample for the Content Analysis (Number of Articles per Criteria in Parenthesis)

As a next step, the first database (Table 17) was refined according to the explanations in Subsection 4.1.3 (p. 70). As Figure 29 shows, the first database with the recorded hits per keyword was filtered in two steps. First, articles that really concentrate on self-tracking are identified by searching for “self-track” and “quantif” in the title, abstract, and keywords captured in the Excel file. This resulted in 196 articles. In the same sense, those articles detected with multiple keywords were also added, representing another 18 articles. Overall, these steps led to a collection of 214 articles selected for the content analysis. On this account, a first screening of the content of the title, abstract, and keywords of these articles resulted in exclusion of 100 articles, based on several criteria. Those exclusion criteria during the screening are shown in Figure 30 (for 65% of the excluded articles, the full text was checked). They encompass PhD project presentations, panel descriptions, or treatments of a completely different topic. As a result, the second database contains 114 articles for the literature evaluation.

The scope of the second database is described in Table 18 that shows the number of articles per discipline, outlet, and electronic library.

**Table 18.** Overview (Disciplines, Outlets, Electronic Libraries, # of Articles)

| Discipline | Outlet Type | Journal/ Conference Proceedings | Electronic Library | # of Articles |
|---|---|---|---|---|
| IS (17) | Conference (17) | AMCIS | AIS Electronic Library | 4 |
| | | ECIS | AIS Electronic Library | 5 |
| | | ICIS | AIS Electronic Library | 7 |
| | | MKWI | PDF Proceedings | 1 |
| HCI (97) | Conference (78) | CHI/CHI EA | ACM Digital Library | 40 |
| | | Mobile/BCS-HCI | ACM Digital Library | 4 |
| | | UbiComp | ACM Digital Library | 34 |
| | Journal (19) | CHB | Sciencedirect | 4 |
| | | HCI | Taylor & Francis | 6 |
| | | IEEE TMC | IEEE Xplore Digital Library | 1 |
| | | IJHC | Sciencedirect | 3 |
| | | PUC | Springer Link | 4 |
| | | TOCHI | ACM Digital Library | 1 |

Before reporting the results for the quantitative and qualitative analyses, the following subsection discusses the validation of the data in order to ensure the quality of the analyses.

### 4.2.2 Quality Criteria for the Content Analysis

The data analysis of the literature review at hand mainly consists of qualitative analysis. The quantitative analysis (the bibliometric study) takes into consideration exclusively objective meta-data and presents the results in a descriptive way. To that end, this section concentrates on ensuring the quality of the content and concept analysis. Following the description in Subsection 3.2.2 (p. 45), the three main quality criteria (objectivity, reliability, and validity) are examined for each phase of the literature review. Overall, in qualitative work, rich descriptions of every aspect of the literature review are key mechanisms for establishing high quality standards.

**Objectivity** is a special concern for qualitative research, as qualitative research greatly depends on decisions or interpretations of the researcher.

> In the data-collection phase, objectivity results in meaningful data for interpretation. On this account, several decisions guided the data selection. One was to select not only one but multiple research disciplines engaged with self-tracking research in order to identify useful articles (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017). Another decision concerned the quality of the selected articles, ending with the choice to only include highly rated journal articles and conference papers for each discipline. Moreover, following prior literature reviews (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017) and another exploratory search on Google Scholar, a list of keywords was determined that led to identifying articles that pay particular attention to self-tracking. Finally, no specific time period was chosen, in order to obtain a more objective result in comparison to prior literature reviews that only focused on a predefined time period.
>
> For the analytics phase, an objectivity approach ensures meaningful data analysis. The data analysis of the qualitative part of the dissertation consists of carving out examined concepts within self-tracking research. As Webster and Watson (2002) posit, the extraction of concepts from literature should be supported with the help of existing frameworks or dimensions. On this account, the IS themes model from Sidorova et al. (2008) and the self-tracking phases from Li et al. (2010) were employed to structure the IS themes and results within self-tracking research. Furthermore, the other characteristics of the analysis (e.g., research methods, see Subsection 4.1.4, p. 71) are also investigated by other literature reviews. So, the decision to investigate these characteristics was not the author's own subjective decision. Subjectivity in reading the full texts of articles and noting how each characteristic is represented still remains, as there was only one round of content analysis.
>
> Finally, maintaining objectivity in the interpretation phase represents a great challenge. On this account, comparisons with other literature reviews were used to interpret the results in a more objective way.

In order to obtain **reliable** results, repeatability is a key interest. It ensures a high level of objectivity and allows updates of the literature review at a later point in time. On this account, the results of the literature review serve as a meaningful knowledge basis for other scholars who orient their research efforts according to the results.

For the data-collection phase, five subsections of this chapter are dedicated to describing the exact scope and decisions made in the context of the literature review (see Subsections 4.1.1 to 4.1.5, pp. 72–69). In order to ensure the completeness of the description, the subsections follow the guidelines from vom Brocke et al. (2009), Fettke (2006), and Webster and Watson (2002). Furthermore, the subsections also incorporate argumentative defenses for any decision made, notably for the exclusion of any articles from the content analysis. On this account, the identification of the articles is fully repeatable.

Especially in the analytics phase, data processing (i.e., the content analysis) represents the main challenge for reliability. It is ensured with a multi-angle analysis that is based on the different information extracted from one article and its presentation in various forms (according to typical IS themes or self-tracking stages). Additionally, extensive documentation of the results supports repeatability.

To ensure reliability in the interpretation phase, comparisons with other literature reviews and the models of Sidorova et al. (2008) and Li et al. (2010) are taken into consideration.

Finally, the last quality criterion concerns **validity** that ensures plausibility, credibility, and trustworthiness.

In the data-collection phase, the selection of the characteristics of an article impact validity strongly. On this account, Subsections 4.1.3 and 4.1.4 (pp. 70–71) include explanations and arguments for the selected characteristics and their fit for the investigation.

For the analytics phase, a reduced version of an inter-rater reliability (see Subsection 3.2.2, p. 45) was investigated. For a reduced database, the analysis of the characteristics was undertaken by two different researchers. The reduced database consists of 7% (8 articles) of the articles in the full database. The comparison reveals that for most aspects there are large overlaps in the findings of the two researchers. Especially for the allocation of IS themes and the self-tracking phases, the results of the content analysis of both researchers match. Some variances concerning the other characteristics can be explained with the missing training of the second researcher.

To ensure validity in the interpretation phase, comparisons with other literature reviews and the models of Sidorova et al. (2008) and Li et al. (2010) are taken into consideration.

The next section describes the results of the data analysis for each characteristic.

## 4.3 Results of the Descriptive and Content Analysis

The following subsections present the results of the literature review in two separate analyses. To begin, a quantitative bibliometric study of the 2,096 articles reveals research efforts on self-tracking per year, discipline, outlet, and keyword. Then, the second, a qualitative analysis, concentrates on the content of articles of a smaller, refined subsample (114 articles) according to the description in Subsection 4.1.3 (p. 70).

### 4.3.1 Bibliometric Study of the Keyword Hits

The following analysis consists of the counted results of the keyword search, based on the first two databases from Figure 29 (p. 73). On the one hand, the first database shows the number of hits for one keyword. The number of articles that represent such a hit amount to 2,096 articles and they include duplicates (as one article can represent a hit for several keywords). On the other hand, the second database eliminates these duplicates and allows a more article-based view. The database without duplicates counts 1,836 articles. Both databases are used to analyze the number of articles and hits published per discipline, type of outlet, and year.

To begin, the data overview from Subsection 4.2.1 (p. 73) shows that for both databases, most of the hits and articles are located within the IS discipline. In more detail, considering the number of articles without duplicates for the outlet type, the results show that there is only a small difference in the numbers of articles per outlet type: 803 for conferences and 1,043 for journals. The large number of identified articles in journals is predominantly biased by the results for the HCI discipline. Isolating the results for the IS discipline reveals far more hits within the conference proceedings than in journals. Figure 31 reveals more details: two-thirds of all identified articles have been published in the proceedings of AMCIS or ICIS, and 15% in ECIS. The remaining 20% can be

allocated to other conference proceedings and all other journals. From the journals, only MISQ stands out, having published 5% of all identified articles.

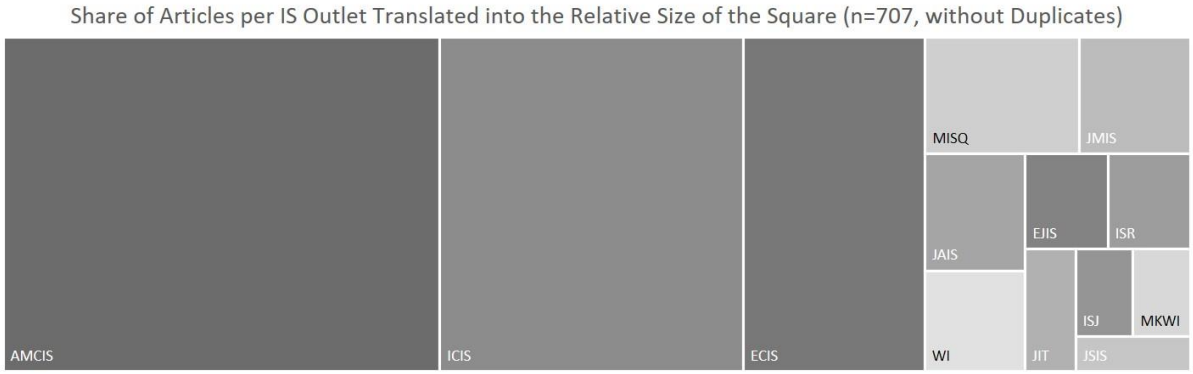



**Figure 31.** Share of Articles (without Duplicates) per Outlet only for the IS Discipline

As a next step, the historical development is considered. Figure 32 shows the absolute number of articles per year that were identified with the selected eight keywords, starting in 1990. Even though the oldest article in the database originates from 1870, no significant development (increase or decrease) can be observed until 1990. For that reason, Figure 32 starts with the number of articles from the year 1990. Moreover, the sum of the selected articles from 1990 to 2018 represents almost 90% of all articles identified with the keywords (without duplicates and for all disciplines). Turning toward the historical development, the figure shows that the number of articles increases notably in 2007 and up to 2016.[20] Another interesting aspect concerns the difference between the number of hits between 2016 and 2017. The difference is quite low (four articles less in 2017 than in 2016). This difference may suggest the start of a certain stability of the number of articles that investigate self-tracking (notably considering that the overall number of articles published per year increases for all articles). Then, closer inspection of the evolution of the articles for each discipline shows that similarities exist for articles from the IS and HCI discipline (see Figure 33 and Figure 60, p. 199). The number of identified articles is quite small until 2007. After a short peak around 2007 and 2008, there is a constant increase in articles on self-tracking that peaks again in 2014 and up to 2016. In contrast, considering the number of identified articles in psychology (1,977), the number of hits per year has more than quintupled and steadily changes every year in the same manner as shown in Figure 59 (p. 199), which only shows 1990 until 2018. From 1870 up to 1976, in most years only one or two articles are recorded. Besides the general increase around 1977, no specific trend can be derived from this development.

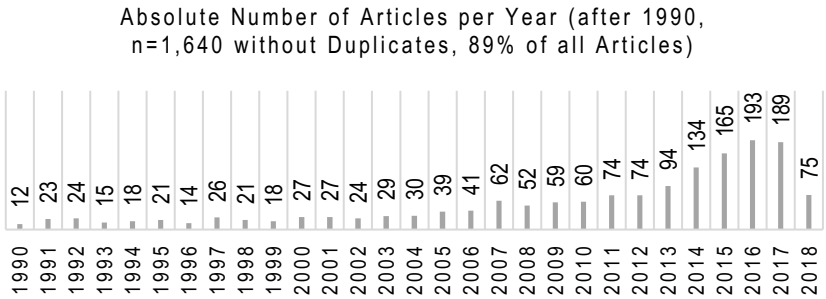



**Figure 32.** Absolute Number of Articles per Year from 1990 on – Without Duplicates

[20] Data collection took place in mid-2018. On this account, the number of articles identified for 2018 must be discarded as they do not represent a full year of publications.

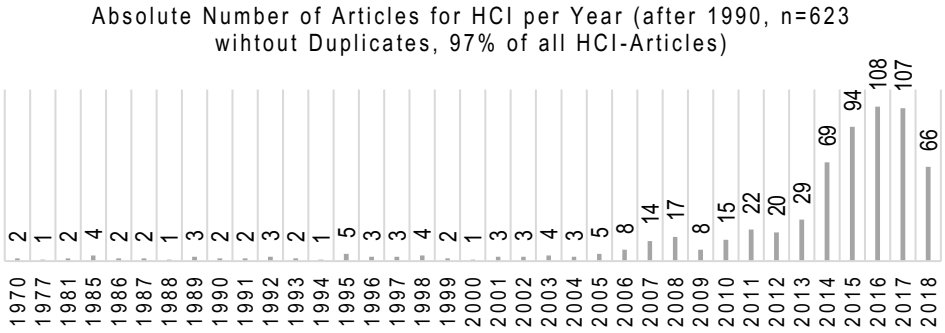



**Figure 33.** Absolute Number of Articles for HCI per Year from 1990 on – Without Duplicates

In this sense, another historical development analysis considers the hits per keyword, i.e., the database including duplicates. The analysis aims at understanding the development for each keyword and helps in drawing conclusions on the relevancy of each keyword. Figure 34 depicts that from 1870 until 1977, principally the keywords “self-management,” “self-measurement,” “self-monitoring,” and “self-experimentation” steadily yielded a small number of hits. In 1977, an increasing number of hits was recorded, especially for the keywords “self-monitoring” and “self-management.” The remaining keywords only show sporadic results. From 2001 on, hits for “self-optimization,” “self-experimentation,” “self-measurement,” and “personal IS” emerge and generate hits at a constantly lower level. In contrast, it is striking that hits for “self-management” and “self-monitoring” strongly increase over the years, notably in 2016. In addition, since 2013, two other keywords (“self-tracking” and “quantified self”) show a similar development. Before 2013, hits for both keywords “self-tracking” and “quantified self” only appeared for the first time in 1989 for “self-tracking” and for “quantified self” in 2009. Since 2013, the hits were rather low and unsteady. Then, considering the historical development for each discipline separately (see Figure 61 until Figure 63, from p. 200-p. 200), the historical development for the IS discipline is quite similar to the HCI discipline. A keyword that generates many hits is “self-monitoring.” followed by “self-management.” However, since 2012, the keywords “self-tracking” and “quantified self” gain increasing importance as well. The remaining keywords generated insignificant hits per keyword. For the IS discipline, a similar development appears. Yet, “self-management” is much more dominant than “self-monitoring.” In addition, “self-tracking” and “quantified self” generate fewer hits in comparison to the HCI discipline. Moreover, “personal IS” and “self-optimization” receive more attention within the IS discipline than in the HCI discipline. In contrast, the results for the hits per keyword strongly differ for psychology: only the keywords “self-monitoring” and “self-management” reveal constant and significant hits (see Figure 61, p. 199).

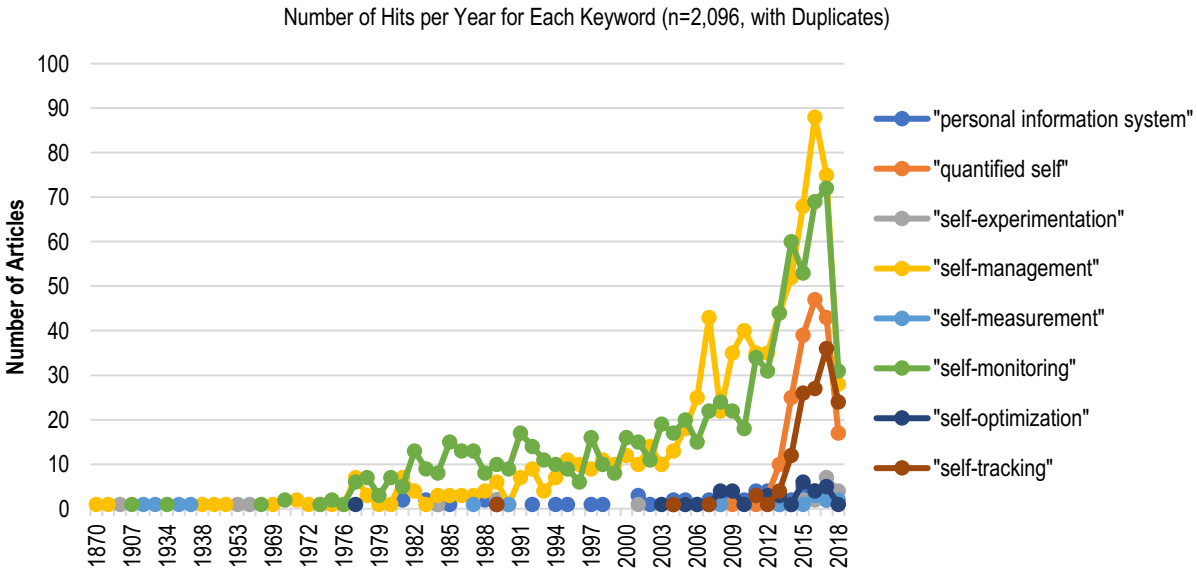



**Figure 34.** Evolution of the Number of Hits per Year for Each Keyword

Overall, the results show that research on self-tracking strongly increased at the beginning of this decade (since 2009). Overall, the results show a stagnating number of articles for 2017 that follows the constant increase during the previous years. This was mostly observed for the IS and HCI discipline. The most productive keywords are “self-monitoring” and “self-management.” Then, the two keywords “self-tracking” and “quantified self” follow in the overall number of hits. Furthermore, the results show that within the IS discipline, the hits mostly concentrate on conference proceedings. Far fewer articles that represent hits for the keywords are published in journals – notably, in comparison to HCI, where most of the identified articles originate from journals (almost twice as many).

Having finalized the first quantified impression of the data from the literature review, the following section examines a selected set of articles with the help of a content analysis.

### 4.3.2 Content and Concept Analysis of Self-Tracking Research

The content analysis focuses on describing and summarizing current research efforts on self-tracking. As already described in Subsection 4.1.4 (p. 71), the research efforts encompass the following characteristics:

1) Addressed IS research themes and interests within self-tracking research;
2) Research results for each stage of self-tracking;
3) Employed concepts from prior literature;
4) Employed research methods, approaches, and the sample sizes;
5) Context of articles, level of analysis of the self-tracking activity, and the self-tracking domain.

Identifying these characteristics in an article requires reading the full text. On this account, the scope of the databases analyzed in the bibliometric study is far too large. As a result, Figure 29 (p. 73) reveals that the database was refined and resulted in 114 articles considered for the content analysis.

(1) Research Themes and Interests

The first characteristic describes the general IS themes addressed by an article. The assessment of IS theme follows the framework of Sidorova et al. (2008), who derive the following typical research themes investigated within the IS discipline (for a detailed description see Appendix 9.4.2, p. 200): IT usage, IT artifact, practices, impact, and capabilities.

Figure 35 depicts all articles that address specific IS research themes in the context of self-tracking. Overall, the majority of the articles pay particular attention to IT usage, the IT artifact, practices, and the impact of IS. In contrast, scholars rather neglect the research theme of capabilities. Furthermore, articles also tend to combine different IS themes such that two IS themes are investigated at the same time. Prominent combinations encompass the following pairs: IT artifact-impact, IT usage-impact, and IT artifact-IT usage.

The largest field of interest, IT usage, encompasses research questioning why and how individuals use self-tracking appliances. Some articles concentrate on appliances that track such functions as sleep tracking, physical activity, brain waves, or moods (Albaghli et al. 2017, Chung, Gorm, et al. 2017, Cordeiro et al. 2015, Dudley and Jones 2018, Eikey and Reddy 2017, Harari et al. 2017, Y. H. Kim et al. 2016, Lunney et al. 2016, Matthews, Murnane, Snyder, et al. 2017, Paluch and Tuzovic 2017, Rapp and Cena 2016, Ravichandran et al. 2017, Rivera-Pelayo et al. 2017, Rooksby et al. 2014, Schneider 2016, Sjöklint et al. 2015, Zhou et al. 2016). Some empirical studies discovered that a larger share of users (as expected) stopped using self-tracking appliances. So, a main interest relies on ensuring long-term usage of such appliances (van Berkel et al. 2015, Harrison et al. 2014). On this account, some articles especially focus on studying barriers to self-tracking (Baumgart 2016, Choe et al. 2014, Epstein et al. 2015, 2016, Harrison et al. 2014, 2015) and continuous-discontinuous behavior (Buchwald et al. 2015, Jarrahi et al. 2018). For example, research consist of interviews with former trackers (Dincelli and Zhou), studies that replace tracking devices (Gross et al. 2017), or individual differences that may explain abandonment and rejection in questionnaires (Baumgart 2017, Baumgart and Wiewiorra 2016, Halttu and Oinas-Kukkonen 2017, Harari et al. 2017, Kupfer 2018, Kupfer, Kehr, et al. 2016, Pfeiffer et al. 2016).

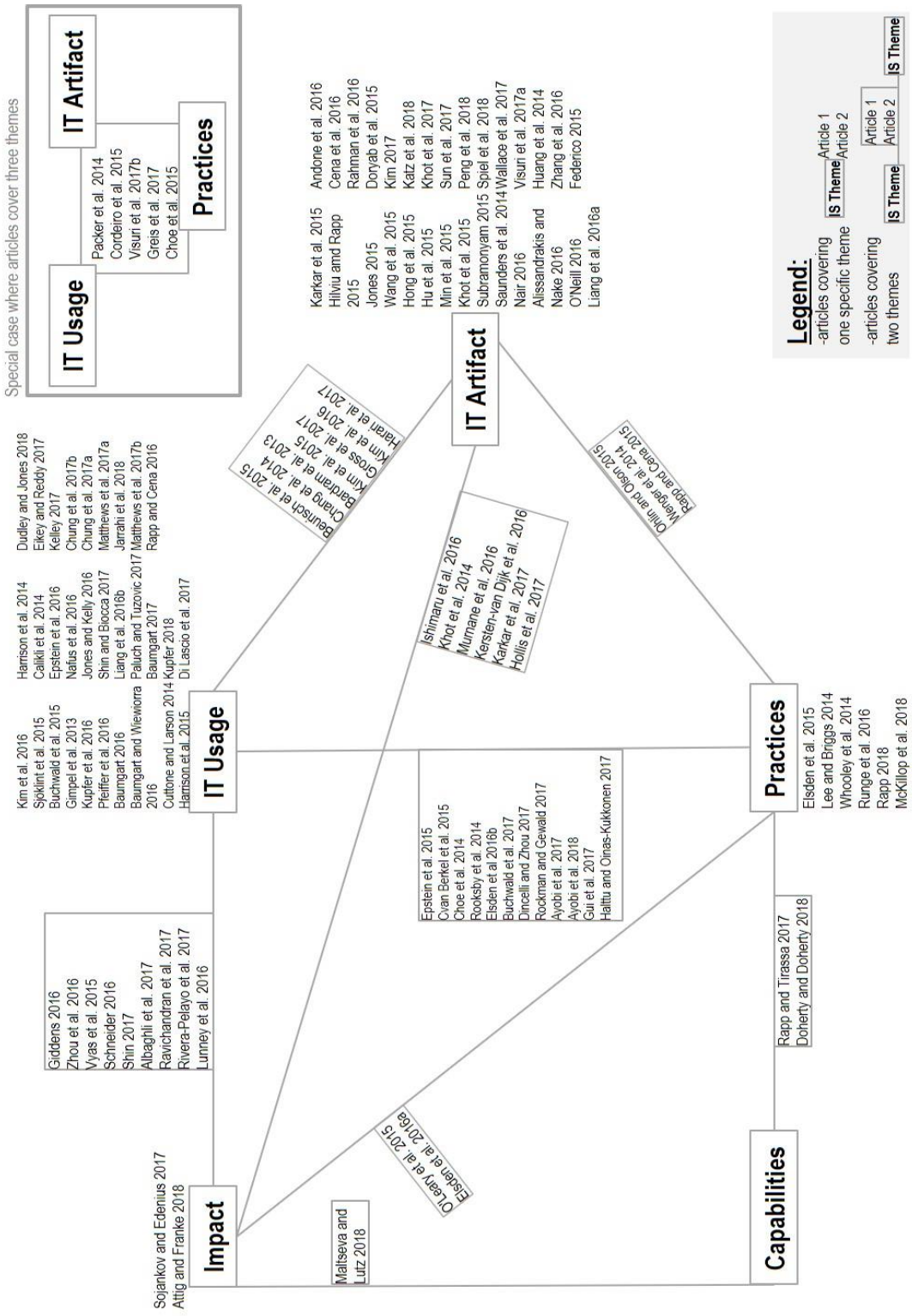



**Figure 35.** Overview on Covered IS Themes by Self-Tracking Research from IS and HCI Amended from Sidorova et al. (2008, p. 479)

The second largest theme rests on the IT artifact: a self-tracking appliance. Scholars are engaged with conceiving and implementing new types of self-tracking appliances and methods, or improving existing ones. A key point resides in the design and understanding of appliances or the selection of metrics and representations of information for the user (Alissandrakis and Nake 2016, Andone et al. 2016, Chang et al. 2014, Choe et al. 2015, Cordeiro et al. 2015, Federico 2015, Hilviu and Rapp 2015, Hong et al. 2015, Huang and DeSanctis 2005, Kersten-van Dijk et al. 2017, Khot et al. 2017, Nair 2016, O'Neill 2016, Peng et al. 2018, Rapp and Cena 2016, Subramonyam 2015, Wallace et al. 2017). Research seeks to simplify visualizations, find completely new ways of

visualizing (tangible information or projections), or identify missing visualizations. Another stream of research focuses on improving technical aspects or algorithms of self-tracking devices, which improve the overall user experience or accuracy (Alissandrakis and Nake 2016, Doryab et al. 2014, Greis et al. 2017, Hu et al. 2015, Ishimaru et al. 2016, Jones 2015, Lee et al. 2015, Liang et al. 2016, Rahman et al. 2017, Visuri et al. 2017). Such approaches encompass data integration, correlation detection, or increasing security functions.

Insights concerning practices in the context of self-tracking concentrate on understanding exactly how and why individuals engage in self-tracking that is not necessarily supported with IS appliances (Ayobi et al. 2017, 2018, Choe et al. 2014, Cordeiro et al. 2015, Doherty and Doherty 2018, Elsden, Durrant, et al. 2016, Elsden, Kirk, et al. 2016, Gui et al. 2017, McKillop et al. 2018, Ohlin and Olsson 2015, Rapp 2018, Runge et al. 2016, Wenger et al. 2014, Whooley et al. 2014). Scholars study needs and habits, which relate to technologically supported or non-supported activities (e.g., food journaling with photos, understanding of metrics and numbers in games, object interaction, bullet journaling, quantified selfers). Obviously, especially activities concerned with health, fitness, and well-being represent the dominant central areas of interest. Considering the pure activity of self-tracking (without an IS relation) helps to derive design propositions or frameworks for system designers.

Research on the impact of self-tracking frequently investigates the potential for behavioral change, one main ambition of self-trackers who want to increase physical activity or their well-being (Attig and Franke 2018, Giddens et al., Lunney et al. 2016, Murnane et al. 2016, Rivera-Pelayo et al. 2017, Zhou et al. 2016). Kersten-van Dijk et al. (2017) identify a lack of sufficient objective evidence that self-tracking leads to behavioral change. They reveal that most research questions pay particular attention to understanding user learnings and interpretations of different feedback types in the course of interviews or small field trials, but the real impact remains unclear (Albaghli et al. 2017, Hollis et al. 2017, Kersten-van Dijk et al. 2017). In contrast to the impact of self-tracking, other research investigates the impact of certain aspects of self-tracking. A prominent example consists of data-sharing that is often associated with self-tracking. Scholars ascertain the effect of privacy concerns or personality on self-tracking data sharing (Maltseva and Lutz 2018, Shin and Biocca 2017). Furthermore, another particular aspect concerns the impact of novel technologies that enable renewed functionalities of self-tracking appliances, such as eye tracking for word counting or emotional forecasting for depression management (Hollis et al. 2017, Ishimaru et al. 2016).

Articles concerned with capabilities in the context of self-tracking focus on personality traits, the self-understanding of an individual, and states of experience (Doherty and Doherty 2018, Maltseva and Lutz 2018, Rapp and Tirassa 2017). Scholars seem to neglect these IS themes, only considering them in combination with other IS themes.

To take another perspective on the current status quo of self-tracking research, the research results of articles are discussed next.

(2) Research Results per Self-Tracking Stage

The stage model from Li et al. (2010) enhances the structure of the presentation of research results on self-tracking. It ensures a meaningful categorization and a simple but consistent overview of research results. The stage model consists of the five stages of self-tracking: preparation, collection, integration, reflection, and action (for more information see Subsection 2.3.2, p. 20).

The first step was to solely consider the research results of articles from the IS discipline and allocate them to the stage model. Figure 36 illustrates that pure IS research is rather sparse, encompassing 17 articles. In addition, Figure 36 depicts that sporadically, articles can be allocated to one stage. Most of the articles treat a combination of different stages, e.g., the reflection and action stages (see the text fields in Figure 36 above the brackets referring to more than one stage). Overall, articles mainly consider the whole self-tracking stage and rather neglect the collection, integration, and action stages.

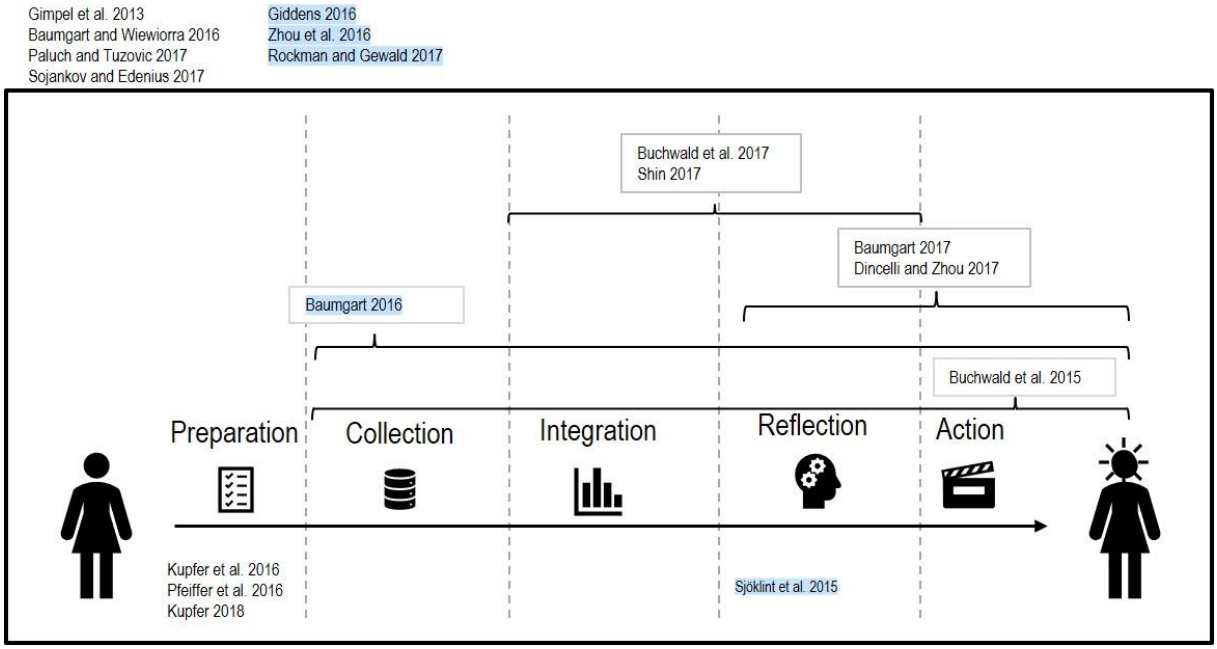



**Figure 36.** Overview on IS Research on the Different Self-Tracking Stages Amended from Li et al. (2010, p. 561) – Citations Marked in Blue also Investigate Barriers of Self-Tracking Usage

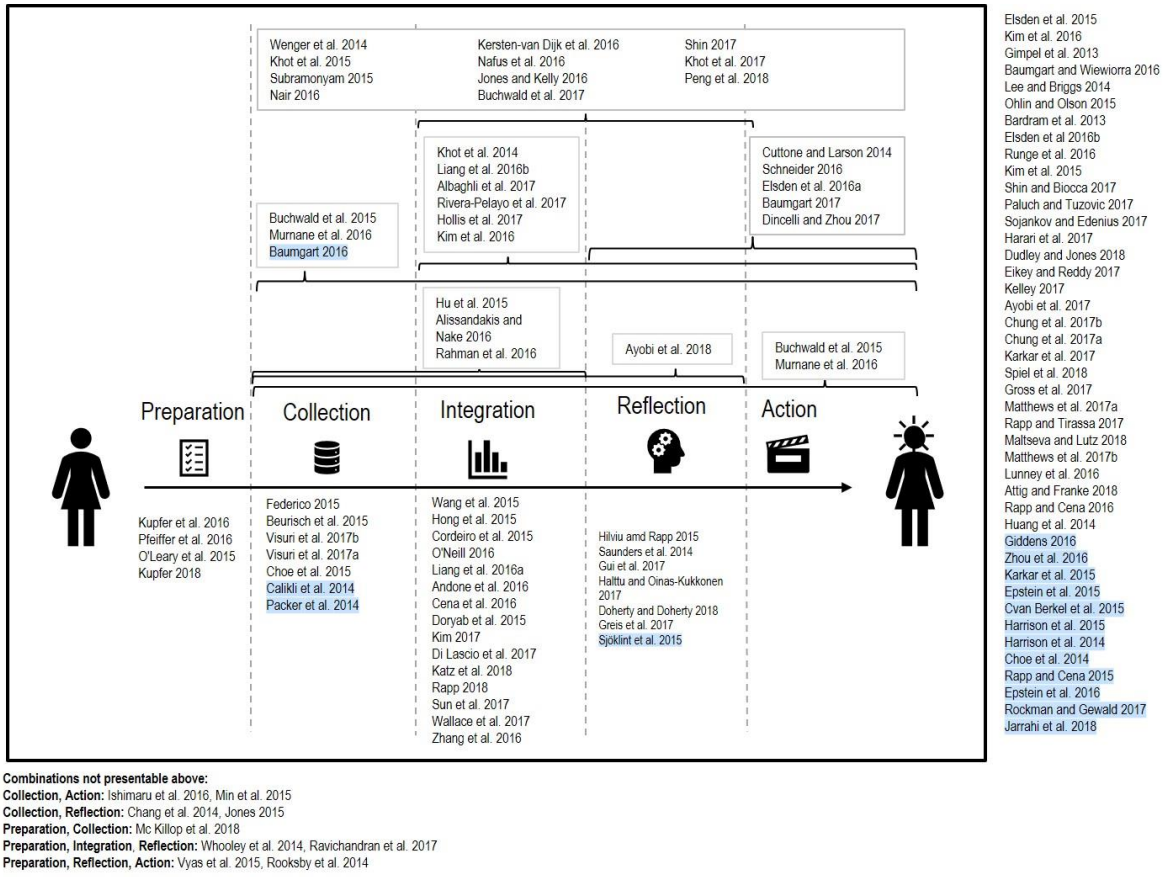



**Figure 37.** Overview on IS & HCI Research on the Different Self-Tracking Stages Amended from Li et al. (2010, p. 561) – Citations Marked in Blue also Investigate Barriers of Self-Tracking Usage

The next step included the allocation of HCI[21] articles to the stage model, resulting in a completely different picture. Figure 37 portrays that there is much more research for stages neglected by IS research: the collection and the integration stages. The same applies to combinations of different

[21] According to the rule set described in Subsection 4.1.4 (p. 71), articles from psychology did not qualify for the content analysis.

stages (e.g., integration and reflection). Notably, a large number of articles concentrates on the complete process of self-tracking, including barriers.

In more detail, research results in the stage of preparation consist of understanding the decisions to engage in self-tracking with appliances or not (Kupfer 2018, Kupfer, Kehr, et al. 2016, O'Leary et al. 2015, Pfeiffer et al. 2016) and the selection of a self-tracking measure. The decision to continue or discontinue the usage of self-tracking appliances takes into consideration a plethora of constructs from the IS usage-behavior literature (e.g., perceived ease of use, attitudes). Another focus is on motivations for self-tracking (Kupfer, Kehr, et al. 2016, Rooksby et al. 2014) or the integration of self-tracking into an individual's life (Vyas et al. 2015, Whooley et al. 2014).

The stage of collection describes the generation and storage of data. Research results on the collection stage aim at improving data collection on different levels. For example, Visuri et al. (2017) identify five distinct user groups, each with a specific data-collection behavior derived from the interactions of individuals with a tracking device. On this account, they improve algorithms of reminders that help individuals to avoid data gaps by increasing device usage. In contrast, Federico et al. (2015) try to stimulate data collection by inventing a new form of user interface (tangible user interface for mood tracking), which is supposed to ease data entry. On this account, more tracking data is generated with completely new interfaces. Moreover, another research direction yields research results on how the data-collection stage impacts the other stages (integration, reflection, action). Missing data or useless data restricts data visualization and, therefore, reflection and action, so they negatively influence the succeeding stages (Calikli et al. 2014, Chang et al. 2014, Jones 2015). To overcome this challenge, Packer et al. (2014) developed a prototype that allows annotations, corrections, and comparisons, which was really appreciated during a validation phase with study participants. In addition, other approaches underline the necessity of increasing awareness of the tracking activity itself. For this reason, scholars emphasize that automatic tracking should be accompanied by analogue tracking. Empirical results from a small field study confirm the relevancy of this suggestion (Choe et al. 2015). Furthermore, the concept of including gamification elements into self-tracking systems is also a possibility that seems promising (Murnane et al. 2016).

The stage of integration concentrates on the preparation of data that relates to making sense of data (e.g., visualization). This stage is a prerequisite for the succeeding stage of reflection, where an individual reflects upon the collected and visualized data. Notably, HCI research brings forth various prototypes and mockups that users evaluate (Albaghli et al. 2017, Alissandrakis and Nake 2016, Cordeiro et al. 2015, Khot et al. 2015, 2017, Kim 2017, Liang et al. 2016, Murnane et al. 2016, Nafus et al. 2016, O'Neill 2016, Peng et al. 2018, Sun et al. 2017, Wallace et al. 2017, Wenger et al. 2014, Zhang et al. 2016). For example, rather innovative prototypes include chocolate, drinks, or avatars to visualize tracked information. Scholars expect users to better understand their tracking data with these new approaches. After empirical evaluation, research results reveal that every new type of visualization requires a certain time for users to familiarize with the visualization before being able to validate its impact. Moreover, facing large datasets that self-tracking appliances generate, research on the integration stage focuses on conceiving, implementing, and testing algorithms or pattern detection that makes sense of the large datasets (Alissandrakis and Nake 2016, Andone et al. 2016, Doryab et al. 2014, Hu et al. 2015, Lee et al. 2015, Liang et al. 2016, Rahman et al. 2017, Rivera-Pelayo et al. 2017). Besides typical activity tracking data (e.g., steps per day), forecasting feelings is also of interest. Feelings are often associated with success of self-tracking activities or the motivation for self-tracking. As a result, a self-tracking device can automatically react to mood changes and support preventative actions that a bad mood would inhibit. So, the user may skip the self-tracking stage of reflection and change behavior directly (Hollis et al. 2017). Another research result also concerns the role of cognitions in the stage of integration. On the one hand, it touches learning about the actual behavior in comparison to the idea of a behavior (Baumgart 2016). On the other hand, it treats how individuals relate to collected data, including investigation of the influence of other aspects on data collection, for example, the construct of trust (Buchwald et al. 2015, p. 201). Finally, the research results in the stage of integration cover specific integration methods, such as filtering, that help the user to discover his or her own data. This positively influences self-induced exploration and leads to positive aspects such as surprise, utility, and valence (Buchwald et al. 2015, Jones and Kelly 2016). In the same sense, positive aspirations, such as curiosity and self-improvement (Whooley et al. 2014), appear to positively shape the integration stage. In the short term, positive aspirations

initiate the user to exploring and being interested in his or her data. In the long term, such aspirations are also relevant for continuous usage of self-tracking appliances or methods.

Concerning the stage of reflection, it is vital to understand its relatedness to the previous stages. Complete and conclusive data gathered in the stage of collection and visualized in the stage of integration helps the user to draw conclusions. Concerning the reflection, research results show that a self-tracking user needs some time and knowledge to reflect on self-tracking data. Furthermore, reflection is biased by implicit aspects (Ayobi et al. 2017, Ravichandran et al. 2017). For example, paying particular attention to wrong aspects, individuals might draw incorrect conclusions and try to change a behavior that is not exactly easy to modify (e.g., sleep stage), whereas they could change another aspect more easily (e.g., go to bed earlier). Other research results concern the critical reflection of the underlying ontology of self-tracking applications: not everyone aspires to improving one's own fitness level, losing weight, or collecting data all day long. However, most IS applications concentrate on those assumptions (Matthews, Murnane, Snyder, et al. 2017, Spiel et al. 2018). For example, anorexic patients need support in a completely different direction than most nutrition applications yield (i.e., losing weight). Furthermore, research results show that the stage of reflection is notably characterized by comparisons. On this account, individuals compare expected behavior and actual behavior to draw conclusions within the stage of reflection. Two main approaches are employed in self-tracking research: goal-setting (Baumgart 2016, Saunders 2014, Sjöklint et al. 2015) or social comparison/influence (Chang et al. 2014, Gui et al. 2017, Vyas et al. 2015). Overall, in most cases, a general tendency to change a behavior and a personal orientation toward the future are essential aspects to initiate reflection (Doherty and Doherty 2018, Subramonyam 2015).

It is striking that there is no article that unanimously focuses on the action stage. Yet, several articles consider the effectiveness of self-tracking in combination with other stages (Albaghli et al. 2017, Cuttone and Larsen 2014, Hollis et al. 2017, Ishimaru et al. 2016, Min et al. 2015, Rivera-Pelayo et al. 2017, Schneider 2016, Vyas et al. 2015). One example investigates how individuals can improve own physical skills with the help of self-tracking. For example, they learn to more precisely estimate their daily step count at the beginning of a day without looking on a self-tracking device.

Finally, articles that promote research results in all stages together mostly consist of frameworks that take a more holistic position on the self-tracking phenomenon. Such frameworks encompass user typology, motivations, or stages of self-tracking (van Berkel et al. 2015, Epstein et al. 2015, Gimpel et al. 2013, Jarrahi et al. 2018, Li et al. 2010). In particular, research results reveal barriers and problems that appear in different stages of self-tracking. Selected research results provide insights into the relationship between the self-tracking device and its user (Epstein et al. 2016, Harrison et al. 2015, D. J. Kim et al. 2016) or compare manual and analogue tracking with automatic tracking (Eikey and Reddy 2017, Elsden, Durrant, et al. 2016). Especially IS research results illuminate the understanding of usage behavior concerning all stages of self-tracking. The results consist of explanatory models and the identification of aspects that impact self-tracking usage (Bardram et al. 2013, Baumgart and Wiewiorra 2016, Chung, Gorm, et al. 2017, Lunney et al. 2016, Rapp and Cena 2016, Shin and Biocca 2017, Zhou et al. 2016).

The next characteristics concentrate on investigating the cumulative tradition within self-tracking research. To that end, the employed prior concepts and insights within self-tracking articles are presented.

(3) Theoretical Background per IS Theme

Summarizing the concepts and insights employed in the theoretical background of articles provides another perspective on self-tracking research. Over 20% of all articles did not dedicate an own-article section to a theoretical background. These articles originate almost exclusively from HCI conferences (UbiComp and HCI). On this account, a cumulative tradition is questionable when it appears ineffective because it remains unknown whether the articles contribute to any prior work or incorporate previous research. The remaining 80% of all articles that include a theoretical background section are listed in Table 19. In order to structure the articles in a useful way, each article per theoretical background concept is allocated to an IS theme derived from Sidorova et al. (2008). This ensures an inductive way to establish a meaningful structure for the large number of articles for selected concepts (e.g., self-tracking, disease, or behavioral change). An article often builds upon multiple theoretical concepts, some articles listed multiple times in the columns of a

row of Table 19. For example, on one hand, Ayobi et al. (2018) study how individuals typically track their life with analogue bullet journals.[22] On the other hand, Ayobi et al. (2018) also study how a specific technology (Instagram) supports such bullet journalism. On this account, IS usage and practices are concerned with such an article.

Eleven main categories were identified that aggregate concepts often employed within the 114 articles: self-tracking, the self, diseases, goals, behavioral change, psychology, user behavior, computer technology, privacy, social aspects, others. The following table depicts each concept identified within articles per IS theme in one row. For each concept and IS theme, the allocated articles are provided as well.

Overall, Table 19 shows that within theoretical background sections that describe prior research, capabilities are neglected. Only two concepts from the prior literature that relate to capabilities are covered: the self and behavioral change. Additionally, compared to all IS themes, the themes of the IT artifact and practice are notably neglected as well. In more detail, articles concerned with the IT artifact do not consider prior literature on goals, privacy, and social aspects. What stands out is that articles on practices do not consider prior IS literature on usage behavior, even though this is one major research theme (IT Usage) within self-tracking research.

**Table 19.** Overview on Research Themes (Mapping of IS Themes and Theoretical Background of Articles)

| Meta-Theme/ Theory | Concepts and Articles Related to… | | | | |
|---|---|---|---|---|---|
| | **IT Usage (in total 63 articles)** | **IT Artifact (in total 50 articles)** | **Practice (in total 30 article)** | **Impact (in total 20 articles)** | **Capabilities (in total 3 articles)** |
| Self-tracking | self-tracking, quantified self, personal informatics | | | | |
| | (Ayobi et al. 2017, 2018, Buchwald et al. 2015, Choe et al. 2014, Chung, Gorm, et al. 2017, Cuttone and Larsen 2014, Gimpel et al. 2013, Greis et al. 2017, Gross et al. 2017, Jarrahi et al. 2018, Kelley et al. 2017, Kupfer 2018, Matthews, Murnane and Snyder 2017, Rapp and Cena 2016, Rockmann and Gewald 2017, Rooksby et al. 2014, Sjöklint et al. 2015) | (Andone et al. 2016, Doryab et al. 2014, Greis et al. 2017, Gross et al. 2017, Hollis et al. 2017, Karkar et al. 2015, Katz et al. 2018, Kersten-van Dijk et al. 2017, Nair 2016, Saunders 2014, Sun et al. 2017) | (Ayobi et al. 2017, 2018, Choe et al. 2014, Greis et al. 2017, McKillop et al. 2018, Rapp 2018, Rockmann and Gewald 2017, Rooksby et al. 2014, Whooley et al. 2014) | (Attig and Franke 2018, Hollis et al. 2017, Karkar et al. 2017, Kersten-van Dijk et al. 2017) | None |
| The Self | self-control, self-reflection, self-monitoring, self-observation and self-care | self-experimental, self-monitoring | the self, self-monitoring | self-quantification, self-observation, self-determination, self-monitoring | self-experimental, self-quantification |
| | (Ayobi et al. 2017, 2018, Baumgart and Wiewiorra 2016, Cena et al. 2016, Choe et al. 2014, 2015, Cuttone and Larsen 2014, Paluch and Tuzovic 2017, Zhou et al. 2016) | (Choe et al. 2015, Karkar et al. 2015, 2017, Y. H. Kim et al. 2016) | (Ayobi et al. 2017, 2018, Choe et al. 2014, 2015, Rapp and Tirassa 2017) | (Attig and Franke 2018, Karkar et al. 2017, Maltseva and Lutz 2018, Zhou et al. 2016) | (Maltseva and Lutz 2018, Rapp and Tirassa 2017) |
| Diseases | eating disorder, multiple sclerosis, bipolar disorder, health benefits | diabetes, irritable bowel syndrome, well-being | multiple sclerosis, health, endometriosis, disease characterization | irritable bowel syndrome, well-being | None |
| | (Ayobi et al. 2017, Chung, Agapie, et al. 2017, Eikey and Reddy 2017, Lunney et al. 2016, Matthews, Murnane and Snyder 2017, Matthews, Murnane, Snyder, et al. 2017, Paluch and Tuzovic 2017, Rockmann and Gewald 2017, Shin 2017) | (Doryab et al. 2014, Hollis et al. 2017, Karkar et al. 2017, Katz et al. 2018, Spiel et al. 2018) | (Ayobi et al. 2017, McKillop et al. 2018, Rockmann and Gewald 2017) | (Hollis et al. 2017, Karkar et al. 2017, Lunney et al. 2016, Shin and Biocca 2017) | |
| Goals | goal setting, reaching, achieving | None | goal setting, reaching, achieving | goal-setting | None |
| | (Epstein et al. 2015, Rockmann and Gewald 2017, Sjöklint et al. 2015, Zhou et al. 2016) | | (Epstein et al. 2015, Rockmann and Gewald 2017) | (Zhou et al. 2016) | |
| Behavior Change | persuasiveness/persuasive systems, feedback, transtheoretical model | persuasiveness/persuasive systems, feedback, transtheoretical model, intervention | persuasiveness/persuasive systems, experience, possession, change | feedback | experience |
| | (Chang et al. 2014, Epstein et al. 2015, Halttu and Oinas-Kukkonen 2017, Y. H. Kim et al. 2016, Rockmann and Gewald 2017) | (Chang et al. 2014, Hu et al. 2015, Huang et al. 2014, Kersten-van Dijk et | (Doherty and Doherty 2018, Epstein et al. 2015, Halttu and Oinas-Kukkonen 2017, | (Kersten-van Dijk et al. 2016) | (Doherty and Doherty 2018) |

[22] This represents an analogue way of "tracking, organizing, and planning" (Ayobi et al. 2018, p. 3). Bullet journalists use notebooks for organizing their thoughts or to-do's in the form of lists, short sentences, or drawings.

| Meta-Theme/ Theory | Concepts and Articles Related to… | | | | |
|---|---|---|---|---|---|
| | IT Usage (in total 63 articles) | IT Artifact (in total 50 articles) | Practice (in total 30 article) | Impact (in total 20 articles) | Capabilities (in total 3 articles) |
| | | al. 2016, Y. H. Kim et al. 2016, Saunders 2014) | Rockmann and Gewald 2017) | | |
| Psycho-logy | willpower, anchoring, habit, status quo bias, motivation, attitude, cognitive-dissonance, affordance, reflection, expectation-confirmation theory, curiosity | theory of mind, positive psychology, affordances, cognitive process dimension, motivation, emotions, memory | curiosity, affordance, reflection, memory | reflection, emotion, memory | None |
| | (Baumgart 2016, 2017, Buchwald et al. 2015, Epstein et al. 2015, Gimpel et al. 2013, Halttu and Oinas-Kukkonen 2017, Jarrahi et al. 2018, Kupfer 2018, Kupfer, Kehr, et al. 2016, Rivera-Pelayo et al. 2017, Shin and Biocca 2017, Sjöklint et al. 2015) | (Hilviu and Rapp 2015, Hollis et al. 2017, Huang et al. 2014, Peng et al. 2018, Rapp and Cena 2015, Sun et al. 2017) | (Elsden, Durrant, et al. 2016, Epstein et al. 2015, Halttu and Oinas-Kukkonen 2017, Rapp and Cena 2015, Rockmann and Gewald 2017) | (Hollis et al. 2017, Rivera-Pelayo et al. 2017) | |
| Usage Be-havior | continuous and discontinuous intention, acceptance, adoption, perceived ease of use, use | discontinuance | None | discontinuance, technology acceptance, adoption, perceived ease of use | None |
| | (Buchwald et al. 2015, Epstein et al. 2016, Kupfer 2018, Lunney et al. 2016, Matthews, Murnane, Snyder, et al. 2017, Pfeiffer et al. 2016, Shin and Biocca 2017) | (Kersten-van Dijk et al. 2016) | | (Kersten-van Dijk et al. 2016, Lunney et al. 2016) | |
| Com-puter Tech-nology | gamification, user experience, lifelogging, digital possession, health/sleep/food/mood/mental health apps/technologies, machine learning | Eye tracking, automatic data capture, productivity monitoring, data interaction, visualization, biofeedback, narrative systems, design of trackers, lifelogging, reflective systems, machine learning | post phenomenology, accountability, resource use, performance expectancy, Gamification, World of Warcraft, lifelogging, digital possession, machine learning | eye tracking, lived informatics, sleep/mood tracking technology, lifelogging, reflective systems | None |
| | (Bardram et al. 2013, Chung, Agapie, et al. 2017, Chung, Gorm, et al. 2017, Eikey and Reddy 2017, Elsden, Durrant, et al. 2016, Kelley et al. 2017, D. J. Kim et al. 2016, Y. H. Kim et al. 2016, Matthews, Murnane, Snyder, et al. 2017, Ravichandran et al. 2017, Rivera-Pelayo et al. 2017, Rockmann and Gewald 2017, Visuri et al. 2017, Zhou et al. 2016) | (Hollis et al. 2017, Ishimaru et al. 2016, Katz et al. 2018, Khot et al. 2017, Y. H. Kim et al. 2016, Peng et al. 2018, Spiel et al. 2018, Sun et al. 2017, Visuri et al. 2017, Zhang et al. 2016) | (Elsden, Durrant, et al. 2016, Elsden, Kirk, et al. 2016, Elsden, Nissen, et al. 2016, Ohlin and Olsson 2015, O'Leary et al. 2015, Rapp 2018, Rockmann and Gewald 2017, Runge et al. 2016, Visuri et al. 2017) | (Elsden, Nissen, et al. 2016, Hollis et al. 2017, Ishimaru et al. 2016, Ravichandran et al. 2017, Rivera-Pelayo et al. 2017, Visuri et al. 2017) | |
| Privacy | privacy calculus, self-disclosure | None | privacy calculus | privacy, self-disclosure | None |
| | (Buchwald et al. 2017, Dincelli and Zhou, Kelley et al. 2017, Shin and Biocca 2017) | | (Buchwald et al. 2017, Dincelli and Zhou) | (Maltseva and Lutz 2018, Shin and Biocca 2017) | |
| Social Aspects | social influence, online communities, social cognitive theory, sharing, communication | None | social influence | social cognitive theory | None |
| | (Buchwald et al. 2015, Chung, Agapie, et al. 2017, Gimpel et al. 2013, Gui et al. 2017, Kelley et al. 2017, Zhou et al. 2016) | | (Gui et al. 2017) | (Zhou et al. 2016) | |
| Other | employee identity, willingness to pay, analogue tracking, information boundary theory, materiality, critical design, interruptibility | perceptual learning, food, single case design, materiality, critical design | journaling, interruptibility | employee identity, information boundary theory, single case design, gamification | None |
| | (Ayobi et al. 2018, Baumgart and Wiewiorra 2016, Cordeiro et al. 2015, Elsden, Durrant, et al. 2016, Giddens et al., D. J. Kim et al. 2016, Liang et al. 2016, Shin 2017, Visuri et al. 2017) | (Gross et al. 2017, Karkar et al. 2017, Khot et al. 2017, Kim 2017, Visuri et al. 2017) | (Ayobi et al. 2018, Cordeiro et al. 2015, Elsden, Durrant, et al. 2016, Visuri et al. 2017) | (Attig and Franke 2018, Giddens et al., Karkar et al. 2017, Shin and Biocca 2017) | |

Following this additional information about the cumulative tradition within self-tracking, the next characteristic pays particular attention to research methods, research approaches, and the scope of samples/databases of self-tracking research.

(4) Employed Research Methods, Research Approach, and Sample Sizes

Table 20 summarizes the three characteristics (research method, research approach, and sample size) to give an overview of methodological aspects of research on self-tracking. In order to structure the articles in a useful way, the results for the characteristics are allocated to an IS theme derived from Sidorova et al. (2008).

To start with the IS theme of IT usage, Table 20 shows that non-empirical research is mostly undertaken. Scholars develop frameworks, models, or prototypes that are often validated but with small sample sizes and biased sample compositions, e.g., convenience samples, single-person samples. Furthermore, scholars also employ field studies, interviews, and surveys. Most of their insights are of a qualitative nature, or a combination of qualitative and quantitative findings. The mean sample size of such empirical investigations amounts to 100 participants in the sample of an article.

Second, research on IT artifacts mainly focuses on conceptual work (i.e., developing algorithms, prototypes, and frameworks) that was validated predominantly with interviews. Other articles concentrate on validating previously developed prototypes in field studies or experiments. The sample sizes are generally smaller, which leads to a low mean sample size of 58 participants per article. In this IS theme category exists the only essay in the database.[23]

Third, the study of practices is strongly shaped by qualitative methods with little quantitative work. Such a research approach actually fits the investigations of research questions that try to understand human behavior in complex and unique situations. On this account, interviews, ethnographies, and field experiments or studies are applied. Moreover, scholars develop frameworks, prototypes, and algorithms that are also often tested directly in a real-world setting.

Fourth, insights on the impact of self-tracking are generated with both qualitative and quantitative approaches. Sample sizes are generally higher than for IT artifacts and practices, and on average consist of 100 participants per article. A plethora of research methods helps to gather insights on the effectiveness of self-tracking usage: interviews, conceptual work with validation techniques, field studies and experiments, surveys, and case studies.

Finally, only a little work focuses on capabilities. It encompasses conceptual work accompanied by validation through surveys. Most work pays particular attention to qualitative insights and only one study (Maltseva and Lutz 2018) had an empirical validation by survey with a large sample of 410 participants.

Overall, especially HCI research produces qualitative empirical insights from interviews or lab/field studies, whereas IS research slowly concentrates on generating quantitative larger-scale empirical insights. HCI research is characterized by the fact that it also includes the development of rather unusual but innovative prototypes. One example is a tea-preparation app with tracking features (Kim 2017) or a visualization means for physical self-tracking activity with the help of a 3D printer filled with chocolate ink (Khot et al. 2014, 2015, 2017).

**Table 20.** Overview on Research Methods, Approaches, and Sample Sizes per IS Theme

| Characteristics | Instances of the characteristics related to… | | | | |
|---|---|---|---|---|---|
| | IT Usage (63 articles) | IT Artifact (50 articles) | Practice (30 article) | Impact (20 articles) | Capabilities (3 articles) |
| Research method | -Conceptual (Frameworks, Models, Prototypes) + Validation (Field Experiments, Interviews, Surveys, Field Studies, Focus Groups)<br>-Field Study<br>-Ethnography<br>-Interviews<br>-Survey<br>-Survey, Interview<br>-Case Study<br>-Field/Lab Experiment<br>-Construct development | -Conceptual (Frameworks, Algorithms, Prototypes) + Validation (Field/Lab Experiments, Interviews, Surveys)<br>-Field experiment/ Study<br>-Essay | -Conceptual (Frameworks, Algorithms, Prototypes) + Validation (Field/Lab Experiments, Interviews, Surveys)<br>-Interviews<br>-Field Study<br>-Field Experiment<br>-Ethnography | -Conceptual (Frameworks, Algorithms, Prototypes, Model) + Validation (Field/Lab Experiments, Interviews, Survey)<br>-Field /Lab Experiment<br>-Field Study<br>-Case Study<br>-Survey<br>-Interviews | -Conceptual (Framework, Guideline, Model) + Validation (Survey) |
| Research approach | -Qualitative<br>-Qualitative & Quantitative<br>-Quantitative | -Qualitative<br>-Qualitative & Quantitative | -Qualitative<br>-Qualitative & Quantitative | -Qualitative<br>-Qualitative & Quantitative | -Qualitative<br>-Qualitative & Quantitative |

[23] Doherty and Doherty (2018) take a critical perspective on the so-called construal of experiences with self-tracking technologies, elaborating on how the society's' understanding and employment of such technologies shape the meaning of the technology.

| Characteristics | Instances of the characteristics related to... | | | | |
|---|---|---|---|---|---|
| | IT Usage (63 articles) | IT Artifact (50 articles) | Practice (30 article) | Impact (20 articles) | Capabilities (3 articles) |
| | | -Quantitative | | -Quantitative | |
| Sample size (participants) | Mean: 105<br>Min:3<br>Max: 595 | Mean: 58<br>Min:3<br>Max: 575 | Mean: 85<br>Min: 1<br>Max: 711 | Mean: 101<br>Min: 3<br>Max: 476 | One sample with 410 |

After having analyzed the characteristics above, the last part of the content analysis presents characteristics concerned with a thematic scope of the research on self-tracking.

(5) Context, Level of Analysis, Domains

The final part is concerned with the global context, level of analysis, and domains of the selected research articles. These characteristics were analyzed for each article and are summarized as follows.

First, almost 70% of the 114 articles are solely concerned with self-tracking activities in a private context (e.g., sleep, illness, everyday life, tea consumption, mood). Three articles solely treat professional self-tracking concerns (corporate wellness programs, mood at work). For 17% of the articles, the sample or the self-tracking activity under study fall into both private and professional contexts simultaneously. The remaining 13% do not specify a self-tracking activity, or the activity cannot be allocated to one context.

Second, another interesting aspect concerns the level of analysis. Less than 10% of all articles focuses on self-tracking of groups (e.g., work colleagues or households). The remaining articles consider self-tracking on an individual level.

Third, the analysis of the self-tracking domain (fitness, health, energy consumption) reveals that most articles pay particular attention to self-tracking in the area of health, fitness, and well-being. This covers any physical activity, sedentary behavior (sitting), chronic diseases, sleep, mood, smartphone usage, pregnancy, or nutrition. Fewer articles situate their self-tracking research in the domain of mobility, nutrition, education, communication, finance, smart home/energy consumption, or performance. For each of these neglected domains, only one or two articles exist within the sample. Almost one-third of all articles undertakes a rather integrated approach; their results should be applicable for all self-tracking domains. This also often includes lifelogging, the holistic tracking of each activity of an individual. In contrast, five articles do not specify a domain for their research.

The results of the literature review (bibliometric study and content analysis) presented above show an increasing interest among scholars from all three disciplines in self-tracking, notably in the last 5 to 10 years. Many articles have been identified that are somehow intertwined with self-tracking. A sub-selection of articles that predominantly focus on self-tracking provide plenty of insights on different characteristics of articles on self-tracking. Before starting the interpretation of the presented results, the next section presents the limitations of the literature review.

## 4.4 Limitations

The results reported above are subject to the choice and definition of the research scope and methodological limitations.

All decisions made on the scope in Subsection 4.1.1 (p. 69) limit the identified articles and, therefore, the content-related insights. On this account, the possibility that the results in other IS, HCI, or psychology outlets are different cannot be ruled out. The center of interest on top-ranked outlets is not unusual and follows the reasoning of other scholars (Bernroider et al. 2013, Sørensen and Landau 2015, Vessey et al. 2002). The same applies for the selection of the research disciplines. Eventually, sociology and medicine might provide interesting insights as well (Lupton 2014, de Moya and Pallud 2017), or other exclusion criteria might have included more Psychology articles in the final database, which might have changed the results. Moreover, the selection of libraries might limit the results of the analysis, as libraries have shown varying availability of certain journal volumes. The libraries were chosen by the availability of journals or conference proceedings according to the university's license subscriptions. On this account, another subscription contract might engender more or fewer articles, which could impact the results. Additionally, the keyword selection strongly influences the findings. In order to overcome this limitation, keywords were derived from an exploratory literature review on Google Scholar and comparisons with prior literature show that the list of keywords significantly overlaps with the list of other reviews (Ayobi et

al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017). This confirms an objective and meaningful selection of keywords.

From a methodological point of view, the forward and backward search[24] suggested by vom Brocke et al. (2009) was excluded. For such a large database, this implies extensive manual work that can still be done in future work. Furthermore, prior literature reviews in this domain (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017) set an example of others that did not follow forward and backward search. The chosen models from Li et al. (2010) and Sidorova et al. (2008) for the content analysis may constitute a limitation of the results. Even though they help to structure the results in a meaningful and comparable way, they might neglect some new aspects that could be discovered with a more inductive approach. Yet, in comparison to prior literature reviews (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017), the results of the present study reveal similarities that shows that this study could reproduce their results, to a certain extent. Finally, the extraction of the characteristics per article underlies the subjective interpretation. On this account, a simplified inter-rater comparison of the results of the content analysis showed strong accordance for a selected subset of articles, ensuring a certain level of reliability.

With the limitations in mind, the next section discusses the research results and establishes a research agenda for future research.

## 4.5 Discussion and Research Agenda

This chapter aims at structuring and summarizing research insights on self-tracking research in the disciplines of IS, HCI, and psychology. A literature review detects 1,846 articles in 23 journals and 8 conference proceedings, with eight keywords related to the phenomenon of self-tracking. An exponential increase in the number of published articles per year suggests a rising interest since 2007, notably for articles including the keywords “self-tracking” and “quantified self.” For an in-depth analysis of the content of self-tracking articles, 114 out of the 1,849 articles were selected, with predefined exclusion criteria. The bibliometric study and the content analysis reveal that self-tracking research receives increased intention, and a variety of concepts, results, and insights are investigated (RQ2a). This chapter discusses results from both types of analysis. On this account, the chapter also draws a research agenda for future endeavors (RQ2b). Finally, it describes theoretical contributions and practical implications.

In order to answer **the first research question** (“What research insights currently exist about the phenomenon of self-tracking?”), the bibliometric study illustrates a growing number of articles according to the selected keywords for all three disciplines. Especially the results for “self-monitoring,” “self-management,” “self-tracking,” and “quantified” have strongly increased. On the one hand, this reflects a greater interest in self-tracking in IS, HCI, and psychology research. On the other hand, the results must be taken with caution, as there is a general increase of articles in research (see Subsection 3.2.1, p. 44). In any case, scholars exhibit a solid interest in the phenomenon of self-tracking. Notably, IS and HCI research seem to be engaged in research concentrating on self-tracking. Most of the identified articles from psychology originate from ambiguous keywords such as “self-monitoring” and “self-management,” shown to have manifold significations not necessarily related to self-tracking. Interestingly, De Moya and Pallud (2017) observe a similar issue regarding their keyword “self-management,” Overall, in psychology, self-tracking is mostly observed as a marginal aspect. Taking previous literature reviews on self-tracking (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017) as an example led to basing a content analysis on a filtered database containing articles that fully pay attention to self-tracking and do not only mention it as a side note or an example. Consequently, 114 articles were selected for a content-related analysis to explore current insights into the self-tracking phenomenon to streamline future research. These 114 articles cover a time period from 2013 to 2018, and originate only from the disciplines of HCI and IS. The latter discipline accounts for 15% of all articles, showing that a large body of knowledge lies within HCI.

The discussion of the results of the content analysis is driven by theory and consists of a comparison of the results with previous literature reviews in the context of self-tracking: Ayobi et al. (2016), De Moya and Pallud (2017), and Kersten-van Dijk et al. (2017).

[24] Backward search “refers to reviewing older literature cited in the articles” (vom Brocke et al. 2009, p. 10) and focuses on identifying relevant articles from the reference list of each article. Forward search “refers to reviewing additional sources that have cited the article” (vom Brocke et al. 2009, p. 10).

To begin, Ayobi et al. (2016) identify three different research streams by searching for only one keyword ("personal informatics") in the ACM Digital Library between 2010 and 2015. They analyze 20 papers and identify three research streams within self-tracking:

1) Psychological research: Concerned with behavioral change and psychological theories (two frameworks from self-tracking articles are presented);
2) Phenomenological research: Concerned with usage behaviors that also include investigations of contradictory usage behavior as a focal point;
3) Humanistic research: Refers to possible impact of self-tracking on self, society, and culture.

Compared to the inductively extracted concepts employed in the theoretical background of the articles of the database of this chapter (see Table 19), it is striking that these findings confirm the existence of the sub-concepts and their relevancy. Yet, results here suggest the existence of additional research streams. Especially technical aspects, such as machine learning, data integration, and interaction interfaces, are not covered by the three research streams from Ayobi et al. (2016). Furthermore, relevant aspects related to economical (willingness to pay, information boundary theory) or educational research streams (perceptual learning) are identified here. Moreover, these results enlarge the list of sub-concepts of each research stream discovered by Ayobi et al. (2016). For example, the concept of affordances, cognitive-dissonance theory, or expectation-confirmation theory may be attributed to the psychological research stream. Moreover, goal-setting or discontinuance research enlarges the phenomenological stream.

Furthermore, Ayobi et al. (2016) also investigate insights into the thematic and methodological scope of self-tracking research and detect (1) a lack of attention toward other domains than those such as health or well-being, (2) the use of heterogeneous methodologies, and (3) missing research on group self-tracking. These results prevailingly confirm their insights. Most articles only consider predominantly health, fitness, or well-being, and research methods are of a qualitative nature. In addition, these results confirm a lack of long-term investigations and sample sizes still rather small considering that self-tracking is a mainstream application of PIS. In contrast to the results of Ayobi et al. (2016), a small percentage of the articles used in this dissertation attribute attention to self-tracking of groups (employees, households, or training partners).

Second, De Moya and Pallud (2017) analyze 43 articles identified with six keywords from 2007 to 2016, according to four different levels of understanding of a phenomenon called the Funnel paradigm.[25]

1) For the first level, they reveal that most research consists of empirical observations originating from data interpretation, design, or self-tracking of others (e.g., pets). The present results confirm these insights in part and show a large number of interviews and field studies that investigate IT usage, practices, and the IT artifact. Less research is concerned with the impact of self-tracking or capabilities related to the phenomenon of self-tracking. This study explicitly excluded research on self-tracking of others, due to the definition of self-tracking from Section 2.3 (p. 17), which focuses on an individual and his or her self-tracking activities only.
2) For the second level, De Moya and Pallud (2017) reveal that almost no literature exists on an adequate methodology for self-tracking research, and they call for more ethnographic studies. Furthermore, they suggest using self-tracking appliances as a research method itself. In contrast to their insights, the present results show that an increasing number of studies use ethnographic approaches, combining interviews, document analyses, surveys, and observations in field and lab environments. Moreover, the results here imply that in the context of behavioral impact studies, self-tracking is already used as a research instrument. For example, in resource-conservation studies, self-tracking has been applied successfully within feedback interventions (Kupfer, Schöb, et al. 2016), so the author is unable to confirm this scientific void identified by De Moya and Pallud (2017).
3) For the third level, they identify leveraged theories of eight articles. On this account, they find that aspects like sharing behavior, social capital, motivation, and altruism are taken into consideration in articles in order to explain the phenomenon of self-tracking. They notably highlight the field of IS as it contributes to the understanding of self-tracking. The results here confirm their results and enlarge them with additional theories scholars have taken into consideration by scholars (see Table 19).

[25] The Funnel paradigm represents a conceptual tool that structures the analysis of literature reviews. Four levels of analysis represent a particular understanding of the investigated phenomenon, from observable to unobservable aspects.

4) For the fourth level, they reveal that critical research is missing in the literature. In contrast to this, the present author found that research already started to fill this void with some articles that critically scrutinize self-tracking research (Doherty and Doherty 2018).

Finally, the literature review of Kersten-van Dijk et al. (2017) analyzed 24 articles originating from research in four libraries with various combinations of 20 keywords. In contrast to the literature reviews presented above (Ayobi et al. 2016, de Moya and Pallud 2017), Kersten-van Dijk et al. (2017) concentrate on a specific aspect within self-tracking research: the potential of self-tracking as a behavioral-change strategy. The authors only identify a potential for self-tracking to support behavioral change by raising awareness, uncovering correlations rooted in self-efficacy or self-tracking. Concerning the impact of self-tracking on behavioral change, they find contradictory results. From a methodological perspective, they find that the interview is the dominant research method and that research with objective data is missing. It mostly remains unclear if behavioral change exists and if it is significantly data-driven. Moreover, samples underlie selection biases and subjectivity, and may not be generalized because they consist of students, the researcher himself, or his or her peers (social network). Furthermore, study durations are rather limited, and dropouts or system usage is underreported or shows conflicting results. The results of the literature review at hand generally confirm the insights from Kersten-van Dijk et al. (2017), notably for the methodological issues. Concerning aspects that impact self-tracking, this literature review identifies additional concepts such as privacy or social influences.

**The second research question** ("What research gaps and future research directions can guide IS researchers?") of this chapter investigates research gaps and future research. Its answer depends on the results of the bibliometric study and the content analysis. On this account, it is answered in the discussion. According to Mueller-Bloch and Kranz (2015), the identification of the research agenda is structured by the types of research gaps. Table 21 illustrates the research gaps and helps to draw a research agenda. The research gaps are derived from the results of the content analysis and the discussion above. They encompass methodological conflicts, contradictory evidence, knowledge void, action-knowledge conflicts, an evaluation void, and a theoretical application void.

**Table 21.** Identified Research Gaps through the Literature Review

| Type of Research Gap | Research gap |
|---|---|
| Methodological Conflict | -Qualitative research and small sample sizes dominate<br>-Focus on early adopters and only few studies on normal users (not engaged into Quantified self or specifically technologically savvy) |
| Contradictory Evidence | -Research reveals certain hurdles for a mainstream implementation (even though self-tracking shows to be interesting for everyone, also elderly ones)<br>-Mainstream implementation conflicts with specific field of applications for particular problems (e.g., chronical diseases)<br>-Unclear if automatic or manual data collection is better for self-tracking (notably behavioral change) |
| Knowledge Void | -Abandonment is still not sufficiently explained<br>-Specific IS themes (capabilities and impact) remain under researched<br>-Focus on health, fitness, and well-being but unclear if self-tracking is applicable in other areas<br>-Influence of individual differences on self-tracking (e.g., self-efficacy) is under researched |
| Action-Knowledge Conflict | -Insights of self-tracking practices originate often from predominantly qualitative insights and minorities (early adopters, chronical ill individuals) → mainstream focus is missing<br>-Only few researchers apply new techniques like machine learning or predictions<br>-Data collection shows inaccurate data which might be explained by the usage fatigue of individuals |
| Evaluation Void | -Lack of large-scale (empirical) validation for models, artifacts, and frameworks<br>-The exact and long-term impact of self-tracking on behavioral change remains unclear |
| Theory Application Void | -Depending on the research stream, there is still large potential of applying theories from psychology, sociology, or other disciplines to better understand and promote self-tracking (e.g., personal predispositions)<br>-Some articles use no prior literature at all |

After having conceptualized the research gaps, the research agenda is derived to overcome each research gap:

- **Methodological conflict and evaluation void:** In order to overcome the methodological conflicts, scholars should invest more research on quantitative insights. An increasing number of large-scale investigations may result in more insights on the underlying mechanisms of self-tracking. Furthermore, even though convenience samples, single-person experimentations, and small sample sizes are vital to understanding the phenomenon as a first step in research, more academic rigor is needed to improve the quality and significance of research results.

Finally, in practice, self-tracking has already gained attention as a mass product, while research just slowly detaches from the idea that it is an early-adopter phenomenon. Taking all together, future empirical investigations should concentrate on representative samples that also include novice users, non-users, or digital immigrants, instead of focusing on digital natives. These improvements will fill the evaluation void of self-tracking research.

- **Contradictory evidence:** Scholars should investigate with more rigor the influences on self-tracking usage behavior (i.e., mainstream vs. subgroup phenomenon). A center of interest should attend to continuous and discontinuous usage. Notably, IS research offers a growing body of knowledge in this field and self-tracking may contribute to this research stream with new theoretical insights. Other contradictory results concern behavioral change. The effectiveness of self-tracking on behavioral change should be investigated with more caution. Furthermore, many self-tracking device manufacturers or service providers pay particular attention to automatic tracking. However, recent research shows that the missing awareness during data collection may distort the whole self-tracking experience. Such studies suggest including analogue tracking methods.
- **Knowledge void:** Future research should investigate what kind of capabilities play a role within self-tracking. This encompasses external and internal predispositions. Additionally, as self-tracking does not only concern health, fitness, and well-being, self-tracking research should diversify the findings on different self-tracking domains (e.g., financial expenditures, resource consumption, communication, travel). This implies integrating knowledge from other fields (e.g., economics, sociology). Moreover, besides developing new but immature self-tracking prototypes, research should also focus on investigating research with existing mature technologies.
- **Action-knowledge conflict:** More research with representative samples and mainstream technologies is needed to resolve this conflict. Such representative samples should consist of a larger number of participants and include mainstream and inconvenient users. Moreover, the long-term effect of self-tracking needs more attention from researchers. This goes hand in hand with the issue observed in the data-collection and integration stage. Individuals show a certain tracking fatigue, or devices collect inaccurate data. These observations negatively influence self-tracking usage behavior. This observation calls for technological improvements as well.
- **Theory-application void:** The integration of theory is still rather vague within self-tracking research. Furthermore, some attempts from scholars show that personal predispositions may influence behavioral change and usage behavior. Yet, this research direction is still under researched and needs more attention in the future. Other disciplines offer a wide range of theories that should be applied and tested.

The results of the literature review indicate that self-tracking research has been continuously evolving since 2007. It detects a focal interest of research that is not limited to behavioral change, usage behavior, or social implications. Even though the attention of scholars to self-tracking is rapidly increasing, the findings also show that research is scattered in various directions and cumulative tradition should be improved. The derived research agenda has the potential to streamline future research and to offer valuable insights for other scholars and practitioners.

Overall, the literature review **contributes** to IS literature as it collects, identifies, and illustrates research on self-tracking from three different disciplines. It is the most recent overview and, therefore, extends prior IS and HCI literature reviews (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017) in five respects: (1) time period – no specific time period was chosen, and the most recent publications up to mid-2018 were included; (2) outlet-driven – the search is driven by a selection of top-ranked journals and proceedings, in comparison to the database-driven search of other scholars; (3) database size – the database at hand for the content analysis is much larger with more than twice as many articles; (4) analysis method – another concept mapping method was applied, especially in comparison to De Moya and Pallud (2017) and Ayobi et al. (2016); (5) keywords – a different number and other keywords than the other scholars.

In this sense, the contribution of this review has been to update prior literature reviews by confirming or refuting their results. These results support the main research streams identified by Ayobi et al. (2016). Moreover, this literature review enlarges their identified research streams and adds a technical component. In contrast to this holistic approach, the literature review of Kersten-van Dijk et al. (2017) takes a specific theoretical perspective on self-tracking and finds mostly self-reported support for the effectiveness of self-tracking in the context of behavioral change. The

findings of this literature review underline their identified issue, notably in other themes and problem areas of self-tracking research. Finally, De Moya and Pallud (2017) reveal that self-tracking research strongly relies on observable facts, and current findings here confirm this limitation. Yet, results here suggest that self-tracking research has already evolved largely within the last two years, because this literature review discovered a growing number of unobservable aspects.

Moreover, the dissertation contributes to research by supporting guidance for other authors. First, it motivates other scholars to engage in research on self-tracking by showing the increasing relevancy within IS research. Second, the detailed overviews help other scholars to orient their research endeavors and quickly find research gaps to engage in meaningful research that builds on prior knowledge. Third, the research agenda calls for specific points of improvement within self-tracking research, which indirectly may increase theoretical implications of self-tracking research in the future.

Furthermore, the results of the bibliometric study appear to be the first to quantify the trend of a self-tracking literature review and provide an overview on the historical development of the phenomenon. The selection of the articles for the content analysis reveal that more mature insights on self-tracking mainly evolve from 2013 on.

Finally, the results of the literature review contribute to practice because they help practitioners from marketing or product development to easily comprehend the status quo of research. They can use the overviews to detect interesting articles. For example, practitioners can find design suggestions for self-tracking devices or interfaces in the articles allocated to the IS theme of IT artifact and in the integration stage of the self-tracking stage model. Furthermore, the schematic results quickly reveal specific articles that treat barriers and show practitioners what issues they should consider in the process of product development or marketing. Moreover, insights on the willingness to pay or vendor trust might directly interest practitioners in the context of pricing and marketing. The general overview also helps to derive strategic decisions from management for product development.

In summary, from 1,849 articles from three disciplines (IS, HCI, psychology), 114 articles were identified and analyzed according to their research insights (historical evolution, research questions, research results, prior literature, details on the thematic scope, and methodology). The overall results show that self-tracking research is constantly evolving and seems to have reached a certain peak. Especially IS usage and research on the IT artifact represent mature fields of interest. Concerning the stages of self-tracking, notably the action stage (behavioral change) has been neglected by research. Overall, research is still scattered and lacks cumulative tradition, i.e., the integration of theoretical insights from other domains. For this reason, the chapter proposes a research agenda to help other scholars to streamline research and improve the quality of insights. The next chapter addresses some challenges of the research agenda in order to advance empirical research on self-tracking.

# 5 Empirical Study on Usage Behavior of a Self-Tracking Appliance

Chapters 5 and 6 (p. 111) address the research gaps that have been identified in the literature review presented in Chapter 4 (p. 67). The goal is to extend IS research on self-tracking in particular and on PIS in general, with a focus on self-tracking systems usage behavior. This research stream is emphasized due to the contradictory results discovered in prior work (Buchwald et al. 2015, Pfeiffer et al. 2016), which imply that individuals show such extreme reactions to self-tracking appliances that some perceive many barriers when thinking about adopting and using them (e.g., usage fatigue, skepticism due to data collection, lack of value proposition). Furthermore, many individuals also choose to discontinue usage after a first usage phase of several weeks.

In order to help resolve this contradiction, this chapter applies traditional IS knowledge. Furthermore, the chapter also aims at filling the recognized methodological void concerning empirical quantitative research needed to leverage the academic insights to establish self-tracking as a mainstream trend (see research gaps in Section 4.5, p. 89).

As a result, Figure 38 shows that the focal point of this specific chapter lies in the first part of the IS life cycle and contributes to a better understanding of the adoption and continuance (also called continuous usage) of self-tracking appliances.

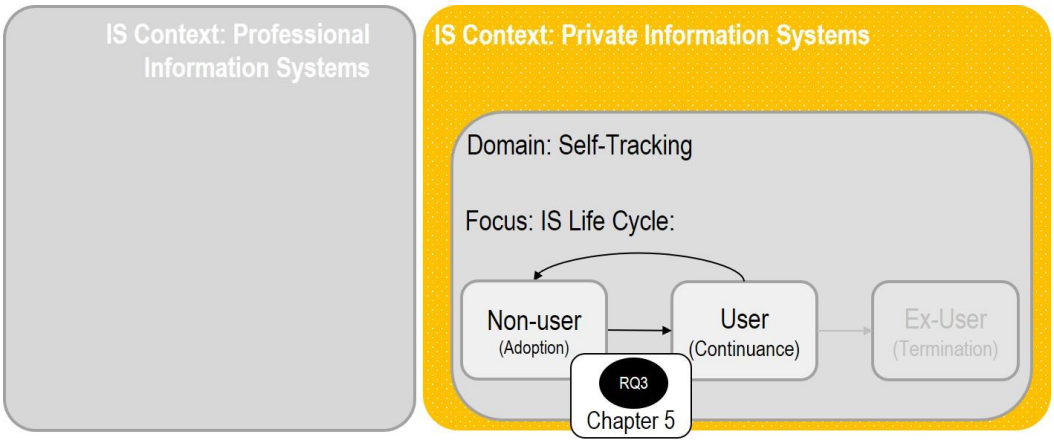



**Figure 38.** Research Focus for Chapter 5: Empirical Evaluation of Traditional IS Models on Usage Behavior

IS and HCI research have made multiple efforts to understand the usage of self-tracking appliances with various theoretical foundations and insights. In the context of a first wave of self-tracking research, great enthusiasm exists for self-tracking. However, especially when it comes to long-term usage, a certain fatigue is observed (Ayobi et al. 2016). After first optimistic studies that demonstrate the great potential of self-tracking (e.g., for health-related issues), a second wave of research concentrates on identifying barriers and problems that occur when standard users (not the first user generation of Quantified Selfers) adopt the technology (Buchwald et al. 2015, Choe et al. 2014, Epstein et al. 2015, Pfeiffer et al. 2016, Rooksby et al. 2014). Moreover, impact studies also show that self-tracking does not always lead to the expected impact in the form of a behavioral change (Kersten-van Dijk et al. 2017). So, a third wave of research is currently concerned with several theoretical foundations that will help to better explain usage behavior in this domain – notably, long-term usage. Explanatory constructs, models, and theories, such as self-control (Baumgart and Wiewiorra 2016), cognitive-dissonance theory (Baumgart 2016, 2017), goal setting (Chung, Agapie, et al. 2017, Sjöklint et al. 2015), motivation (Gimpel et al. 2013), or the trans-theoretical model (Shin and Biocca 2017), are employed to investigate usage behavior. So far, however, such new constructs, models, and theories are rarely tested with quantitative data.

Yet, scholars have directly developed new models or adjusted traditional IS models without considering the potential of the original IS models without any adjustments (Buchwald et al. 2015, Lunney et al. 2016, Pfeiffer et al. 2016). This contradicts the suggestion of Crowston et al. (2010) who call for a step-by-step approach to conducting research in the private context that includes self-tracking: namely, that traditional models and their limitations should be investigated first, before breaking completely new ground. Accordingly, this chapter follows the suggestion of of Crowston et al. (2010) to leverage the existing IS foundation and to apply existing IS knowledge to the self-tracking domain. From this rationale, the following research question is presented:

*RQ3: To what extent do traditional usage models explain usage behavior of self-tracking appliances?*

The research question is answered by employing a traditional but well developed and frequently used model (Dwivedi et al. 2017, Williams et al. 2015) to explain usage behavior, adoption intentions, and continuous-usage intentions: Known as the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003), the model originates from an empirical comparison of various models with different constructs as predictors for behavioral intentions and usage behavior. Typically, behavioral intentions encompass both adoption and continuous usage intentions. Usage behavior can be gathered from self-reports or objective usage data (if available). Three main aspects drove the decision to apply this model. First, in comparison to other models, UTAUT models have been applied to measure both system adoption and continuous system usage. Second, UTAUT has been applied for mandatory as well as volitional system usage (still in an organizational context). And third, an updated version of the model was conceived especially for the consumer context (Venkatesh et al. 2012). The model is supposed to focus on volitional systems and expands the utility-based view of UTAUT1 with experience-based constructs (e.g., enjoyment). Due to this center of interest on volitional systems and on private users (as consumers), the model should apply to explaining usage behavior of self-tracking appliances. In the following discussion, the two models are distinguished as UTAUT1 (Venkatesh et al. 2003) and UTAUT2 (Venkatesh et al. 2012).

A field study with over 700 participants explores the explanatory power of both UTAUT models at two points in time: before the users have been exposed to the system and after a longer period of usage (longitudinal data). As a field study investigates research questions in the real world without any manipulation (Alavi et al. 1989), the study at hand investigates the behavioral intentions and usage behavior in a real-world setting without any specific manipulation concerning the usage behavior of a self-tracking appliance. Furthermore, in order to address the methodological void identified in the previous chapter, the selected sample should be more explicitly diversified than in prior studies from the literature. This especially concerns demographics and experiences with self-tracking appliances, as prior studies often used tech-savvy or advanced users of an appliance. To that end, this study collected data for the UTAUT model constructs for a real technology previously unknown to the participants. Data concerning UTAUT1 and UTAUT2 was gathered at two points in time (t1, t2) with the help of online surveys as the means of data measurement.

The remainder of this chapter is structured as follows. The first section describes the UTAUT1 and UTAUT2 models and derives the hypotheses on the interactions between the different constructs of these models that explain self-tracking usage behavior. The next section explains the field study that was undertaken to measure all necessary constructs to test the derived hypotheses. The third section presents the dataset as well as its quality. Fourth, the results are shown, and finally, the last two sections treat limitations and discuss the results.

## 5.1 Hypothesis Development

For the development of UTAUT1, Venkatesh et al. (2005) found that 7 out of 33 constructs from various explanatory models significantly influence the intention to use a system or significantly influence system usage directly. Departing from the seven significant determining constructs, Venkatesh et al. (2005) theorize four new constructs that explicitly influence the intention to use a system: performance expectancy, effort expectancy, social influence, and facilitating conditions. All constructs together form the UTAUT1, the first version of the model (see light grey boxes in Figure 39).

- Performance expectancy (PE) refers to “the degree to which an individual believes that using the system will help him or her to attain gains in job performance” (Venkatesh et al. 2003, p. 447). It includes, for example, the previously known constructs “perceived usefulness” or “extrinsic motivation.”
- “The degree of ease associated with the use of the system” (Venkatesh et al. 2003, p. 447) defines effort expectancy (EE). It integrates constructs such as “perceived ease of use” from previously known models.
- Social influence (SI) merges previously known constructs such as “subjective norm” or “image.” It is defined as “the degree to which an individual perceives that important others believe he or she should use the new system” (Venkatesh et al. 2003, p. 450).

- Facilitating conditions (FC) refer to the "degree to which an individual believes that an organization and technical infrastructure exists to support use of the system" (Venkatesh et al. 2003, p. 451) and integrate constructs such as "perceived behavioral control" from previous models.

Given the increased technological availability of IS for consumers and the widespread PIS usage, an update of the UTAUT model should include the consumer context and consider experienced users. Consequently, in their now well-established model, Venkatesh et al. (2012) added to the utility-based constructs from UTAUT1 three additional constructs (see dark grey boxes in Figure 39) that form UTAUT2: hedonic motivation, habit, and price (also called perceived value or PV). Venkatesh et al. (2012) argue that in comparison to the organizational context, consumers are driven rather by intrinsic motivation, price – also important in the context of effort – and habit that represents an impact made by usage experience.

- "Hedonic motivation (HM) is defined as the fun or pleasure derived from using a technology" (Venkatesh et al. 2012, p. 165).
- Habits (HA) describe behaviors that are "acquired through repetition and learning" and driven "through inertia, in parallel to cognitive processes" (Turel 2015). Habit is considered as "prior behavior" and "the extent to which an individual believes the behavior to be automatic" (Venkatesh et al. 2012, p. 165).
- Price or perceived value (PV) refers to the actual costs and pricing a consumer must bear in order to use the IS.

All the constructs defined above directly influence behavioral intention (BI) and indirectly affect usage. BI is the core construct in the UTAUT models, and many studies limit themselves to exclusively investigating BI as a proxy for behavior. Buchwald et al. (2015) also theorize that such constructs (also called beliefs) form intentions and system usage in the domain of self-tracking. Therefore, a first step is the analysis of whether the UTAUT models explain the adoption intention and the intention to continuously use a self-tracking appliance in this specific study setting.

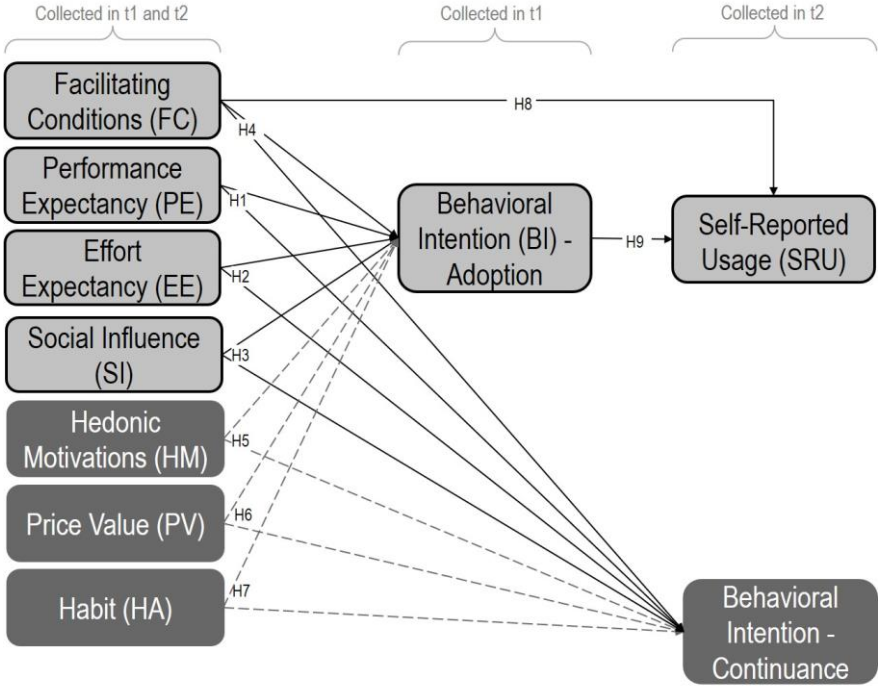



**Figure 39.** The UTAUT1 & UTAUT2 Amended from Venkatesh et al. (2003, p. 447, 2012, p. 160)

In line with Venkatesh et al. (2003, 2012), Recker (2014) acknowledges that users evaluate advantages and disadvantages of an IS. This concerns predominantly the perceived usefulness (which refers to the new construct PE) or the perceived ease of use (which refers to the new construct EE). The extent of the evaluation influences adoption and notably continuous intention. Buchwald et al. (2015, p. 6) transfer this to the self-tracking context and posit that perceived usefulness is related to the beliefs of an individual that the usage of a self-tracking appliance

improves a certain aspect of his or her private life. Self-measurement and self-reflection as a vital part of self-tracking lead to behavioral change. So, self-tracking may positively influence the attainment of a person's performance goal and, thus, an aspect of an individual's life. This prospect can motivate an individual to adopt self-tracking appliances and, if self-tracking proves to be impactful, can also drive continuous usage. First, empirical evidence for adoption intention already exists from Pfeiffer et al. (2016), leading to presentation of two sets of two-part hypotheses:

*H1a/b: The higher the performance expectancy, the higher the intention (a) to adopt a system / (b) to continuously use a system.*

*H2a/b: The higher the effort expectancy, the higher the intention (a) to adopt a system / (b) to continuously use a system.*

Buchwald et al. (2015, p. 6) argue that social influence not only shows an impact on continuous usage, especially when it concerns "vibrant and controversial new technologies." The thoughts and opinions that important others hold also influence the adoption intention, as well as continuous intention to use self-tracking appliances. First empirical evidence for adoption intention already exists from Pfeiffer et al. (2016). Accordingly, the following sets of hypotheses are presented:

*H3a/b: The higher the social influence, the higher are the intentions (a) to adopt a system / (b) to continuously use a system.*

*H4a/b: The higher the facilitating conditions, the higher the intentions (a) to adopt a system / (b) to continuously use a system.*

Especially for continuance, the habit of using a system does not necessarily require an individual to consciously use the system. The user may just automatically engage in using the system without any parallel cognitive processes. This also induces no application of conscious self-observation and evaluation of the system (Turel 2015). Thus, an individual may not critically reflect on habitual system usage, nor ponder whether to use or continue to use a system. Consequently, according to social-cognitive theory, a habit inhibits discontinuance intention. To this effect, Buchwald et al. (2015, p. 4) argue that in the domain of self-tracking, the "frequent, often even daily usage supports the transition process into a habit." So, if self-tracking systems are used frequently, the habit can be established. Furthermore, other scholars engaged in self-tracking research reinterpret the habit construct as a multiplier. When individuals already track one aspect of their life, they might easily adopt other self-tracking appliances (Baumgart and Wiewiorra 2016, Maltseva and Lutz 2018). For these reasons, this study posits that active self-tracking of one aspect of an individual's life positively influences adoption and continuous intention, thus leading to the next set of hypotheses:

*H5a/b: The stronger the habit, the higher the intentions (a) to adopt a system / (b) to continuously use a system.*

Venkatesh et al. (2012) and Recker (2014) include in the UTAUT model an economic evaluation by the system user. As UTAUT2 focuses more on consumers, the perceived value in comparison to the actual costs has become essential to explaining system usage in comparison to UTAUT1, which mostly concentrates on employees that do not have to pay directly for an IS. To that end, a balance between the price and the perceived value is crucial for a consumer deciding to adopt an IS. Analaogous for continuous usage of self-tracking appliances, Buchwald et al. (2015) theorize that not only are the perceived sunk costs relevant, but also the perceived value. In the case of an individual not seeing enough value in using the device, he or she might terminate usage no matter the costs. These propositions prompt the next set of hypotheses:

*H6a/b: The higher perceived value, the higher the behavioral intention with respect to (a) adoption intention / (b) continuous usage intention.*

Notably, in the consumer context, hedonic motivation plays a special role when IS are not employed for mandatory reasons to perform a work-related task. When individuals expect or experience fun from system usage, they particularly tend to adopt or continue to use a system. First, empirical evidence for the relevancy of hedonic motivation in the context of adoption intentions for self-tracking appliances already exists from Pfeiffer et al. (2016), who note that self-tracking systems in particular offer components that focus on the enjoyment of the system (e.g., to play with data or share it with friends), leading to the next set of hypotheses:

*H7a/b: The higher the hedonic motivation, the higher the intention (a) to adopt a system / (b) to continuously use a system.*

Moreover, in line with Venkatesh et al. (2003, 2012), assessing the direct influence of facilitating conditions and behavioral intentions on self-reported behavior leads to two additional hypotheses:

*H8: The higher the facilitating conditions, the higher the self-reported usage behavior.*

*H9: The higher the behavioral intention (adoption intention / continuous usage intention), the higher the self-reported usage behavior.*

Finally, as shown by Venkatesh et al. (2003, 2012), other constructs moderate the influence of PE, EE, SI, and FC, including gender, age, experience, and the voluntariness[26] of use. This study only includes gender and age because no experience with self-tracking appliances was gathered within the study. Furthermore, voluntariness was not measured, as the self-tracking appliance under study is considered as completely voluntary and no specific obligation exists to use the self-tracking appliance.

Overall, the UTAUT1 and the UTAUT2 constructs are measured at two different points in time (t1, t2). So, as depicted in Figure 39, hypotheses H8 and H9 are tested once. In contrast, hypotheses H1 through H7 are tested twice producing 16 hypotheses (before and after system exposure) that aim to explain why individuals tend to use a self-tracking appliance. The following section presents the detailed study design to test the hypotheses drawn above.

## 5.2 Method of the Field Study

To answer the research question ("To what extent do traditional usage models explain usage behavior of self-tracking appliances?") and to test the hypotheses, a large field study was conducted in the Netherlands in 2015, to investigate the usage behavior of a self-tracking smartphone app for tracking (hot-) water consumption. This subsection describes facts about the data collection: context of the study, employed self-tracking appliance, study design, and timeline. A second step explains the data analysis.


**Figure 40.** Mobile Self-Tracking Application for (Hot-) Water Consumption in the Shower

The field study is part of an overall field experiment described in Appendix 9.5.1 (p. 202). Its main goal was to investigate the impact of direct-feedback information on (hot-) water consumption in the shower. Each participant received and installed a smart shower meter (for more information, see Subsection 2.3.1, p. 18). The installation did not require any specific technical skills and was already probed in previous large-scale studies. In this project, an additional smartphone app that tracks indirect feedback accompanied the direct feedback of the smart shower meter (developed in the context of an EU project with the device manufacturer Amphiro). Two aspects led to the decision to only consider the smartphone app for answering the research question of this chapter

[26] Voluntariness refers to "the extent to which potential adopters perceive the adoption to be non-mandatory" (Moore and Benbasat 1991, p. 195).

("To what extent do traditional usage models explain usage behavior of self-tracking appliances?"). First, the barrier to deinstalling the smart shower meter is much higher than that to deinstall or just not use the smartphone app, so continuous intention can only be properly measured for the smartphone app. It is possible that participants tend to leave the device installed even though they would like to discontinue usage, as deinstallation takes some effort. Second, taking future research and technical issues into consideration, it would only be possible to log actual usage data for the smartphone app in comparison to the smart shower meter. For those two reasons, this study focuses on the usage behavior for the smartphone application rather than for the smart shower device.

The smartphone app depicted the information measured with the smart shower meter (see Figure 40). Four different views provide a graph consolidating values for all showers synchronized with the device for the following metrics per shower: water volume in liters (l), energy consumption in kilowatt hours (kWh), temperature in degrees Celsius (°C), flow rate in liters per minute (l/min). Each view additionally gives summarizing metrics (value for the last shower, average, all showers together, number of showers) and a line graph that depicts the data for all synched showers.

The relevant key facts for the process of this investigation are presented in this section. Figure 41 shows the study timeline.

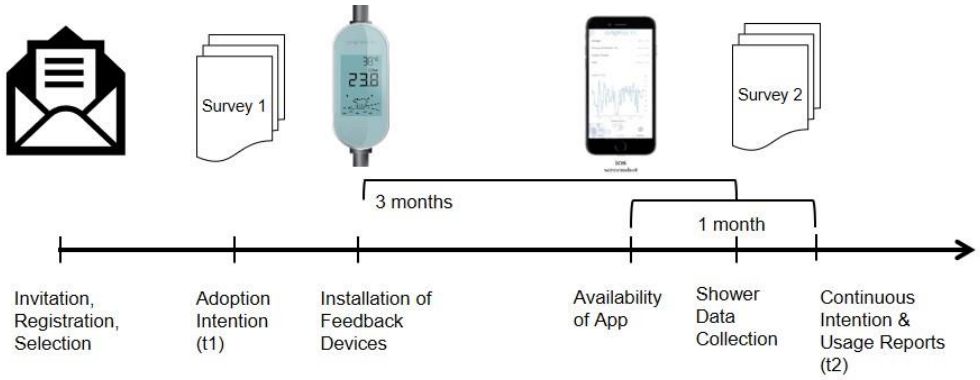



**Figure 41.** Study Design and Timeline of the Field Study for Investigating Usage Behavior of a Self-Tracking Application for (Hot-) Water Consumption in the Shower

In cooperation with a large Dutch water utility, participants were recruited through different channels. Employees from the headquarters and remote employees were recruited with emails and flyers. Moreover, a certified B-Corporation[27] that cooperates with the utility helped to recruit non-employees through Facebook, Twitter, newsletters, and its homepage. Individuals were able to register for the study by completing a short registration survey. This survey helped the study team to identify suitable participants according to two vital requirements dictated by the study design and technical constraints. First, the study participants' bathrooms needed a standard showerhead with a hose. Other types of showers, such as rain showers or showerheads integrated in the wall, do not allow for the installation of the smart shower meter. Second, study participants needed an iOS or Android phone with Bluetooth 4.0 LE compatibility to support the data transfer between the smart shower meter and the smartphone application. Following the registration survey, all suitable participants were invited to complete a pre-study survey (survey 1) that collected general information about each participant (e.g., demographics) and asked for the intention to use the smartphone application. The latter was done with the UTAUT1 and UTAUT2 constructs (for a full overview, please see the items in t1 in Appendix 9.5.3, p. 205). After the completion of this first survey, the study devices were sent out to all participants, who then installed the devices themselves with the help of a short manual. Additionally, further information about the device and the study was provided in the manual, and answers to frequently asked questions derived from prior studies with the smart shower meter were provided on a website. Overall, the installation process was very successful; only a few participants requested installation support or direct contact due to a broken device (less than 5% of all study participants). Two months after the installation phase, the availability of the app was announced by email. After the announcement, participants

[27] Companies strive to achieve the "highest standards of verified social and environmental performance, public transparency, and legal accountability to balance profit and purpose." Other exemplary companies are Ben&Jerry's or Patagonia, Inc. https://bcorporation.net/about-b-corps

were able to download and install the app from the Google Play Store and the Apple App Store. One month later, the study participants were invited to complete the post-study survey (survey 2), which collected more general information about the participant and the continuous intention of the smartphone application, again using the UTAUT1 and UTAUT2 constructs (for a full overview, please see the items for t2 in Appendix 9.5.3, p. 205). Additionally, at the same time (t2), survey 2 gathered self-reported data on app usage.

Data analysis consists of testing the hypotheses from Section 5.1 (p. 96) with multiple regressions following Gupta et al. (2008), Alkuhanaizan and Love (2012), and AbuShanab and Pearson (2007). Moreover, Williams et al. (2015) show that multiple regressions represent the second most often employed analysis method for UTAUT studies. So, this type of analysis is a common way of analyzing UTAUT models and determining the explanatory power for predicting adoption and continuous usage intention. As a result, on the one hand, the performance of traditional models for the specific application domain of PIS can be evaluated; on the other hand, according to insights from continuous and discontinuous research, self-reported usage data and adoption intentions with actual usage at a later point in time can also be compared. The comparison helps to show the relationship between adoption intention and continuous usage, which has rarely been performed in the past. The data analysis was performed with SPSS Version 25.

As a next step, after having described the study design and the data analysis, the following subsection presents the database and the validation of the gathered data.

## 5.3 Database and Validation of Measurement Model

Turning to the actual data that was employed for the study, this section describes and explains the validity and reliability of the acquired data. Both aspects of data quality must be established before analyzing the data with multiple regressions.

### 5.3.1 Database

Overall, of approximately 3,670 individuals targeted, 950 individuals responded and agreed to participate in the study. As outlined above, registration for the study was possible using an online survey. Due to technical incompatibilities concerning the shower or the smartphone amenities, 739 of the respondents qualified to participate in the study. The eligible participants were invited to complete the pre-study survey (survey 1) and of these, 637 completed the pre-study survey and received the smart shower meter. After the treatment phase of three months, 503 participants provided shower data, which resulted in 73,977 shower extractions. After data cleaning,[28] 63,206 extractions were used for the analysis of the saving effects.

The post-study survey (survey 2) resulted in 538 responses. The sample sizes are important for the overall study. Focusing on the hypothesis from Section 5.1 (p. 96) concerning behavioral intentions and self-reported usage, only the valid responses for the UTAUT constructs are of interest. Due to drop-outs (e.g., due to personal changes, relocations) during the three months of the study, the final sample sizes decreased. Table 22 shows the available data. At the beginning in t1 (beginning of August), 637 participants completed the UTAUT questions on the pre-study survey. After data cleaning (due to invalid or incomplete answers), 549 responses for UTAUT1 and UTAUT2 remained. At the end of the field study in t2 (January 2017), 286 participants had fully answered the questions on UTAUT1 and UTAUT2, and 215 individuals said that they successfully installed the app. So, in order to test the full UTAUT model with measurements at two points in time and including self-reported usage, the sample size of 215 is relevant.

**Table 22.** Overview on the Data Sample for the UTAUT Study

| Type of data | Measurement Variables | Collection Time | Sample Size |
|---|---|---|---|
| Self-reported | UTAUT1, UTAUT2 | t1 | 549 |
| | UTAUT2, UTAUT2 | t2 | 286 |
| | Smartphone app usage | t2 | 215 |

As a next step, the demographic aspects of a data sample are analyzed. This helps to estimate the representability of the sample. Table 23 shows information on gender, age, education, and income for the two samples in t1 and t2, the full sample after the pre-study survey and the sample with all participants answering to the UTAUT constructs and smartphone app usage in t2. A comparison

[28] The device has an internal memory for 250 shower extractions. After the treatment phase of three months, for some households with a high number of household members, missing data existed. For that reason, such corrupted data was excluded.

with statistical data from the Netherland shows that the samples are in the range of the census data provided by the national department of statistics of the Netherlands (Statistics-Netherlands 2014).

**Table 23.** Demographics of the Study Participants for Two Sample Sizes (n=549 and n=215)

| Demographics | | % for t1 (n=549) | % for t2 (n=215) | Demographics | | % for t1 (n=549) | % for t1 (n=215) | Demographics | | % for t1 (n=549) | % for t2 (n=215) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gender | Female | 44% | 47% | Highest Education | Elementary school | 0,2% | 0% | Income | <12000 | 6% | 7% |
| | Male | 56% | 53% | | middle school with diploma | 11% | 12% | | 24001-36000 | 9% | 10% |
| Age (years) | ≤19 | 0.4% | 0.5% | | A-Levels/High school | 7% | 7% | | 36001-48000 | 15% | 24% |
| | 20-29 | 12% | 16% | | Professional formation degree | 10% | 8% | | 48001-60000 | 15% | 18% |
| | 30-39 | 27% | 35% | | University of applied science degree | 39% | 49% | | 60001-72000 | 10% | 9% |
| | 40-49 | 26% | 24% | | Higher education degree | 16% | 21% | | >84001 | 13% | 14% |
| | 50-59 | 20% | 15% | | Other | 1% | 1% | | no answer | 31% | 19% |
| | ≥60 | 14% | 9% | | No answer | 16% | 1% | | | | |

Before analyzing the data to validate the hypotheses, the next subsection evaluates its quality.

### 5.3.2 Data Quality of the Measurement Model

Quality criteria for quantitative empirical research are well established in the literature. Accordingly, this study followed the suggestions of Burton-Jones and Lee (2017) and MacKenzie et al. (2011) in order to test psychometric constructs. In accordance with the quality criteria for quantitative work presented in Subsection 3.2.2 (p. 45), the following section describes how all criteria (objectivity, validity, reliability) are tested for three different models.

In contrast to most qualitative data that was obtained in previous research, **objectivity** of the data gathering with a standardized survey is well assured. On the one hand, the use of Likert-type evaluation scales and anonymous questioning helps to keep subjectivity at a very low level and delimits the subjective influence of the investigator.

**Table 24.** Measurement Model of the UTAUT Constructs in t1 and t2

| UTAUT constructs in t1 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | α | Mean | SD | AVE | CR | Loadings | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Facilitating Conditions | 0.88 | 6.43 | 1.49 | 0.89 | 0.94 | 0.943 | **0.94** | | | | | | | |
| Performance Expectancy | 0.87 | 5.58 | 1.65 | 0.89 | 0.94 | 0.941 | 0.49 | **0.94** | | | | | | |
| Effort Expectancy | 0.86 | 5.86 | 1.46 | 0.88 | 0.94 | 0.937 | 0.60 | 0.64 | **0.94** | | | | | |
| Social Influence | 0.64 | 4.19 | 2.7 | 0.73 | 0.85 | 0.857 | 0.23 | 0.38 | 0.33 | **0.86** | | | | |
| Hedonic Motivation | 0.88 | 5.61 | 1.75 | 0.90 | 0.95 | 0.946 | 0.51 | 0.78 | 0.66 | 0.40 | **0.95** | | | |
| Perceived Value | 0.90 | 3.27 | 3.04 | 0.91 | 0.95 | 0.953 | 0.12 | 0.29 | 0.21 | 0.30 | 0.30 | **0.95** | | |
| Behavioral Intention | 0.96 | 5.96 | 1.75 | 0.96 | 0.98 | 0.979 | 0.60 | 0.74 | 0.68 | 0.32 | 0.75 | 0.25 | **0.98** | |
| Habit | 0.34 | 4.94 | 4.26 | 0.60 | 0.75 | 0.776 | 0.40 | 0.42 | 0.41 | 0.26 | 0.42 | 0.22 | 0.44 | **0.78** |
| UTAUT constructs in t2 | | | | | | | | | | | | | | |
| | α | Mean | SD | AVE | CR | Loadings | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Facilitating Conditions | 0.85 | 6.55 | 1.12 | 0.87 | 0.93 | 0.940 | 0.94 | | | | | | | |
| Performance Expectancy | 0.88 | 4.37 | 1.80 | 0.89 | 0.94 | 0.945 | 0.08 | 0.95 | | | | | | |
| Effort Expectancy | 0.79 | 5.10 | 1.59 | 0.83 | 0.91 | 0.909 | 0.08 | 0.58 | 0.91 | | | | | |
| Social Influence | 0.62 | 3.52 | 1.75 | 0.72 | 0.84 | 0.851 | 0.11 | 0.41 | 0.24 | 0.85 | | | | |
| Hedonic Motivation | 0.88 | 4.56 | 1.68 | 0.89 | 0.94 | 0.950 | 0.04 | 0.83 | 0.64 | 0.39 | 0.95 | | | |
| Perceived Value | 0.8 | 2.87 | 1.44 | 0.83 | 0.91 | 0.913 | -0.05 | 0.37 | 0.23 | 0.32 | 0.37 | 0.91 | | |
| Behavioral Intention | 0.73 | 5.04 | 1.77 | 0.79 | 0.88 | 0.886 | 0.12 | 0.52 | 0.29 | 0.15 | 0.51 | 0.24 | 0.89 | |
| Habit | 0.24 | 4.78 | 1.59 | 0.57 | 0.72 | 0.754 | 0.27 | 0.12 | 0.03 | 0.20 | 0.13 | 0.05 | 0.13 | 0.75 |

Note: Square Root of AVE is listed on the diagonal of bivariate correlations.
SD = Standard deviation

Concerning **reliability,** the indicator, internal, and construct reliability were tested for each construct, such as facilitating conditions or social influence. For assessing indicator reliability, the (outer) loadings of a construct are of interest (Hair et al. 2017). A high level of 0.708 for the loadings shows that the items have much in common. As Table 24 and Table 25 depict, this applies to all constructs. Then, traditionally, internal reliability is assessed with Cronbach's Alpha (α), which implies internal consistency of constructs and ensures that the items of a construct are related to each other (MacKenzie et al. 2011). Recommended levels for Cronbach's alpha vary from 0.5 to 0.7 (Peterson 1994). MacKenzie et al. (2011) state that, generally, the more items, the higher Cronbach's alpha. As Table 24 and Table 25 show, all constructs besides habit for t1, as well as for t2, met the given thresholds. So, habit is dropped from further data analysis. Finally, construct reliability is evaluated with the composite reliability (CR) ratio, which relates "the variance accounted for by the latent construct to the variance in the items" (MacKenzie et al. 2011, p. 314).

The threshold for CR is greater than 0.6 or 0.7 (Ahmad et al. 2016). Table 24 and Table 25 reveal that all constructs have an adequate composite reliability level.

**Table 25.** Measurement Model of the UTAUT Constructs in t1 and Usage in t2

| UTAUT constructs in t1, Usage in t2 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | α | Mean | SD | AVE | CR | Loadings | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Facilitating Conditions | 0.95 | 6.65 | 0.83 | 0.947 | 0.946 | 0.897 | **0.95** | | | | | | | | |
| Performance Expectancy | 0.83 | 5.78 | 1.09 | 0.863 | 0.926 | 0.929 | 0.41 | **0.93** | | | | | | | |
| Effort Expectancy | 0.83 | 6.05 | 1.01 | 0.856 | 0.922 | 0.925 | 0.51 | 0.57 | **0.93** | | | | | | |
| Social Influence | 0.61 | 4.12 | 1.50 | 0.721 | 0.838 | 0.849 | 0.12 | 0.28 | 0.29 | **0.85** | | | | | |
| Hedonic Motivation | 0.81 | 5.83 | 1.08 | 0.851 | 0.914 | 0.917 | 0.46 | 0.70 | 0.65 | 0.33 | **0.92** | | | | |
| Perceived Value | 0.91 | 3.64 | 1.47 | 0.895 | 0.945 | 0.946 | 0.01 | 0.27 | 0.22 | 0.31 | 0.27 | **0.95** | | | |
| Behavioral Intention | 0.73 | 6.21 | 1.04 | 0.947 | 0.973 | 0.973 | 0.60 | 0.67 | 0.65 | 0.21 | 0.68 | 0.19 | **0.97** | | |
| Habit | 0.24 | 5.38 | 1.46 | 0.640 | 0.780 | 0.800 | 0.40 | 0.36 | 0.42 | 0.27 | 0.38 | 0.17 | 0.44 | **0.80** | |
| Usage | 0.66 | 3.31 | 1.14 | 0.752 | 0.858 | 0.807 | -0.04 | 0.14 | 0.08 | 0.05 | 0.13 | 0.17 | 0.05 | 0.10 | **0.87** |
| Note: Square Root of AVE is listed on the diagonal of bivariate correlations. | | | | | | | | | | | | | | | |

As a next step, according to the descriptions in Subsection 3.2.2 (p.45), the following criteria were tested, which ensure **validity** of the data: content, construct, and internal/external validity. Criterion validity was excluded, as it is tested hand in hand with construct validity (Straub, Boudreau, et al. 2004). To ensure content validity, previously tested items from the literature were used (for more information about content validity, see Subsection 3.2.2, p. 45, and notably Subsection 6.1.3, p. 117), which underlie intensive testing by university staff and IS experts (Venkatesh et al. 2012). Furthermore, as the wording of the items was adapted slightly to the application domain of self-tracking appliances, they were discussed with other IS academics in the context of an expert panel. Three types of construct validity exist – convergent, discriminant, and nomological validity. Convergent and discriminant validity are evaluated at the same time because both sets of test criteria involve looking into the loadings of the items of a construct when examining correlations between the items (Burton-Jones and Lee 2017). So, to assess convergent validity, "the average variance in the indicators that is accounted for by the focal construct is calculated" (MacKenzie et al. 2011, p. 313). To that end, the average variance extracted (AVE) is calculated for each construct by averaging the squared multiple correlations for the items of a construct. A construct accounts for a majority of the variance in its items on average when a threshold of 0.5 is kept (Fornell and Larcker 1981, MacKenzie et al. 2011). Then, to assess discriminant validity, the square root of the AVE for each construct is calculated, which should exceed the correlation between the constructs (Fornell and Larcker 1981). As Table 24 shows, all thresholds are met for each construct. Additionally, for convergent and discriminant validity, the common method bias must be assessed to ensure that no systematic variance induced by the selection of the data-collection method occurs (Straub, Boudreau, et al. 2004). To evaluate the common method bias, the Harman's single factor test is employed, which checks that the total variance explained for the dependent variable does not originate from one single factor. The threshold of explained variance for one single factor is at 50%. For the UTAUT constructs in t1 and t2, one single factor explains 50% and 40% of the total variance, respectively. For the combination of UTAUT in t1 and Usage in t2, one single factor explains 43% of the total variance. So, only the constructs of UTAUT in t1 are close to the cut-off point at 50% but still considered acceptable. Then, nomological validity evaluates the loadings of constructs in a model (Burton-Jones and Lee 2017). The validity of the constructs in a nomological net are assessed in the results section, where all constructs are employed to define the explanatory power of the UTAUT for self-tracking appliances. Finally, the trade-off between internal and external validity was indirectly decided by the choice of study design. Due to the real-world setting, the results are rather generalizable, and causality of other factors of influence cannot be excluded.

Overall, after dropping the habit constructs in t1 and t2, the measurement is concluded to be valid and the results for the structural model are addressed.

## 5.4 Results for the Structural Model

The hypotheses are tested in two separate subsections. Figure 42 shows the UTAUT models and hypotheses that were assessed in these two subsections. As a first step (structural model on the left of Figure 42), the explanatory power of the UTAUT antecedents for behavioral intentions (adoption and continuance) is considered.

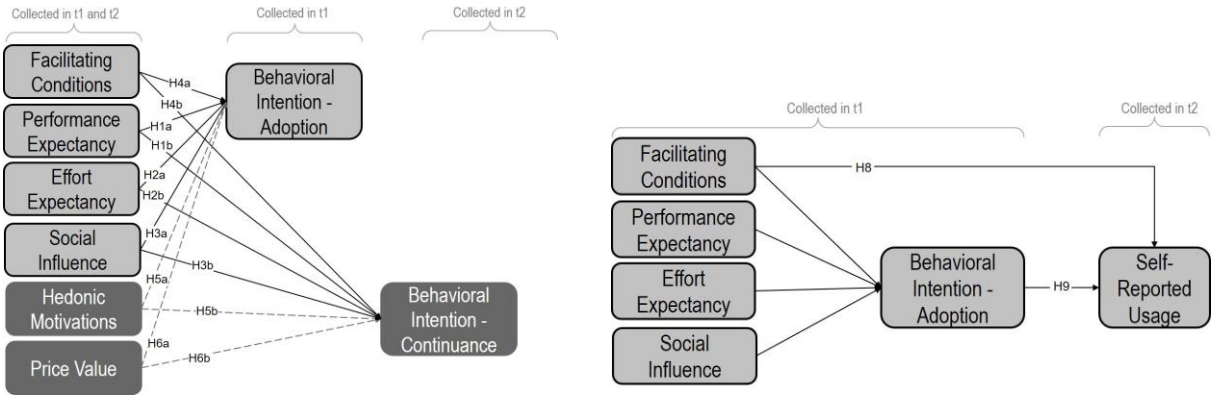



**Figure 42.** Structural Models for Analyzing the Exploratory Power of UTAUT Models for Self-Tracking

As a next step (structural model on the right of Figure 42), the following subsection assesses the impact of behavioral intentions and facilitating conditions in t1 (before the usage period) on self-reports of actual usage in t2 (after one month of familiarization with the smartphone app). In both cases, multiple linear regressions are being used to detect correlations and explanatory power.

### 5.4.1 Explanatory Power of UTAUT Constructs for Behavioral Intentions

This study follows Gupta et al. (2008) in using multiple regressions that present the regression estimation results with the $R^2$ (explained variance) for behavioral intentions at both points in time (t1 and t2) and for both UTAUT models (UTAUT1 and 2). Additionally, the β-coefficients for each model in order are assessed to determine the predictive value of each construct toward the behavioral intention. For the first dependent variable, the adoption intention, regressions were run with the independent variables of UTAUT1 and UTAUT2 collected in t1. For the second dependent variable, the continuous-usage intention, regressions were run with the independent variables of both UTAUT models collected in t2. Only the HA construct was not included, as it did not pass the validity and reliability tests as explained in the last subsection.

**Table 26.** Structural Model UTAUT1 and UTAUT2 for Predicting Behavioral Intention

| Results/Predictors | Adoption Intention | | Continuous Usage Intention | |
|---|---|---|---|---|
| | UTAUT1 in t1 | UTAUT2 in t1 | UTAUT1 in t2 | UTAUT2 in t2 |
| Sample Size | 549 | 549 | 286 | 286 |
| $R^2$ (Behavioral Intention) | 0.647 | 0.678 | 0.278 | 0.313 |
| H4: Facilitating Conditions | 0.220*** | 0.198*** | 0.085 (n.s.) | 0.103* |
| H1: Performance Expectancy | 0.474*** | 0.299*** | 0.553*** | 0.330*** |
| H2: Effort Expectancy | 0.238*** | 0.168*** | -0.021 (n.s.) | -0.104 (n.s.) |
| H3: Social Influence | (0.014) n.s. | (-0.018) n.s. | -0.077 (n.s.) | -0.120** |
| H5: Hedonic Motivation | - | 0.305*** | - | 0.315** |
| H6: Perceived Value | - | (0.15) n.s. | - | 0.074 (n.s.) |
| * p<0.1 – ** p<0.05 – *** p<0.001 – n.s. not significant | | | | |

Table 26 above shows that the traditional constructs of UTAUT1 in t1 explained 65% of the variance – $R^2$=.65, F(4,544)=248.89, p<0.001 – of behavioral intention (adoption) toward usage of a self-tracking appliance. Especially PE helps to predict adoption intention (β=0.47, p<0.001) at a high level of significance. At a lower effect size, EE (β=0.22, p<0.001) and FC (β=0.24, p<0.001) also predict adoption intention. According to the data at hand, SI does not significantly predict adoption intention.

Furthermore, Table 26 shows that the traditional constructs of UTAUT2 in t1 explained 67% of the variance – $R^2$=.67, F(6,542)=190.58, p<0.001 – of behavioral intentions toward usage of a self-tracking appliance. Especially PE helps to predict adoption intention (β=0.3, p<0.001) at a high level of significance. To a lesser extent, FC (β=0.2, p<0.001), EE (β=0.17, p<0.001) and HM (β=0.31, p<0.001) also significantly predict adoption intention. According to the data at hand, SI and PV do not significantly predict adoption intention.

In addition, the results reveal that the traditional constructs of UTAUT1 in t2 explained 28% of the variance – $R^2$=.28, F(4,255)=24.49, p<0.001 – of behavioral intentions (continuous usage) toward usage of a self-tracking appliance. Only PE predicts continuous usage intention (β=0.55, p<0.001) at a high level of significance. All other variables were not found to be significant.

Furthermore, Table 26 depicts that the traditional constructs of UTAUT2 in t2 explained 31% of the variance – $R^2$=.31, F(6,250)=18.95, p<0.001 – of behavioral intentions (continuous usage) toward usage of a self-tracking appliance. Especially PE predicts continuous-usage intention (β=0.e33, p<0.001) at a high level of significance. At a lower level of significance, SI (β=-0.12, p<0.05), HM (β=0.32, p<0.05), and FC (β=0.1, p<0.05) also predict continuous-usage intention.

**Table 27.** Overview of the Test Results for Hypotheses H1-H7

| Hypothesis | Impact Relation | t1 | | t2 | |
|---|---|---|---|---|---|
| | | UTAUT1 | UTAUT2 | UTAUT1 | UTAUT2 |
| H1a/b | PE→BI | Supported | Supported | Supported | Supported |
| H2a/b | EE→BI | Supported | Supported | Not supported | Not supported |
| H3a/b | SI→BI | Not supported | Not supported | Not supported | Not supported |
| H4a/b | FC→BI | Supported | Supported | Not supported | Supported |
| H5a/b | HM→BI | - | Supported | - | Supported |
| H6a/b | PV→BI | - | Not supported | - | Not supported |
| H7a/b | HA→BI | - | No valid data | - | No valid data |
| H8 | FC→SRU | Not supported | - | - | - |
| H9 | BI→SRU | Not supported | - | - | - |
| - = no part of the model/not tested | | | | | |

Table 27 summarizes the results for the hypotheses H1-H7. Overall, as H1 and H5 were supported throughout all models and both points in time, only PE and HM (only assessed in UTAUT2) are shown to be significant predictors of BI toward using a self-tracking appliance. Additionally, as the results for H4 show, FC significantly impacts BI in almost all models and at both points in time (except UTAUT2 in t1). Moreover, EE is shown to be only a good predictor for adoption intention (in t1) according to the results for H2. Then, concerning H3, SI shows as insignificant except for UTAUT2 in t2 – yet, the predictor impacts negatively on continuous-usage intention, which does not correspond to the impact direction of hypothesis H3. Furthermore, PV, which is assessed in UTAUT2, has been shown to be an insignificant predictor in this model for the data at hand and the tests of H6. Finally, hypothesis H7 for HA could not be tested due to poor data quality.

All in all, depending on the model and the points in time, between 28% and 67% of the variance in behavioral intention can be explained. The general results for the predictors described above show they are mostly robust over different models and points in time. Yet, the extent of the explained variance varies substantially between the adoption and the continuous-usage intentions.

After having examined most of the hypotheses with this regression analysis, the next subsection aims at verifying the remaining hypotheses that relate to the explanatory power of UTAUT to explain the usage of a self-tracking appliance.

### 5.4.2 Explanatory Power of UTAUT for Self-Reported Usage

Concerning the second objective in the study, whether the adoption intentions toward using the self-tracking appliance from t1 translate into actual usage (self-reported by the users in t2) was examined. To begin, the explanatory power of both UTAUT models at both points in time was assessed for the adoption intentions in the small sample that only includes participants who also reported their usage of the self-tracking appliance. Then, the assessment of the structural model to explain self-reported usage (SRU) follows.

For the first part, UTAUT1 in t1 explained 63% of the variance – $R^2$=.62, F(4,210)=62.02, p<0.001 – of behavioral intention (adoption) toward usage of a self-tracking appliance. PE shows the largest effect size (β=0.38, p<0.001), followed by FC (β=0.30, p<0.001) and EE (β=0.28, p<0.001). Again, SI was not found to be a significant predictor (β=-0.014). For UTAUT2 in t1, 64% of the variance – $R^2$=.64, F(6,208)=86.3, p<0.001 – of behavioral intention (adoption) toward usage of a self-tracking appliance was explained. PE has the largest effect size (β=0.29, p<0.001), followed by FC (β=0.28, p<0.001), EE (β=0.22, p<0.001), and HM (β=0.21, p<0.05). Again, SI is shown to be an insignificant predictor (β=-0.04), as is PV (β=0.03).

For the second part, Table 28 shows the results of the structural model in explaining SRU. It depicts that UTAUT1 in t2 explained only 10% of the variance – $R^2$=.10, F(2,211)=1,03, p<0,4 – of SRU in t2; however, as the p-level shows, it was not found to be significant. None of the hypothesized predictors show impact on SRU: BI (β=0,11) and FC (β=-0,11) reveal insignificant correlations.

**Table 28.** Structural Model UTAUT Models in t1 and Usage in t2

| Model | UTAUT1 in t2 |
|---|---|
| Sample Size | 215 |
| $R^2$ (Self-Reported Usage) | 0,1 |
| H8: Facilitating Conditions in t1<br>H9: Behavioral Intention in t1 | (0,114) n.s.<br>(-0,105) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | |

Overall, the first results for the predictors of adoption intention confirm the robustness of the results of the previous subsection: UTAUT explains adoption intentions to a high extent. Then, concerning the second results, neither hypothesis H8 or H9 can be supported. The explanatory power of the UTAUT constructs BI and FC are shown to be insignificant to explain the variance for SRU. This reveals a gap between intentions and actual behavior.

Before discussing the results in the light of literature and practice, the next section presents the limitations of this study.

## 5.5 Limitations

The results reported above are subject to the choice and definition of the research design and methodological limitations.

The research design impacts the results in different ways: it limits generalizability and interpretability of the results. First, several aspects limit the generalizability of the study: e.g., opt-in possibility for potential study participants, sample consisting of only one nationality, employment of one specific technology. The findings are based on an opt-in sample of iOS users of a single country (the Netherlands). Moreover, even though the sample of 637 households is probably more representative of the general population than the student samples (Lee et al. 2003, Williams et al. 2015) to which many studies resort, the generalizability and scalability of the results to other platforms and countries have yet to be determined (Lee and Baskerville 2003). Moreover, the study encompasses a specific self-tracking appliance, so findings might not be applicable to other self-tracking appliances and domains. Also, smartphone app usage in general also represents a particular case, which may be different from the usage of other self-tracking appliances (e.g., wristbands). Many apps are free of charge; hence, many individuals may install a variety of apps and barely or never use them. This assumption is also reflected in the extremely low retention rates of apps (20%) during the first days after installation (Chen 2018). This fact is hardly surprising: The average smartphone user has 42 apps installed (Frey et al. 2016); frequent usage of all of these apps is quite unlikely. In that context, it is also important to understand whether the intention-behavior-gap observed is particularly large in the self-tracking domain where a smartphone app complements a hardware tracking device. For example, in parallel to the app of this study, the participants also had access to real-time feedback on the smart shower meter itself, which may have decreased interest in the consolidated data presented in the app. Third, the (dis)satisfaction with the specific characteristics of that particular app influences participants' continuous usage intention or self-reported usage and may bias the results. At the same time, this is the case with any IS; even if a study focuses on a more generic type of technology (e.g., "mobile banking" or "smartphone usage"), the participants probably have very concrete instances of those technologies in mind when answering those questions (e.g., the particular mobile banking software provided by their local bank). Yet, the UTAUT model does not provide for these potential sources of distortion. More research with other technologies should be conducted to determine whether these findings apply to other domains as well. Finally, it was not possible to properly track usage with logged data that would complement the subjective self-reports of the participants in the surveys. For that reason, objective data is neglected in the analysis of the data.

The methodological limitations consist of issues mainly concerning the number of items, the operationalization, and the selection of the sample. First, the number of items is rather small. Due to the overall study design, the cooperation partner requested keeping the surveys as short as possible, which resulted in a limitation of the items for the UTAUT constructs. Second, due to the novelty of the technology, some of the traditional UTAUT items (in particular on SI and HA) were not appropriate in their original wording for the self-tracking domain. The newly created items did not pass or only just passed the quality tests of the measurement model and, hence, relationships for HA and BI could not be tested. These results suggest that these constructs may need further adaption in the context of brand-new technologies (e.g., re-examination of content validity). In contrast to previous research findings in the literature, individuals who change their behavior due

to the influence of social norms may not even be aware of the influence (Nolan et al. 2008). This should be kept in mind when examining the impact of the social-influence construct. Third, notably the sample used to assess the full UTAUT model, including usage (in t2) underlies a selection bias, as only participants who reported that they have successfully installed the smartphone application were chosen.

Furthermore, it would be interesting to examine in more detail the demographical data on the participants, in order to understand whether intentional drivers differ between more demographic segments. The current results are only compared for different age groups and gender.

Having the limitations described above in mind, the next section concludes the chapter with a detailed discussion.

## 5.6 Discussion

The final section of this chapter discusses the findings, illustrates contributions to the literature, and highlights implications for practice.

The primary goal of this chapter was to assess the extent to which traditional usage models explain usage behavior of self-tracking appliances. In IS research, usage behavior is often proxied with adoption and more recently with continuous-usage intention. To that end, in a field study with over 700 participants, two traditional usage models (UTAUT1/2) were applied to investigate the explanatory power of the models for behavioral intentions and for usage of a self-tracking smartphone app. Data for the constructs of the models were gathered with the help of two surveys before the actual usage and after a first month of usage of the smartphone app (two-wave study). Multiple linear regressions show varying explanatory power for these behavioral intentions and usage. Moreover, the regressions help to detect significant predictors.

First, there is strong support for both UTAUT1 and UTAUT2 to explain **adoption intentions** (BI) for a novel self-tracking smartphone app. With $R^2$ values ranging between 64% and 67%, both models explain a high percentage of the variance in adoption intention. This number is considerably higher than the findings in the original articles or meta-reviews (~40% in UTAUT1 and ~ 44% in UTAUT2) (Dwivedi et al. 2017, Venkatesh et al. 2003, 2012). These results are in line with the observations from Pfeiffer et al. (2016), who achieved an $R^2$ of 0.62 for the intention to use wearable self-tracking technology. They also employed some TAM, UTAUT1, and UTAUT2 constructs and added others (e.g., trust, personal innovativeness) and mostly specified for health, fitness, and well-being. Moreover, taking into consideration gender and age, the results show some differences concerning the size of $R^2$. The explained variance is considerably higher for men than for women (see Table 50). Additionally, the $R^2$ is especially higher for participants aged between 40 and 49 years and older than 60 years (up to 70% or 80% of the variance could be explained; see Table 54 and Table 55). Then, regarding the effects of key determinants, the data at hand confirm the hypothesized influence of PE, EE, and FC. In addition, HM significantly determines adoption intention in UTAUT2. This suggests that HM is more relevant in private volitional systems, such as the smartphone app of the study at hand (van der Heijden 2004). In contrast, PV and SI do not meet the required significance levels of .05 and show that they are not significant predictors in the study. The lack of a significant impact of PV on adoption intention is probably due to the technology having been provided free of charge in this study setting. In that case, hypothetical questions about fictive prices do not seem to result in meaningful findings. Furthermore, the findings from Baumgart and Wiewiorra (2016) may suggest that the definition of perceived value needs to be revised or adjusted. Regarding the limited influence of SI, these results contradict those of Hartwick and Barki (1994) and Venkatesh and Davis (2000), raising the possibility – in particular, in the context of self-tracking – that individuals do not necessarily know what other individuals around them expect them to do or not to do. As Nolan et al. (2008) show, individuals who change their behavior due to the influence of social norms may not even be aware of that influence. Finally, HA did not pass the data-quality tests in the measurement model; therefore, the corresponding hypotheses could not be tested. The poor results of HA in the data-quality tests are not surprising for two reasons: (1) without prior usage, participants could not familiarize themselves with the completely new technology to form any habit, and (2) the operationalization of the constructs did not seem to be adequate. Future research should carefully consider if HA should continue to be included in investigations of adoption intention. Overall, both UTAUT models have proven to a large extent to be adequate instruments to explain the adoption intention of self-tracking appliances.

Second, considering the **continuous-usage intention** of the self-tracking smartphone app, the support for both UTAUT models is much lower – only up to 31% of the variance in continuous-usage intention can be explained. Moreover, taking gender and age into consideration, the results contrast with the findings for adoption intention. The model explaining continuous-usage intention performs better for women than for men (see Table 51). Additionally, the $R^2$ amounts to 0.50 for participants between the ages of 30 and 39 years old (see Table 56 and Table 57). Then, regarding the effects of key determinants, there is support for the influence of PE in both UTAUT models. Moreover, FC and HM are shown to be significant predictors only in UTAUT2. EE and SI are completely insignificant, no matter which model was used in t2. So, while EE and FC considerably determine adoption intention, their effect on continuous intention is very small and statistically insignificant. This is hardly surprising; if already familiar with a technology, efforts at mastering a technology or availability of the necessary support infrastructure becomes less important. Regarding SI, PV, and HA, the comments in the paragraph above apply. Overall, PE and HM significantly determine adoption intention and continuous-usage intention. Furthermore, with increasing experience with the technology, the impact of PE and HM on further usage intention appears to increase. These results are in line with the findings by Karahanna et al. (1999), who compared the adoption intention of potential users to the continuous-usage intention of a sample of actual users. Finding only moderate support for explaining continuous-usage intention suggests encouraging further study of continuous-usage intentions or discontinuance intentions, following Bhattacherjee and Lin (2015) and Turel et al. (2015). Especially for continuous-usage intention, current work shows that impact factors such as beliefs and attitudes may change over the life cycle of IS. This is confirmed by results showing FC and EE are relevant for adoption intention but less so for continuous usage. Overall, reconsidering other revised UTAUT models that also include affective components in the context of PIS – where volitional systems are mostly used – is suggested. For example, Dwivedi et al. (2017) develop a meta-UTAUT model that includes attitudes, because they are shown to play a vital role as mediator and direct predictor for usage behavior.

Finally, this study analyzes data on **usage behavior** as well, which many IS scholars do not consider. Even though IS scholars stress the importance of collecting usage behavior (Barnett et al. 2007, 2015, Wu and Du 2012), many studies limit themselves to collecting BI as the main predictor of usage (Straub and Burton-Jones 2007). In fact, a meta-study on system usage by Lee et al. (2003) reveals that 84 out of 99 TAM studies did not collect usage data. Wu and Du (2012) conducted a meta-analysis investigating the prediction reliability of BI. With a high variance in the correlations of intention and system usage (ranging between 0.12 to 0.76), they state that the "significance of the relationship is not guaranteed" (Wu and Du 2012, p. 683). All in all, the authors conclude that "the intention-behavior relationship is not stable and remains open to questions" (Wu and Du 2012, p. 683). In the UTAUT context, the majority of studies also rely on BI as predictor of usage behavior and do not collect any usage data either (Hsu et al. 2013, Lai and Lai 2014). Those studies that did collect both BI and usage behavior yield mixed results for the correlation of those two constructs. While some scholars do not find significant effects of BI on usage behavior (Duyck et al. 2010, Gupta et al. 2008), or find that BI explains only a small proportion of the variance in usage behavior (Alkhunaizan and Love 2014, El-Gayar and Moran), others report that their model explains up to 68% of the variance in usage behavior (Lee et al. 2015, Oh and Yoon 2014, Oliveira et al. 2014). These values include the explanatory power of FC as well, as this construct is a predictor of usage behavior in UTAUT. This study may be among the first to investigate the relationship between adoption intention and usage in the self-tracking domain. Its results suggest that intentions are not very informative for self-reported behavior, as the combination of BI and FC explains only 10% of the variance in the self-reported app usage. However, this does not represent a statistically significant result. Only when considering women and men separately was a small $R^2$ of 0.02 gathered for women (see Table 52). The same applies for one specific age group, namely, participants between 40 and 49 years old, for whom an $R^2$ of 0.11 was achieved (see Table 53). Thus, at least in the case of the smartphone app at hand, participants did not seem to follow through on their good intentions. So, there is a gap between intentions and behavior. In fact, these results are in line with prior observations in the self-tracking domain. This result leads to suggesting investigation of additional factors that better predict system usage in the PIS context. In this sense, for example, Dwivedi et al. (2017) found attitudes to be a significant predictor in a meta-analysis of various UTAUT studies.

Additionally, considering that the smartphone application also represents an IS that promotes sustainable behavior, the data suggests that adoption intention does not predict Green IS usage. This fact is in line with other recent research on pro-environmental behavior in the Green IS context (Gao et al. 2015). The sustainability domain may be on the extreme end of the intention-behavior gap; many individuals have good intentions, but do not follow through on them (Gutsell and Inzlicht 2012). A key difference with other domains of human behavior may be that pro-environmental behavior is not as important to most individuals' identity as behaviors in many other domains (Gatersleben et al. 2014). Therefore, it may be much easier for the individual to predict behavior linked to lifestyle expressions (e.g., Facebook or computer usage) than related to pro-environmental behavior (Gutsell and Inzlicht 2012). Another difference may be that in the sustainability context, the decision at hand typically involves long-term payoffs and public goods. Efforts to protect the environment may not pay off for the individual in a near future, making it harder to follow through on one's good intentions. Overall, one can conceive a number of other reasons for that severe intention-behavior gap. In psychology and IS usage, there has been in-depth theoretical research on the reasons why individuals do not translate their intentions into actual behavior. Explanations encompass self-presentation,[29] social desirability[30] (Auger and Devinney 2007, Boulstridge and Carrigan 2000), a lack of cognitive-dissonance (Chatzidakis et al. 2007, Szmigin et al. 2009), or the third-variable problem, also called "spuriousness" (Kenny 1979, Mauro 1990, Webb and Sheeran 2006). It is also possible that the gap is at least in part due to specific features of the app or the setting. None of the study participants had previous experience with the app (it was only released at the time of the study). The description of the app in the introductory leaflet and in survey 1 were quite concise. Participants forming their own expectations about the design, functions, and available content, with which the first version of the app did not correspond, cannot be ruled out. Moreover, the participants already had access to the real-time feedback on the smart shower meter. Hence, it is conceivable that participants did not perceive the additional information (i.e., consolidated feedback and statistics on energy and water consumption) provided by the app as necessary or more helpful to engaging in energy-efficient behavior. This may have influenced usage negatively.

In self-tracking research, this study **contributes** to the conflicting knowledge research gap and to the methodological void mentioned in the introduction of this chapter (p. 95). Even though the traditional UTAUT1 and UTAUT2 predictors show high explanatory power regarding adoption intentions, continuous intentions are less accurately predicted in both models. This result is in line with the literature (Brown 2008, Pfeiffer et al. 2016) that suggests that for the private context, other variables are needed to understand behavioral intentions and usage. The reported findings also show that adoption intentions do not quite translate into usage behavior, which represents an issue to be investigated by future research. Additionally, this empirical study adds to previous studies on continuous usage on self-tracking that focused on non-empirical insights (Kupfer 2018, Kupfer, Kehr, et al. 2016, O'Leary et al. 2015, Pfeiffer et al. 2016). On the methodological level, it adds to the self-tracking literature by providing quantitative results, including a rather large sample of participants. Furthermore, it extends prior insights mainly paying particular attention to health, fitness, or well-being, by providing findings in a rather under-researched self-tracking area: resource consumption / smart home. Concerning IS research in general, it mostly contributes on a methodological level because this is one of the rare studies that investigate UTAUT models in the context of a field study with longitudinal data, including self-reports on usage (Williams et al. 2015).

The findings here have practical implications for the marketing and product development of technologies. These results indicate that one should not rely on people expressing interest in buying or using products; collecting actual purchase or usage data from a sample of test users may involve more efforts, but tells a different story of actual product adoption and usage. Yet, even self-reported usage data from a sample of individuals testing a product should be treated with caution, as it may not adequately reflect actual behavior. In fact, the results of this study have already influenced practice. After the test trial, the company's developers of the technology decided to upgrade the app to the next level: the graphical user interface was redesigned to be more pleasant, usability was enhanced, and content was structured in a more detailed and intuitive way. Hence, this research and the company hope to drive the user experience to ensure an adoption of the app for the long-term.

[29] Individuals trying to hold up a certain impression (faking bad or good) about themselves.
[30] Individuals showing unconscious tendencies to answer as they think others would expect them to answer.

To conclude, this study investigated the performance of traditional IS models to explain usage behavior of a self-tracking smartphone app in the context of a field study in the Netherlands in 2015. All constructs of UTAUT1 and UTAUT2 were collected with surveys before starting to use the smartphone app (n=549) and after one month of usage (n=215). Before the usage phase (in t1), only behavioral intentions were gathered; after the first month of usage (in t2), usage data was also collected. Multiple regressions notably show that adoption intentions are quite well explained with both established UTAUT models in their original form. In contrast, the explanatory power for continuous-usage intentions is cut in half, and the results suggest that the adoption intentions may not translate into behavior. Moreover, both models fall short in explaining usage behavior. Besides traditional predictors such as PE and FC, affective ones, such as hedonic motivation, have also been shown to be relevant for explaining behavioral intentions. Consequently, a call for concentrating on conducting more empirical research on continuous research on self-tracking usage behavior is an outcome of this study. Furthermore, with respect to the private-usage context, such research endeavors should investigate new paths that take into consideration specific contextual aspects, such as affective variables. To that end, the next chapter adds to the ongoing discourse by developing a construct to measure a predictor that takes into consideration affective issues, namely, attitudes toward self-tracking.

# 6 New Instrument Development to Explain Usage Behavior of Self-Tracking Technologies

As Figure 43 depicts, subsequent to concentrating on the first two steps of the IS life cycle in the previous chapter, Chapter 6 focuses on the last two steps of the life cycle: continuous and discontinuous usage of self-tracking (appliances).

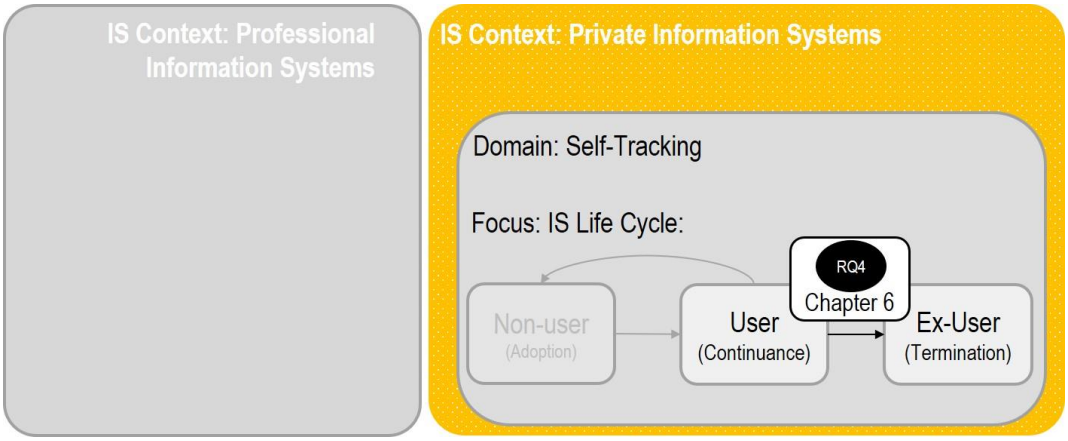



**Figure 43.** Research Focus for Chapter 6: Improving Traditional Usage Behavior Models by Including Attitudes

Chapter 5 (p. 92) empirically investigates how current IS models explain usage behavior of a self-tracking appliance. The results show that traditional IS models are not perfectly applicable for IS usage in the private context, where individuals mostly use volitional IS and choose systems suitable for their aspirations (for more information, see Subsection 2.1.3, p. 10). In order to improve applicability of traditional IS models, some adjustments might improve the understanding of self-tracking appliance usage. This observation is in line with previous work in IS and HCI research that is concerned with investigating prior motivation of self-tracking ambitions, perceived informational and motivational affordances, anxieties, or perceived outcomes (Baumgart 2017, Gimpel et al. 2013, Jarrahi et al. 2018, Maltseva and Lutz 2018). In this sense, self-tracking research especially focuses on continuous usage or usage termination. Interestingly, IS research also pays attention particular to these phases of the IS life cycle to better understand user behavior. Not only prominent explanatory models for adoption (Brown 2008, Dwivedi et al. 2017) but also continuous and discontinuous models (Bhattacherjee and Premkumar 2004, Turel 2015) re-include one construct that has been mostly neglected in IS models: attitudes. Other scholars such as Kroenung et al. (2011b) show that attitudes play a vital role in explaining usage behavior, especially for volitional systems and PIS, because emotional and affective components are more important in usage behavior in this context. Additionally, self-tracking research also recognizes the importance of attitudinal constructs (Gross et al. 2017, Halttu and Oinas-Kukkonen 2017, Lunney et al. 2016, Matthews, Murnane and Snyder 2017). Even though attitudes significantly explain the variance in self-reported usage, their role is still small in typical IS and self-tracking studies (Dwivedi et al. 2017, Lunney et al. 2016).

Attitudes represent a well-known phenomenon that has been measured in (social) science and other disciplines for decades or even longer. A plethora of existing constructs exists, notably in IS research (see Appendix 9.2, p. 180). Yet, as explained above, attitudes represent high potential for explaining usage behavior, which seems underutilized. Moreover, as already discovered in Subsection 2.4.3 (p. 26), most attitude constructs still are rather general (i.e., not technology specific) and still originate from Ajzen and Fishbein (1977), who measure attitudes rather as cognitive aspects. They still neglect the increasing relevancy of the affective component of attitudes, assumed to be vital for understanding usage behavior. To that end, a specific attitude measurement instrument might represent a better predictor of behavior (Dovidio and Fazio 1992, Tanur 1991). On this account, the following research question can be derived:

*RQ4: How can self-tracking attitudes be measured?*

In order to answer the research question, this dissertation basically rethinks the attitudes and investigates how to measure specific self-tracking attitudes. The research will help to construct an instrument that measures attitudes toward self-tracking, for use in research on self-tracking

appliance usage studies. A construct[31] is a measurement which helps to assess latent phenomena such as feelings or thoughts of an individual. A construct is an abstraction for a specific theoretical phenomenon that can be observable or unobservable (Bollen 2001, Petter et al. 2007). For example, task performance can easily be observed, e.g., by identifying the outcomes of a task. In contrast, observing feelings or thoughts of an individual currently performing a task is more complex. Such unobservable phenomena can be measured to a certain degree with proxy variables, so called latent constructs (Bollen 2001). Latent constructs include observable or quantifiable scores, also called items, statements, measures, or indicators in the literature. Such items can be observed through "self-report, interview, observation, or other empirical means" (Petter et al. 2007, p. 625). On this account, the dissertation concentrates on developing corresponding items that improve investigations of the explanatory power of attitudes for future self-tracking research.

The following chapter explains the methodology of construct development and the selected approaches for this dissertation. Then, the results of the application of the methodology are described. Finally, elaborations on the limitations of the work and a discussion conclude this chapter.

## 6.1 Overall Method for Construct Development of Attitudes toward Self-tracking

I follow the construct development process offered by scholars in IS literature (Bagozzi 1993, Haws et al. 2012, Hinkin and Tracey 1999, Hoehle et al. 2015, Lewis et al. 2005, McKenzie-Mohr 2000, Petter et al. 2007, Smith et al. 2014, Straub, Boudreau, et al. 2004). Figure 44 depicts the overall process that can be divided into three major stages. Each stage is detailed in one or more tasks.

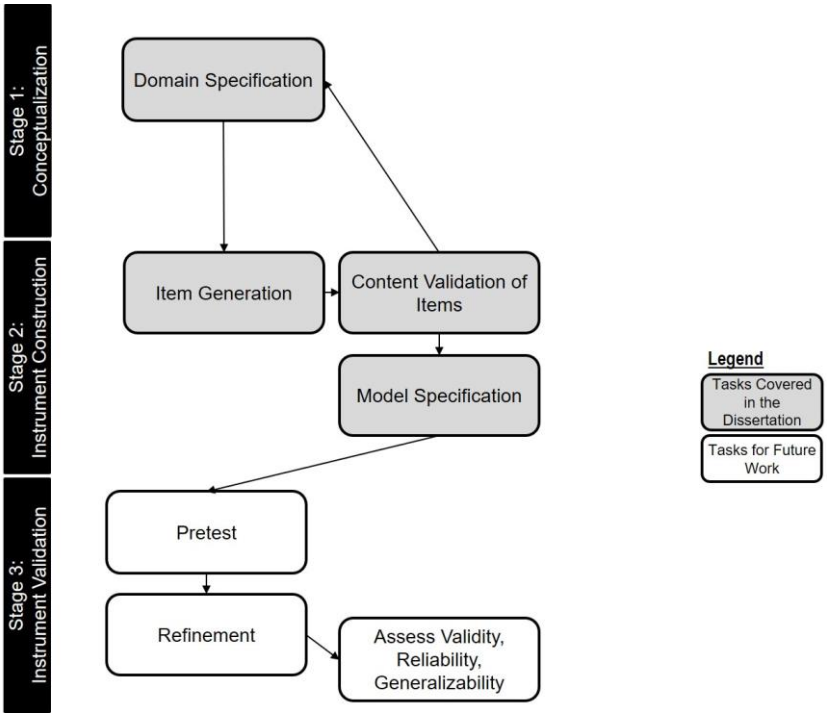



**Figure 44.** Three Stages of Construct Development and Corresponding Tasks Amended from Smith et al. (2014, p. 175)

The first stage of the conceptualization consists of literature reviews or interviews conducted to specify the nature of the conceptual domain, theme, and definition (Lewis et al. 2005). The results of a first qualitative analysis are consolidated in a first set of items. Stage 2 consists of the tasks of collecting a first set of items derived from the qualitative insights of the previous step. Another task assesses the item's content validity: a group of experts screens and pretests a set of items in order to add, delete, or modify them (Lawshe 1975). This aims at ensuring that the developed construct draws "from the theoretical essence of what they propose to measure" (Straub, Boudreau, et al. 2004, p. 387). A third subtask consists of a model specification that structures the items according to a construct's dimension and other constructs (reflective or formative constructs; see Petter et al.

[31] As already introduced in Subsection 2.4.3, p. 27.

(2007)). Stage 3 builds on the results of stage 2, and the preliminary instrument is tested in the field with the tasks of refinement through exploratory and confirmatory factor analysis. The instrument validation consists of a third task that includes tests for validity (content, internal, and construct), reliability, and generalizability.

In the literature, some authors (Moore and Benbasat 1991) pay more attention to the conceptualization and construction part, whereas others (MacKenzie et al. 2011) tend to emphasize statistical instrument validation. As (IS) scholars have highlighted many times that the qualitative groundwork is rather neglected within construct development, the dissertation focuses on the qualitative groundwork to overcome this shortcoming. Hence, the distinction from Moore and Benbasat (1991) and Lewis et al. (2005) guides the approach of this dissertation and it concentrates on the first two stages: the conceptualizaiton and instrument construction. The final stage of the (statistical) instrument validation will be left for future work.

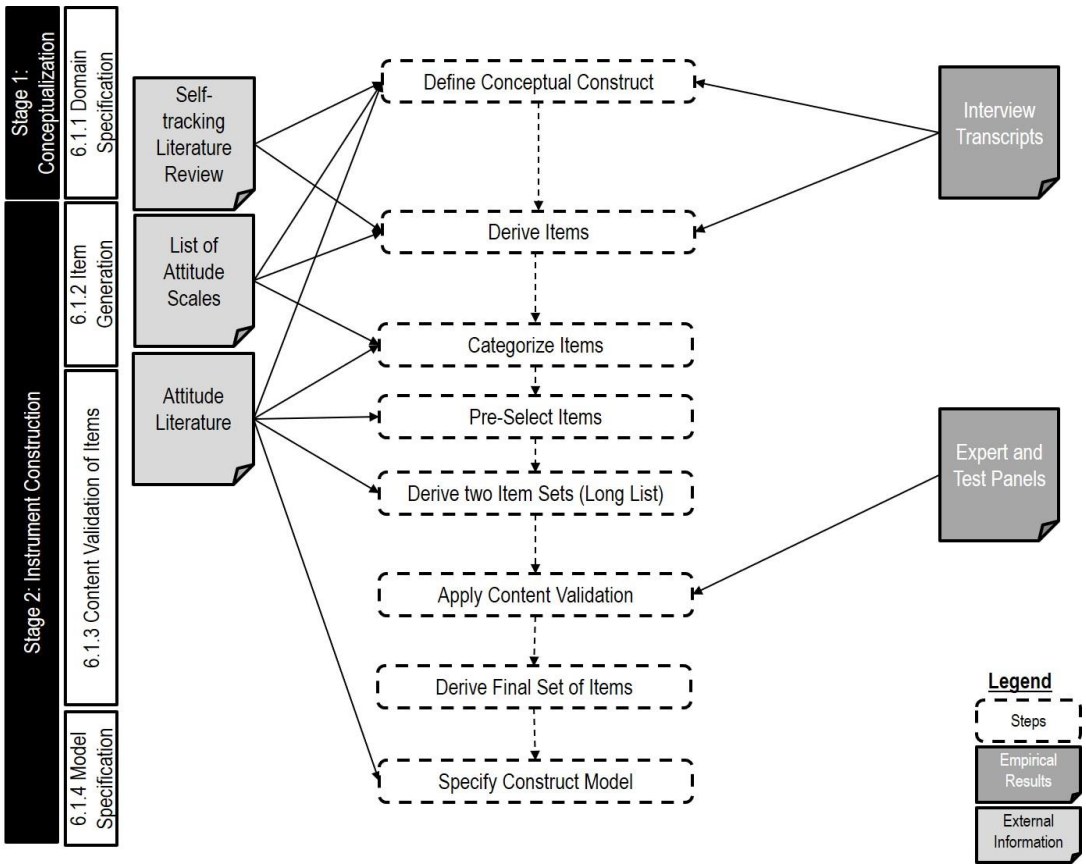



**Figure 45.** Detailed Overview of Conceptualization (Stage 1) and Instrument Construction (Stage 2) as Elaborated from Section 6.1 to 6.4

In accordance to Recker und Rosemann (2010), the structure of the method section follows the major stages and tasks of construct development (stage 1 and stage 2). Figure 45 presents the structure and approach applied in this section. Stage 1 is covered in Subsection 6.1.1 (p. 113) and derives the conceptual domain specification from four sources: a literature review on self-tracking, a list of attitude constructs, literature on attitudes, and interviews. The second stage is covered by three subsections which are divided in various steps. Subsection 6.1.3 (p. 117) explains item generation which also encompasses the categorization of items. The categorization servers for the pre-selection and allocation of items to two different item sets. Then, the purification of the long list with content validation leads to the derivation of the final item sets (short list). Finally, Subsection 6.1.4 (p. 122) describes the model specification that explains the relationship between the items and the construct. The model specification serves for future statistical validation.

### 6.1.1 Domain Specification

Domain Specification is one of the most elementary steps in construct development. A clear idea about which latent construct should be measured represents the necessary foundation for construct

development. Domain specification is also about showing how the construct is different from other instruments that already exist.

Lewis et al. (2005) suggest three major aspects that specify the domain of a construct:

1. The premise, purpose, or importance;
2. The conceptual definition;
3. A list of dimensions.

MacKenzie et al. (2011) provide a more detailed description than Lewis et al. (2005) of the major aspects of domain specification. Yet, MacKenzie et al. (2011, p. 298–299) mostly focus on the conceptual definition and the "entity to which it applies", i.e., a person, relationship, process, or task. They describe four major factors that constitute the construct conceptualization:

(a) Focal construct: An examination of research or work practices establishes the exact meaning of the phenomenon that the construct measures. Such research or work practice encompasses a literature review, previous theoretical and empirical insights, and experts or practitioners in the domain of the subject matter.
(b) "Nature of the construct's conceptual domain": The specification encompasses the so-called property (what the construct represents, i.e., thought, perception, behavior) and entity (to which the construct applies).
(c) "Conceptual theme of the construct": The specification consists of precise vital attributes, characteristics, dimensionality, and stability of the construct.
(d) Definition of the construct: A definition should
    i. Be clear and concise (detailed but concise definition);
    ii. Not be subject to multiple interpretations;
    iii. Not contain wording too technical (no narrow meaning);
    iv. Be a positive definition of the construct (not defined by negation);
    v. Not be "circular, tautological, or self-referential."

Finally, MacKenzie et al. (2011) also suggest carefully considering different dimensions of a construct.

Scholars from various disciplines (and notably from the IS discipline) suggest taking into consideration various material for the domain specification. Lewis et al. (2005, p. 391) lists literature reviews, "case studies, open-ended questionnaires, interviews, or some combination of these sources". The domain specification in this dissertation is based on three pillars: a literature review on self-tracking in different disciplines in Chapter 4 (p. 67), a detailed analysis of the concept of attitudes in Section 2.4 (p. 21), and interviews presented in this chapter. The qualitative and open interviews help to gain empirical insights into the phenomenon and items for construct development.

Open and narrative interviews (in person and per Skype/telephone/Google Hangout; average duration 40 minutes) represent one possible method for exploratory research to get a better idea of attitudes toward self-tracking (Bortz and Döring 2006, Jäger and Reinecke 2009, Stier 1999). The decision to renounce any fixed questions allows fully following different directions and examining diverse perspectives. Instead of interviewees being asked directly for their opinions, they were requested to project their attitudes on a peer (Donoghue 2010). Called a third-person technique, this offers interviewees the possibility of overcoming difficulties in expressing thoughts, emotions, and opinions. Accordingly, the semi-structured-interview format contains three central questions: (1) What personality traits, attitudes, and opinions drive self-trackers? (2) What personality traits, attitudes, and opinions drive non-trackers? (3) Do you engage in self-tracking and do you like this activity?

Prior to the interviews, participants received information about confidentiality and anonymity of their interview responses (Jäger and Reinecke 2009, Myers and Newman 2007), and they could agree or disagree to audio recording (one declined voice recording).

To gather insights from early-adopters/heavy users, nine participants from the QS-Meetup community were recruited. Participants with publicly available contact information received an invitation message. In order to diversify the panel and overcome elite bias (Myers and Newman 2007), 15 other participants were added, out of 32 contacted individuals identified through online research for blogs, web sites, articles, and on Facebook: dietary consultants, sport and fitness

researchers, sociologists, HCI researcher, historian psychologists, students, and journalists. In total, the sample consisted of 7 female and 17 male participants, aged between early 20s and late 60s. The interviews took place in two rounds and two countries: the first round took place in Switzerland (Basel/Zurich) and the second in Germany (Bamberg/Nuremberg).

Following best practices in qualitative research, the sample was as heterogeneous as possible (Robson and McCartan 2011). In this regard, the chosen approach also differs from prior attempts to investigate self-tracking in a qualitative way (e.g., Choe et al. (2014), Rooksby et al. (2014)), given that authors in these studies largely focused on participants who already use self-tracking devices on a regular basis. This dissertation attempts to also include non-adopters outside the QS community, in order to pay particular attention to the differential thoughts and opinions of adopters vs. non-adopters. Data was recorded via audiotape and transcribed later. In 10 of 24 cases, a second researcher was integrated in the process to increase evaluation objectivity.

The interviewee's responses and statements concerning self-tracking serve as a first basis for item generation described in the next section.

### 6.1.2 Item Generation

After having clearly defined the domain of the construct to measure attitudes toward self-tracking, item generation follows. As described above, the literature reviews and the qualitative interviews result in the formulation and gather a large pool of items. In order to derive meaningful items, the interviewees responses serve as input, and they are compared to previous attitude items discovered in the literature. The item generation process involved 213 pages of written transcripts from all 24[32] interviews. The interviews (qualitative data in the form of text) were subjected to content analysis (see Section 3.1, p. 34, for more details).

As suggested by Lewis et al. (2005), the whole set of material was analyzed in different iterations. Three individuals independently reviewed the transcripts, and each conducted one content analysis iteration for all interviews. Two iterations were based on a paper and pen method (i.e., marking sentences and paragraphs and noting comments) and another iteration that took place later was conducted by computer-assisted analysis using MAXQDA 12.[33] The transcripts were coded according to several categories: text passages and statements concerning the interviewee's and a third person's (1) positive feelings and opinions on self-tracking activities, (2) negative feelings and opinions on self-tracking activities, and (3) activities and experiences with self-tracking. The results of two iterations were manually merged, in the form of a face-to-face session, and possible items were formulated either by employing the formulation of the participant or with slight adaptations by the researchers in order to ensure proper item formulation. It follows DeVellis's (2012, p. 61–86) objectives for proper item formulation: length of item, readability, multiple negatives, double-barreled, ambiguous pronoun references, and misplaced modifiers.

Due to the different types of sources (manual and electronic) of the coded material, no inter-rater reliability is calculated. All in all, the manual process of merging the results of the first two iterations revealed a high level of accordance. In the case of disagreements, both researchers discussed the inclusion or exclusion of a text passage in order to find consensus. All resulting items were collected in an Excel file (392 total distinct items). The extent of the collected items needed to be refined, so following the literature (Smith et al. 2014), a first sample size for further construct development varied around 60 different items to achieve a sufficient number for the refined item set.

In order to properly select items for the long list, a categorization of the items took place. Insights from the literature reviews on self-tracking (see Section 2.3, p. 17) and on attitudes (Subsection 2.4.1, p. 22) provided input to establish necessary properties of attitudes for selecting relevant items that properly measure the intended construct. The identified properties encompass the direction of the attitude (toward an object or behavior), the sentiment[34] (positive or negative), the dimension (affective, cognitive, conative), and the type (indirect, general or direct, adjective). Considering these essential properties of attitude scales, the item selection for the new attitude

[32] For the one participant who did not consent to audio taping, personal notes from the interviewer and the second researcher present were taken into consideration.
[33] The software was not available to the researchers before.
[34] Different sentiments are often employed in order to avoid inter-individual biases (Dovidio and Fazio 1992, p. 217, Tanur 1991, p. 209).

construct covers all necessary attitude aspects and can be employed for various investigations within private (IS) research.

First, the direction of an item was easily determined. Only a small number of items obviously expressed an attitude toward an object. Participants expressed their attitude toward an object mainly in relation to self-tracking devices or intangible objects, such as numbers. In general, the categorization of the direction did not pose major problems or insecurities. In just four cases, the direction of the items could not be assessed because they were formulated too generally. For that reason, a separate category was created that includes such items without any explicit direction.

Second, the determination of the sentiment of an item already took place during the content analysis (reading through the transcripts and coding of the content). A structured review revealed that in four cases, a wrongly allocated sentiment had to be corrected.

Third, the dimension (affective, cognitive, and conative) of each item was assessed. The assessment follows the distinction identified in constructs in the literature (Appendix 9.2, p. 180), especially from Shih et al. (2015), Yang and Yoo (2004), Crites et al. (1994), and Thompson et al. (1991, 1994). The formulation structure of an item and notably the employment of attitudinal adjectives/adverbs helps to distinguish the dimension. For that reason, the attitudinal adjectives/adverbs of the derived items lead to the assessment of their dimension. Plutchik's (1990, 2001) framework of emotions led to the distinction between affective and cognitive adjectives, adverbs, and nouns. Affective items included the following adjectives describing attitudes toward self-tracking, according to Plutchik (1990, 2001):

- likable/dislikable
- happy/annoying
- bad/good or great
- lovable/hateful
- delightful/sad
- calm/tense
- excited/bored
- relaxed/angry
- acceptable/disgusted
- joyful or enjoyable/sorrowful
- positive/negative
- desirable/undesirable or frightening
- distracting/obsessive

The following attitudinal adjectives directing self-tracking were derived from the item assessment itself:

- stupid
- idiotic
- uncomfortable or painful/comfortable
- serious
- sensible
- stable
- satisfying
- motivating/demotivating or frustrating
- monster/religion-like
- natural
- exhausting or destructive or struggling
- embarrassing
- convincing
- worrying or confusing
- exciting
- strange

Cognitive items contained the following evaluations:

- wise/foolish
- useful/useless
- safe/unsafe
- beneficial or reward/harmful
- valuable/worthless
- perfect/imperfect
- wholesome or healthy/unhealthy and sick
- successful/educational
- providing/unproviding
- having a need/problem/goal
- reflection/verification/understanding
- competitive
- complex
- structure
- conscious/awareness
- easy/difficult
- important/unimportant

The assessment of conative items was easier, as they describe a behavior around self-tracking. Examples are the following:

- When self-tracking helps the individual with something (e.g., reaching a goal)
- When another behavior is motivated/induced (e.g., using less hot water while showering)
- When self-tracking is needed for another behavior (e.g., training for a marathon)
- Self-tracking is a routine/ritual (e.g., stepping on a weight scale)

For some items, the assessment of the item along a dimension was not precise because the item expressed either aspects of both dimensions (e.g., "I like self-tracking because I can share my data on performance then more easily") or lack of clarity as to which aspect was the primary one (e.g., "Self-tracking is good, it keeps me healthy"). Such cases were flagged and reviewed in more detail. On this account, either a decision was made, or the item was allocated to a mixed category. As an additional step, the opinion of study participants was taken into consideration to confirm or refute the assessment and thus reach an objective rating.

Fourth, an assessment verifies whether an item represents a general attitude (an expression about different aspects of self-tracking), a direct evaluation of self-tracking, or any activity related to it (often with an adverb and sometimes accompanied by a justification). This results in two different item sets that represent the different structure of attitude constructs identified in the context of the attitude-construct literature research (see Subsection 2.4.3, p. 26 and Appendix 9.2, p. 180).

As a result of the categorization of each item, the selection process began, which diminished the set of 392 items to a long list that could be used more effectively for further testing for validity and reliability. The selection focused on extracting items that measure attitudes toward self-tracking from those that measure anything else. Furthermore, it also diminished duplicates.

In order to apply the first test of validity, the next chapter evaluates if the two constructs really measure what they are intended to measure, called a test for content validity.

### 6.1.3 Content Validation

Domain specification and content validity (see 3.2.2, p. 45) represent one of the first steps usually applied to a newly developed construct. Notably, content validity is often disregarded in construct development. This is one major reason for this dissertation paying particular attention to these first steps of construct development, often ignored by scholars, to produce a clear and meaningful construct (Boudreau et al. 2001, Choudrie and Dwivedi 2005, MacKenzie et al. 2011, Petter et al. 2007, Straub, Boudreau, et al. 2004). After the elaboration on domain specification in Subsection 6.1.1 (p. 113), this section concentrates on content validity. On this account, the section introduces different types of content validation and describes the dissertation's chosen approach.

#### Types of Content Validation

In construct development, content validity ensures that the chosen items are relevant and essential, as well as appropriate for operationalization (measurement) of a construct (Ali et al. 2014). Content validity is also described as "the degree to which items in an instrument reflect the content universe to which the instrument will be generalized" (DeVellis 2012, Straub, Boudreau, et al. 2004, p. 242). For that reason, content validity ensures that a construct properly measures the phenomenon it is intended to measure. MacKenzie et al. (2011) deconstructed the approach to measuring content validity into two major goals: (1) Each individual item should represent an aspect of the content domain; and (2) the set of items should represent the complete content domain of the construct. Overall, the main result of a content validation consists of retaining, deleting, or modifying items and sets of items. Usually, content validity is rather qualitative in nature and implies a verification of the constructs in the context of a literature review or expert panel. Yet, there also exist quantitative methods (Tojib and Sugianto 2006) that gain increasing attention as they appear to be more objective and transparent (Ali et al. 2014).

Qualitative methods aim at identifying relevant items and allocating them to the final set of items, including possible dimensions. To that end, experts discuss the relevancy of each item and finally reach a group consensus (e.g., Delphi[35] or Q-sorting,[36] explained below) for a final set of items. Q-sorting, as an originally purely qualitative method, describes experts sorting items (written on cards) into theoretical categories (e.g., dimensions/concepts). The categories can be predefined or

[35] In multiple rounds, experts anonymously evaluate items until a consensus is reached (Tojib and Sugianto 2006).

[36] The name Q-sorting originates from the way of analyzing data of a questionnaire. In contrast to statistical (so called R-) methodologies "which produce similarity indices such as correlations among the column entries of a data matrix (e.g., … items" (Schriesheim et al. 1993, p. 396), the Q-methodology focuses on analyzing similarities among rows (e.g., respondents).

labeled by the participants. Several rounds may be needed to reach consensus by the group of experts that must meet and discuss their decisions (Schriesheim et al. 1993, Tojib and Sugianto 2006). Nowadays, scholars less often employ expert panels but rather rely on individual answers, as there are online-services (such as optimalworkshop.com) that offer online card sorting. Additionally, scholars use a combination of undefined categories in a first round and predefined categories in a second round (Choi et al. 2015, Dong et al. 2016, Moore and Benbasat 1991, Recker and Rosemann 2010). The methodology is especially helpful in confirming or identifying dimensions of multi-item constructs (Hinkin and Tracey 1999, London et al. 2017).

In contrast, quantitative methods focus on the statistical evaluation (reaching a defined threshold) of items by a sample of experts or representatives of the target population. Experts sort and rate items in several rounds, and the result is analyzed statistically (i.e., accordance of ratings or rankings) and evaluated qualitatively (e.g., modifications or inclusions) by the researcher (Lewis et al. 2005, Moore and Benbasat 1991, Tojib and Sugianto 2006). This leads to the calculation of a statistical ratio, e.g., content validity ratio (CVR), content validity index (CVI), weighted mean scores, or inter-rater agreement, which helps the scholar "to make decisions to retain or delete items" (Tojib and Sugianto 2006, p. 34). One of the most prominent quantitative methods was developed by Lawshe (1975) and describes experts' rating of both, each item individually as well as the complete set of items. Each item is evaluated for the level of relevancy usually using a three- or four-point evaluation range (1=not relevant, 2=important (but not essential), 3=essential). Then, item selection follows by calculating the content validity ratio (CVR).

The calculation of the CVR includes the number of items rated as essential ($N_e$) from the total number of items (N):

$$CVR = \frac{N_e - \frac{N}{2}}{\frac{N}{2}}$$

The ratio's result (varying between -1 and 1) reveals 100% agreement of retainment (CVR=1), lower but still acceptable agreement of retainment (0<CVR<0.99), and an agreement to delete (CVR<0). In many applications of this method, authors tend to consolidate the items rated as "important (but not essential)" and "essential" as $N_e$ (Ali et al. 2011, 2014, Karaiskos et al. 2009, Streiner et al. 2015). In order to control agreements by chance, Lawshe (1975) provides an overview of minimum ratings of the CVR with a statistical significance at a one-tailed alpha level of 0.05 (see Appendix 9.3.4, p. 209). Moreover, the content validity can be calculated at the dimension or the construct level. To that end, Lawshe (1975, p. 568) introduces the CVI for the entire instrument as "the mean of the CVR values of the retained items" that meets a threshold of 0.78 (Gilbert and Prion 2016).

The term CVI can be easily confused, as it has been reused for another calculation of content validity, the much more popular concept of CVI notable when a larger sample of experts exists. So, Lynn (1986) adapted the method from Lawshe (1975) and assesses content validity with CVI. In contrast to Lawshe (1975) who uses a binominal distribution, Lynn (1986) uses a normal distribution (Ali et al. 2014). The CVI is usually assessed on a four-point evaluation scale (1=not relevant, 2=somewhat relevant *or* relevant if reworded, 3=quite relevant *or* relevant with minor changes, 4=highly relevant) (Polit and Beck 2006, Zamanzadeh et al. 2015). Moreover, it can be calculated at the item level (called I-CVI/ICVI) or at the construct level (called S-CVI/SCVI). The answer options are often dichotomized into relevant (scale categories 3 and 4) or not relevant (scale categories 1 and 2) ordinals, which also allows using three- or five-point scales. The I-CVI is calculated by the number of relevant judgements for an item (A) divided by the number of experts who evaluated the item ($N_E$[37]):

$$ICVI = \frac{A}{N_E}$$

In order to take an agreement by chance into consideration, Lynn (1986) suggested using between 5 and 10 experts and considering a threshold for inclusion of 0.83. The S-CVI is computed by dividing the total number of items rated as relevant ($N_R$) by the total number of items (Polit and Beck 2006):

[37] Labelled N by the authors (Zamanzadeh et al. 2014). In order to avoid confusion variable was renamed "$N_E$."

$SCVI = \frac{N_R}{N}$

Yet, scholars criticize the method for not taking account of inflated values. For that reason, scholars suggest including an inter-rater reliability (K=kappa) calculation to estimate the agreement by chance correctly (Zamanzadeh et al. 2014). For calculating the inter-rater reliability, the probability of chance agreement ($P_C$) is determined according to the following formula:

$$P_C = \left(\frac{N_E!}{(A! * (N_E - A)!)}\right) * 0.5^{N_E}$$

Then, the following formula calculates the kappa: $K = \frac{(ICVI - P_C)}{(1 - P_C)}$

Kappa values above 0.74 are considered excellent. Kappa values between 0.74 and 0.6 or 0.4 and 0.59 describe a good or fair agreement beyond chance, respectively.

Overall, with the rise of online surveys, rather qualitative methods (notably Q-sorting) are implemented online, and additional placement ratios or ANOVAs can be calculated. On this account, items are retained, deleted, or modified (Anderson and Gerbing 1991, Hinkin and Tracey 1999). According to Tojib and Sugianto (2006), the most often employed techniques for validating the content of items are Q-sorting and CVR. Furthermore, scholars often use a combination of quantitative and qualitative measures.

Succeeding the presentation of the most frequently employed content-analysis approaches is the explanation of the selection and steps of the content validation chosen for the construct development.

Selected and Detailed Content-Validation Approach for the Dissertation

The approach for the construct development described in this chapter originates from approaches developed in IS literature (see Appendix 9.6.1, p. 208 for a schematic summary). Following Nunally and Bernstein (2010), participants for the content validation encompass both experts and representatives from the target population. The experts encompass psychometricians or psychologists, subject matter experts for self-tracking research and attitude research. The target population consists of possible respondents to a survey that investigates attitudes toward self-tracking. As a result, participants provide academic and expert feedback as well as feedback from the target population, which are supposed to be different (Yao et al. 2008). In addition, in order to have a heterogeneous sample, online evaluations were used to collect feedback from these various participants. Online evaluations are seen as highly accessible and easy to use and to analyze (Karaiskos et al. 2009). Therefore, they allow consulting experts and a target population worldwide (Ali et al. 2014, Choudrie and Dwivedi 2005). For the content validity of this chapter, online evaluations were implemented with the online platform surveygizmo.com and analyzed with Microsoft Excel for Mac. Moreover, an online evaluation was implemented for each item set generated with the help of the interviews and the literature review (as described in the previous subsection). Furthermore, in contrast to the suggestions from MacKenzie et al. (2011), Ali et al. (2011) and Newman et al. (2013) were followed combining quantitative and qualitative testing procedures, in order to have objective measurement as well as subjective feedback. This results in a more heterogeneous and robust result. The first round serves predominantly as a pretest for the content validation. The second round consists of a pilot test, and the final round is considered the main content validation round. Notably, the second and third rounds of content validation additionally focus on ensuring that the categorization of the items by dimension (affective, cognitive, conative, see Subsection 2.4.1, p. 22) is correct. The detailed approach for each round is visualized in Figure 46 and described in the following.

**Step 1 – Preparation Pretest:** According to Lewis et al. (2005), a pretest for the content validation of an instrument mainly consists of a small sample of individuals who represent the target population. A pretest focuses on evaluating the clarity and comprehensibility of the instruction texts. In addition, a pretest also checks the design of the questionnaire. Thus, participants with an academic background (students) experienced with self-tracking or with surveys in general were selected. The participants were contacted by email with an invitation to the survey. The survey was implemented for each type of construct: direct, adjective attitude items (A) and indirect, general attitude items (G). The survey consisted of four pages; more details for selected items can be found in Appendix 9.6.3, p. 211:

- The first page introduced the goal of the questionnaire, explanations, and the procedure;
- The second page showed the first version of the instrument (instruction text and items operationalized with a seven-point Likert-type evaluation scale);
- The third page offered possibilities to evaluate or modify each item (e.g., clarity, conciseness) and leave comments;
- The fourth page assessed the expert level of the participants.

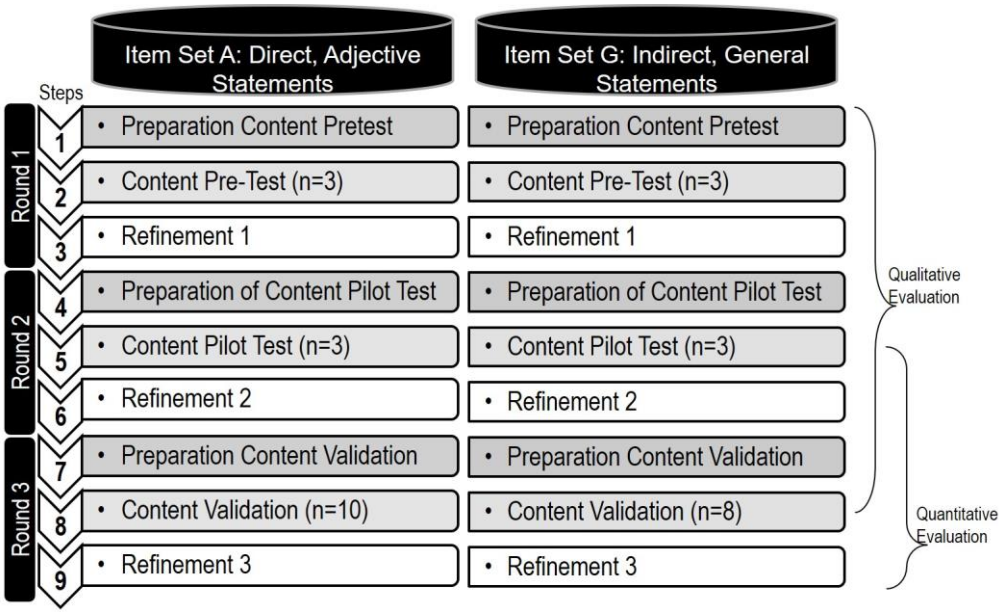



**Figure 46.** Nine Steps to Validate Content Analysis of the First Set of Items in Three Major Rounds

**Step 2 – Content Pretest:** Before the email with the invitation to the pretest was sent, 16 students were invited to a short prescreening to sort possible participants for the different validation round. The prescreening contained questions assessing the experience of participants with survey administration, survey completion, attitude constructs, and self-tracking. Questions to identify participants with less knowledge of attitudes or construct development helped to assess if a participant rather qualified for the first round or the second round of the content validation. Out of the 16 students, 12 answered the prescreening.[38] Three students qualified for the second round (step 5) and the remaining nine students received the invitation to the pretest for the content validation. Four and five students respectively received an email with the link to either the questionnaire for the direct (A) or indirect (G) items. With three completed content validation pretests, the survey was closed and analyzed to obtain a first refinement.

**Step 3 – Refinement 1:** Data analysis for the first refinement mainly consisted of identifying difficulties of participants with individual items and in recording first suggestions for deletions, modifications, or new items. To that end, the responses of the three completed surveys were compared and critically reflected upon. This led to the modification, deletion, and retainment of items for both item sets (A and G).

**Step 4 – Preparation Pilot Test:** Pilot testing is like a wedding dress rehearsal before the wedding day (Lewis et al. 2005). The refined sets of items (A and G) from the first round were presented to domain experts from academia, as well as individuals from the target population. The goal of this evaluation was to have a first impression of the representativeness of each item (and the complete construct itself). This also included feedback on the comprehensibility and comprehensiveness. For that reason, the pilot-test asked the participants to determine the level of necessity (necessary, important, not important) of each item. At the same time, the participants sorted each item to a dimension (affective, cognitive, conative). As a result, this procedure consisted of a combination of a Q-sorting (with predefined dimensions) and ranking. Invitations were sent out via email. The

[38] One email address was not valid anymore and three students did not respond at all, even after three reminders.

survey consisted of five pages and more details for selected items can be found in see Appendix 9.6.4, p. 214:

- The first page introduced the goal of the questionnaire, explanations, and the procedure;
- The second page provided a text field for qualitative evaluation of the instructions for the Likert-type evaluation scale;
- The third page included an exemplary training in evaluation procedure, mentioned in Moore and Benbasat (1991) and Recker and Rosemann (2010). which includes various aspects about an automobile, see "Page 4" of Appendix 9.6.4, p. 214. This was to ensure that participants fully understood the task of sorting and evaluating items in relation to a construct definition and the scale's dimensions;
- The fourth page consisted of the actual evaluation of the items for the construct of interest. The participants were asked to evaluate each item and sort it to a corresponding dimension. Additionally, comments for each item and suggestions for new items could be given;
- The fifth page offered the possibility of leaving any comment and some background information about the participant.

**Step 5 – Content Pilot Test:** The pilot test was sent out to six individuals who all evaluated the items. The sample includes four students who were recruited with the prescreening in round 1.

**Step 6 – Refinement 2:** The analysis of the results employs a quantitative and qualitative component as it includes numerical ratings and suggestions from the participants. The participants evaluated the instruction text and the items through a drop-down menu with ratings and an open text field. The results of the analysis led to deletions, modifications, and retainment of items.

**Step 7 – Preparation:** Following the suggestions from DeVellis (2012), experts rated the relevancy of each item to the phenomenon it was intended to measure. The major content validation, also called item screening, according to Lewis et al. (2005), consists of a prevailingly quantitative procedure similar to the one in the pilot test (see Appendix 9.6.4). Again, Q-sorting served to validate the allocated dimensions for each item at the same time as rating the relevancy. Finally, qualitative feedback in open text fields was taken into consideration.

**Step 8 – Content Validation:** A larger sample of experts was selected for attitudes and self-tracking. Sixteen scholars with a background in psychology (experts on attitudes and construct development) and IS (experts on self-tracking) were contacted. For each item set (A and G), eight scholars were invited to evaluate the items. For item set A, 10 individuals evaluated the item set. For item set G, even with three email reminders, only eight individuals evaluated the item set. As Lawshe (1975) indicates that five individuals are sufficient (also see Appendix 9.6.2, p. 209) and other content validation (see Appendix 9.6.1, p. 208) reveals sample sizes between 6 and 35 participants for one to multiple rounds of content validation together, no more individuals were recruited and data analysis continued. As a result, the total number of participants in the content validation rounds of this dissertation (11 for item set A and 13 for item set G) is situated within the range of previous studies. Moreover, some participants found the evaluation to be challenging. On this account, it was decided to rather rely on the evaluation of a few knowledgeable participants (who have expertise on assessing attitudes) instead of just increasing the number of participants who are familiar with self-tracking, because it is easier to recruit them than attitude- and construct-development experts, as Choi et al. (2015) or Recker and Roseman (2010) did.

**Step 9 – Refinement 3:** The results of the major content validation round were analyzed qualitatively and quantitatively. Feedback on the instruction text and items was evaluated qualitatively. Then, as suggested by Lewis et al. (2005), the CVR and the CVI was calculated for each item. To this end, the rankings from the second and third rounds were combined. Again, the results led to deletions, modifications, and the retainment of items.

After having finalized the evaluation of the items, the model specification is the next step that visualizes the results and serves as input for the statistical validation of the construct in the future.

### 6.1.4 Model Specification

Having established content validity of the set of items, model specification followed. MacKenzie et al. (2011, p. 306) describe a measurement model[39] as an adequate formalization of "the expected relationship between the indicators [i.e., items] and the focal construct[40] and/or sub-dimension they are intended to represent".

Such items "refer to a variable [i.e., construct] that is directly associated with a latent variable [i.e., construct] such that differences in the values of the latent variable [i.e., construct] mirror differences in the values of the indicator [i.e., item]" (Bollen 2001, p. 7283). Items show three dichotomous characteristics. These characteristics refer to:

- Causal or effect items;
- Multiple or single items;
- Items describing a continuous or non-continuous construct.

Causal items impact the construct and effect items are driven by the construct (Bollen 2001). Effect items and their underlying relationship are most often assumed in construct development. The term initially stems from intelligence testing where intelligence items are driven by a person's intelligence. Yet, over the years and with the surge of construct measuring in other domains, the effect relationship between items and latent constructs could not be supported all the time. For example, regarding the construct "exposure toward stressful life events," life events (e.g., marriage, moving, changing jobs, divorcing) cause the exposure to stress, which is a latent construct (Bollen and Bauldry 2011). Other scholars call causal or effect items also formative or reflective items. Reflective items "are affected by an underlying latent, unobservable construct" (Petter et al. 2007, p. 624). Such items constitute "a representative sample of all the possible items that are available within the conceptual domain" (Hair et al. 2017, p. 47). This implies that the items correlate highly with each other, are interchangeable, and can be omitted if reliability is ensured. Items that "determine a construct are called causal or formative indicators [i.e., items]" (Petter et al. 2007, p. 625) literally form the construct,[41] are not interchangeable, and omitting one item would change the nature of the construct. Figure 47 shows the different relationships between the different types of items (reflective or formative) and a focal construct (reflective or formative).

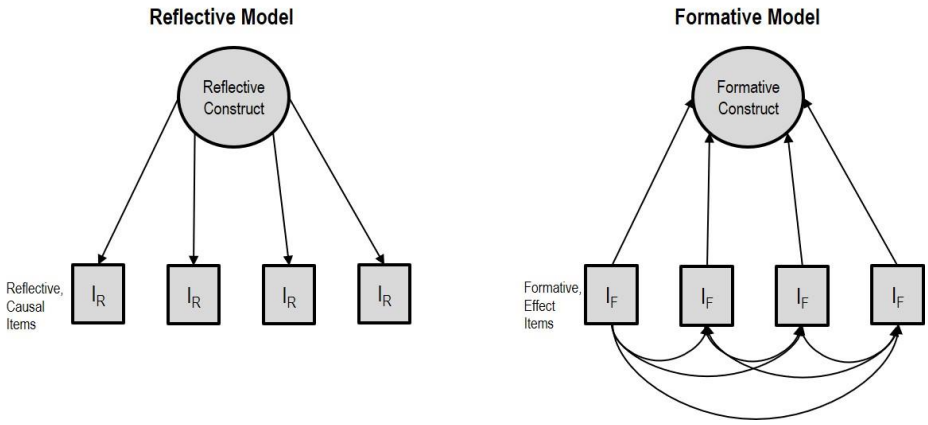



**Figure 47.** Graphical Representation of Reflective and Formative Models (Straub and Gefen 2004, p. 388) or (Petter et al. 2007, p. 626)

Scholars must carefully consider if items are of a causal or an effect nature, because the procedure of statistical validation depends on the type of model (Bollen 2001, Hair et al. 2017, MacKenzie et al. 2011, Petter et al. 2007). For that reason, Bollen (2001) suggests undertaking mental experiments to test if an item is causal or an effect related to the focal construct: Does a shift in the item impact the focal construct, or the reverse? As an example, Bollen (2001) uses the focal construct of "exposure to media violence." Items measuring the "time spent watching violent television," "time spent playing violent video games," or "number of views of violent videos" are

[39] In contrast to the structural model that "describes the relationships between latent constructs" (Hair et al. 2017, p. 44).
[40] The definition of a focal construct and dimensions can be found in Subsection 6.1.1, p. 64.
[41] Strictly speaking, there exist two types of items for formative constructs: causal and composite items, which enable formative measurement. Composite items "fully capture every aspect of a latent phenomenon" (Hair et al. 2017, p. 48). As it is rather unlikely to gather every aspect of a phenomenon, causal items exist. They include an error term which "captures all the other causes of the latent variable [i.e., construct] not included in the model."

causal to the exposure to media violence. Increased time spent playing violent video games also increases the exposure to media violence. In contrast, the direction of the impact is not reversible; an increase in exposure to media violence does not necessarily impact the time spent playing violent video games. Hair et al. (2017) and Coltmann et al. (2008) provide precise guidelines that help to decide on the correct measurement-model structure. They categorize the major criteria that support decision making about the relationship between items and focal constructs (see Appendix 9.6.6, p. 221).

Moreover, the number of items of a latent construct is an important aspect of a measurement model (Bollen 2001). Measuring constructs with multiple items is generally preferable. This entails a more detailed description of the phenomenon the construct intends to measure. For example, in school, an exam often consists of different questions testing different aspects of the taught content. In contrast, it would be difficult to determine if a student has adequately understood and acquired the relevant knowledge when only one question is asked. As a result, there would remain a high probability that the student just studied one aspect of the content and was lucky with the selection of the question.

Additionally, continuity represents a relevant aspect for measurement modeling, which needs to be determined. It refers to the “infinite graduations of magnitude” (Bollen 2001, p. 7284) of the latent construct that may be approximated by the items. Usually, items only allow an approximation of continuous constructs, due to commonly used measurement methods that do not allow infinite graduations. For example, the attitude toward the right of abortion represents a continuous construct. In general, individuals show varying levels of support or disapproval toward the right of abortion. Individuals are not completely against abortion in certain instances, e.g., in the event of rape. However, items that measure these attitudes toward the right of abortion are usually evaluated and approximated with three-, five-, and seven-point Likert-type evaluation scales (e.g., for three categories: agree, neutral, do not agree). In contrast, noncontinuous constructs are measures with interval units, such as population size, number of children, or counts of wrong answers on a test. The continuity of items and latent constructs helps the researcher to select methods for statistical validation (e.g., confirmatory analysis).

Finally, Bollen (2001) adds that a clear domain specification is indispensable for a measurement model. In the case that dimensions are defined, they should be represented as a separate latent construct. These separate latent constructs are also called second-order constructs (e.g., service quality satisfaction, price, service personnel), which represent one aspect of the so-called first-order construct (e.g., satisfaction) (Hair et al. 2017). In the case of multiple dimensions, the relation between the items and the dimensions often require a reflective measurement (Coltman et al. 2008).

All these aspects described above help to clearly structure the construct and enable statistical validation, part of future work beyond this dissertation. Being aware that usually researchers develop different versions of measurement models (Hair et al. 2017), this dissertation only provides one version. It can be used for finalizing the construct development in combination with the statistical validation, as data is generally needed for the finalization of the measurement model. In order to reach this last step of the construct development of the dissertation, the next section presents all results.

## 6.2 Results of Conceptualization, Instrument Construction, and Instrument Validation

As a first step, the interviews described in Subsection 6.1.1 (p. 113) offer multiple insights concerning attitudes toward self-tracking. The results guide the domain specification and the item generation. As explained above, a content analysis of the interview transcripts allows the derivation of the following major insights.

First, while acquiring the interview participants, it was observed that most individuals are not aware that they actually engage in self-tracking, because they do not exactly know what self-tracking encompasses. For example, P17 (participant number 17) was not aware of the fact that his or her note-taking behavior related to his or her gas consumption can be considered self-tracking. However, after clarifying the meaning of the term, he or she realized that his or her notes about his or her gas consumption represent a self-tracking activity. Furthermore, in the course of the interviews, the participants (e.g., P2) realized increasingly the possible ways in their everyday life

that they also engage in self-tracking of their private activities (e.g., menstruation cycle, smoking cessation).

Second, six interviewees answered that there is no specific persona (i.e., precise demographics) of a self-tracker. In the course of the interviews, they realized that their first impression of a typical self-tracker (young male in his thirties with a technical background) was not confirmed when thinking about peers who actually engage in self-tracking. As an example, elderly relatives or friends of participants were engaged in self-tracking, even though they do not show a high technology affinity. Furthermore, P18 stated: "*women just do not show such a great affinity*"; however, later in the interview, the interviewee revealed: "*The Fitbits, the pedometers, have – I think – 60% women in their user groups. And also sleep trackers are really popular for women.*" On this account, it is questionable whether individuals interested in self-tracking share the same demographics.

Third, self-tracking is not bound to specific devices or technologies. Inquiring of the participants revealed a wide range of self-tracking activities that also include various analogue self-tracking methods: pen-and-paper-based, apps, or Excel sheets that help to track water drinking, well-being, medication, mileage, financial expenditures, fitness levels, weight, and blood-sugar data. Many participants were already engaged in analogue tracking before technology was perceived as a way to ease their measuring efforts. As a result, self-tracking does not seem to be bound to technology.

Fourth, the interviews revealed different motives for different groups of individuals. Six participants categorized self-trackers into two-to-four segments. They mainly detected the following categories of self-trackers:

- Long-term users and pattern-seeking individuals: P12 defined them, e.g., as individuals who "*compulsively record a number of data streams with no end date."*
- Goal-pursuing individuals: P12 describes self-trackers as individuals who want "*to accomplish a specific goal within a limited time frame, e.g., the person who wants to lose 10 lbs. over the course of six months and tracks their calories and activities.*"
- Problem-solving individuals (in particular for medical purposes): P12 reveals that there are people who have "*a problem but do not know what causes it and therefore monitor a wide variety of potential factors" with self-tracking.*
- Short-term users: Individuals who use self-tracking systems out of curiosity and only for a short period of time are rather considered short-term users. P4 states that "*once you know how much you walk on a usual day, then you do not need the numbers anymore*."
- Sharing individuals: Even though part of the participants stressed the fact that self-trackers do not need to share their self-tracking results, another participant states that self-trackers tend to like to share their data. This represents a meaning of self-presentation and peer comparison.

Finally, the interviews revealed that a specific affinity or aversion toward self-tracking exists among individuals. P4 underlines: "*I think there are people who just like taking measures or tracking. … Twenty years ago, I already went to the fitness center and there was some kind of document, which you had to fill out and you had to fill in measures, the measured time or number of steps or any data, of course, I did not enjoy it. I abandoned that pretty fast, but there were people who did that with very big meticulousness, they recorded always what they did.*". Furthermore, P16 states that there are people "*who reject that [i.e., self-tracking] or who are not into it.*"

All in all, the key findings of the interviews encompass the observation that according to most interviewees, demographics (e.g., gender, age, education) may not well predict self-tracking behavior. Moreover, technology merely seems to enhance an innate tendency shared by individuals to quantify their lives; they tracked several metrics before dedicated self-tracking technologies arrived. Furthermore, self-tracking is driven by different motives that can be divided into five types of motives of self-trackers. Finally, several participants underlined that some people clearly demonstrate a strong positive or negative attitude toward self-tracking.

In order to measure the observed affinity in a more precise and organized way, the following sections describe and present the results of the construct-development procedure described in Subsections 6.1.1 through Subsection 6.1.4 (pp. 113-122).

### 6.2.1 Domain Specification

The domain specification of the attitude toward self-tracking lays the foundation for the construct development and indicates helpful information for other scholars who attempt to use the construct in the future. The first part defines the domain specification according to Lewis et al. (2005), and the second part follows the definition from MacKenzie et al. (2011), presented in Subsection 6.1.1 (p. 113).

To begin, **Lewis et al.** (2005) suggests elaborating on the premise, purpose, or importance. According to the aspects defined by Lewis et al. (2005), the (1) premise must be elaborated on at first. The purpose of the construct consists of measuring attitudes (positive and negative feelings, thoughts, opinions, or behaviors) of individuals toward a behavior or activity that includes one or more of the actions of self-tracking (see Section 2.3, p. 17). The attitude construct has the potential to enhance IS research on self-tracking and therefore helps to explain why some people are more prone to using self-tracking devices than others. The construct can also be employed in different technology-usage phases, such as adoption and (dis-)continuance research (see Section 2.2, p. 14). Taking all together, the (2) conceptual **definition of attitude toward self-tracking** is the following:

> A pre-disposition to respond (affectively, cognitively, or in a conative way) favorably or unfavorably to actions implying one or more of the following self-tracking actions: self-measurement, data collection/storage, analysis, reflection, and behavioral change concerning private activities.

As already discussed in Subsection 2.4.3 (p. 26), currently employed attitude constructs do not consider the tripartite or dual theory of attitudes any more (with some few exceptions; see Appendix 9.2, p. 180). For that reason, following Bhattacherjee et al. (2018), the construct development pays specific attention to the different dimensions of attitudes defined in the tripartite view of attitudes. As a result, (3) the dimensions of the attitude-toward-self-tracking construct correspond to the typical (but often neglected) ones suggested by literature: affective, cognitive, and conative.

The dimensions are based on Bagozzi (1978, p. 10) and Joyce and Kirakowski (2015, p. 507). For that reason, they are defined as follows:

- Cognitive attitudes: one's thoughts, beliefs, or opinions of items of fact toward self-tracking;
- Affective attitudes: one's positive-negative feelings or emotions toward self-tracking;
- Conative attitudes: one's action tendencies toward self-tracking.

According to **MacKenzie et al.** (2011), the domain specification encompasses research on the (a) focal construct in prior literature. The literature reviews on attitudes and self-tracking (Section 21, p. 21, Chapter 4, p. 67, Appendix 9.2, 180) did not disclose specific construct definitions for attitudes toward self-tracking. Scholars considered only other constructs (e.g., motivation, intention, perceived usefulness, self-control). Yet, there is a large body of attitude literature that helps to specify the construct of attitudes toward self-tracking (see definition above).

Then, the (b) nature of the construct's conceptual domain is defined by a general property and an entity. The general property is represented by the predisposition to respond positively or negatively toward an action related to self-tracking (self-measurement, storage, reflection, analysis, acting). The entity of the attitude toward self-tracking is a person, so the attitude is measured at the individual level. These aspects also comply with the terms from Fishbein and Ajzen (2010, p. 257) for correctly defining an attitude construct: the action, the target, the context, the time of occurrence. The action consists of one of the typical self-tracking actions; the target at which the action is directed is an individual; the context in which the action occurs is in the private life of an individual; and the time of the action's occurrence cannot be precisely specified in this context, but it is limited to the specific self-tracking action. Even though Nunnally and Bernstein (2010) suggest that the target should be precise with more details (e.g., age, ability level, or culture), the attitude toward the self-tracking construct does not target a specific age, ability level, or culture. Only the general ability of an individual to engage in self-tracking is relevant. This ability encompasses using pen and paper, a specific device, or an application to note quantitative and qualitative facts in some way.

As a next step, the (c) conceptual theme of the construct clarifies vital attributes, existing dimensions, and the stability of the construct. The vital attributes and characteristics of the construct

incorporate aspects about any action of self-tracking in the private life of an individual. It is important that the self-tracking action is not bound to a specific domain (such as fitness, nutrition, or consumption tracking). So, the domain specification assumes that individuals have a general predisposition that can be applied to various domains. Then, the three major components of attitudes (affective, cognitive, and conative) describe the multiple dimensions of the construct. In addition, the construct is stable over a certain time, but subject to external or internal changes (Maio and Haddock 2009). Furthermore, the construct can be used in different situations and is not limited to a specific self-tracking application domain).

In order to ensure that the (d) definition of the construct is as unambiguous as possible, the domain specification follows the literature and definitions that have been proven to be clear and concise, without multiple interpretations, worded without any technical terms, positively defined, and not self-referential. As a result, a typical measurement format widely used in IS research for adoption and (dis-)continuance research was chosen: namely, items to which an individual can agree/disagree on a seven-point Likert-type evaluation scale. As Scott (1968) shows, there is a plethora of measurement methods for attitudes. For that reason, the decision was based on current practices within IS research, in order to properly support scholars in conducting studies and integrating the attitude construct in typical models.

Following the domain specification of the attitude-toward-self-tracking construct, the following subsection presents the items derived from the item generation.

### 6.2.2 Item Generation

Overall, 392 items were derived from the interviews described in Subsection 6.1.2 (p. 115). In order to select a useful number of items for the construct, the items must be ordered and selected. To that end, each item is allocated to a direction (toward a behavior or an object), a type (adverb or general), a sentiment (positive or negative), and a dimension (affective, cognitive, and conative) of attitudes. Consequently, Table 29 shows the 34 groups of attitude items that resulted from the allocation. Furthermore, the table displays the number of total items per group and provides an exemplary item for each group in the last column.

**Table 29.** Overview of the Total Sample of Items Allocated to Subgroups Depending on Direction, Type, Sentiment, and Dimension

| Direction | Type | Sentiment | Dimension | Number of Items | Exemplary Item |
|---|---|---|---|---|---|
| ATB | Adverb | Positive | Affective | 39 | Self-tracking is playful. |
| | | | Cognitive | 10 | Self-tracking is useful for sports. |
| | | | Conative | 1 | Self-tracking is a routine/ritual. |
| | | Negative | Affective | 19 | Self-tracking is annoying. |
| | | | Cognitive | 8 | Self-tracking is time-consuming. |
| | | Positive + Negative | Affective | 2 | Self-tracking is annoying but pushes anyway. |
| | Adverb + reasoning | Positive | Affective | 11 | I like to measure/note things such that I do not forget anything. |
| | | | Affective + Cognitive | 4 | I like self-tracking because I can share my data on performance then more easily. |
| | | | Cognitive | 3 | I like to self-track because it helps me to get in detail information about myself. |
| | | | Cognitive-Conative | 1 | Self-tracking is a ritual that supports my psychic balance. |
| | | Negative | Affective | 7 | I dislike self-tracking because I dislike goals. |
| | | | Affective + Cognitive | 1 | Self-tracking is annoying – it only costs time. |
| | | | Cognitive | 2 | Self-tracking is not representative of activities/experiences. |
| | General | Positive | Affective | 28 | Self-tracking makes me happier. Self-tracking helps me to feel good and healthy. |
| | | | Affective + Cognitive | 2 | Self-tracking helps me to feel good and healthy. |
| | | | Cognitive | 126 | I have time to measure things. |
| | | | Cognitive-Conative | 1 | Self-tracking motivates me to change things (healthier lifestyle, more activities, mindfulness) |
| | | | Conative | 19 | I measure my weight regularly. |
| | | Negative | Affective | 22 | Self-tracking does not provide any pleasure. |
| | | | Cognitive | 36 | I find the exact documentation of different aspects about my life demanding. |
| | | | Conative | 7 | I do not want to wear a self-tracking device. |
| ATO | Adverb | Positive | Affective | 9 | Self-tracking apps are cool. |
| | | Negative | Affective | 8 | I dislike numbers. |

| Direction | Type | Sentiment | Dimension | Number of Items | Exemplary Item |
|---|---|---|---|---|---|
| | Adverb + reasoning | Negative | Affective | 2 | I dislike self-tracking because the devices are too expensive. |
| | General | Positive | Affective | 7 | I feel bad when there is a gap in the data set. |
| | | | Cognitive | 5 | Self-tracking devices are my personal electronical assistant. |
| | | | Conative | 2 | Self-tracking devices help me to be aware of my active life/movements. |
| | | Negative | Affective | 1 | Numbers do not motivate me. |
| | | | Cognitive | 3 | Measurements do not treat a sick person, it's people. |
| | | | Conative | 1 | I do not need exact numbers by self-tracking (for finances). |
| ATO+ATB | Adverb | Positive | Affective | 1 | I like the quantified self lifestyle. |
| | | Positive + Negative | Affective | 1 | I like self-tracking, but I do not want to use new technology because I am afraid of misuse of my data. |
| | Adverb + reasoning | Positive | Affective | 1 | I like self-tracking/numbers because it/they help me realize that something is happening. |
| | General | Negative | Conative | 1 | I cannot allow myself to gather data on specific topics. |
| Total | | | | 392 | |

As a next step, the reduction of the 392 items to a useful number of items proceeds. The recommended and usually chosen number of items for content analysis amounts to 40-65 items (DeVellis 2012, Lee and Cheung 2013). To this end, a large number of items had to be dropped in order to reduce the 392 items to a first long list that serves as a basis for the content analysis. The rule set for this reduction aims at avoiding similarities among items, being precise about the construct, increasing clarity, and staying focused on relevant aspects in order to measure attitudes toward self-tracking (DeVellis 2012). As a result, the following decisions were made:

- In order to concentrate on ATB (self-tracking), all 38 items concerning ATO were dropped.
- In order to avoid a technology-based center of attention on self-tracking, 10 items were dropped.
- In order increase clarity, all items that could not be clearly allocated to a distinct direction (ATO+ATB), sentiment (positive+negative), or dimension (cognitive+affective) – nine items – were dropped.
- In order to respect the different types of items, two different item sets were generated: one item set focuses on direct, adjective evaluations (A) of self-tracking and the other one on indirect, general evaluations (G) of self-tracking and related aspects.
- In order to avoid similarities between the formulation of one or more items of the same item set (which corresponds to a row in Table 29), only one formulation was chosen. For example, the reduction only considers one of the two formulations: “Self-tracking is time-consuming” and “Self-tracking is too time-consuming.”
- In order to obtain a reasonably sized and balanced set of items, up to six items per group were chosen for the short-list item set for the direct, adjective evaluations (item set A). For the indirect, general evaluations (item set G), 10 items per group were selected, because compared to the direct, adjective attitude items, the number of groups is smaller and the number of items per group is larger. Furthermore, for the direct, adjective attitude items, 5 out of 10 groups have five or fewer items. For the general items, one out of six groups has five or fewer items. Thus, the selection of items only took place in 5 of the 34 groups.
- For opposing sentiments, only one item was chosen, e.g., either “Self-tracking is fun” or “Self-tracking is no fun” was selected.
- In the case that an item was named several times in the interviews by different participants, they were definitively chosen for the selection.

Consequently, Table 30 and Table 31 show the selection of both item sets (A and G). As Table 30 shows, item set A contains 42 items that were used for the content analysis in the next subsection. Concerning the general items, Table 31 shows the 53 selected items.

**Table 30.** Final Selection of the Direct, Adjective Attitude Items for the Content Analysis (Item Set A)

| Direction | Type | Sentiment | Dimension (Number of Items) | Selected Items |
|---|---|---|---|---|
| ATB | Adjective | Positive | Affective (6) | Self-tracking is fun.<br>I like having an overview.<br>I am interested in collecting data.<br>Self-tracking is an alternative religion.<br>I like to note aspects about my private life.<br>I like to see my progress. |

| Direction | Type | Sentiment | Dimension (Number of Items) | Selected Items |
|---|---|---|---|---|
| | | | Cognitive (6) | Self-tracking is practical.<br>Self-tracking is a verification of my active life.<br>Self-tracking is preventative.<br>Self-tracking is competitive.<br>Self-tracking is easy.<br>Self-tracking is a reward. |
| | | | Conative (1) | Self-tracking is a routine/ritual. |
| | | Negative | Affective (6) | Self-tracking is painful.<br>It is unpleasant to find out things about my private life.<br>Weighting is frustrating<br>Self-tracking is annoying.<br>Self-tracking is embarrassing.<br>I dislike the amount of data that is generated through self-tracking. |
| | | | Cognitive (5) | Self-tracking is time-consuming.<br>self-tracking is too much structure.<br>Self-tracking is only money making.<br>Self-tracking is a compulsive need to control.<br>Self-tracking is too complex. |
| | | Positive + Negative | Affective (2) | Self-tracking is distraction.<br>Self-tracking is annoying but pushes anyway. |
| | Adjective + reasoning | Positive | Affective (6) | I am curious about things, so I like self-tracking.<br>Self-tracking is only interesting at the beginning.<br>Self-tracking is fun through the scientific appeal.<br>I like to measure/note things such that I do not forget anything.<br>I like self-tracking because it makes my performance more tangible for myself.<br>Self-tracking is cool because I have a history on things I did in my private life. |
| | | | Cognitive (2) | I like to self-track because it helps me to get in detail information about myself.<br>Self-tracking is extremely useful for medical problems. |
| | | Negative | Affective (6) | I am afraid of changes; thus, I dislike self-tracking.<br>I do not need self-tracking to know what is good for me. I intuitively know what is good for me.<br>I do not need self-tracking because I am satisfied with my life<br>I dislike self-tracking because I dislike goals.<br>I dislike self-tracking because others could misuse my data.<br>I dislike self-tracking because I do not want to be aware of my problems. |
| | | | Cognitive (2) | Self-tracking is not representative of activities/experiences.<br>I do not have problems, so I do not need self-tracking. |

**Table 31.** Final Selection of the Indirect, General Attitude Items for the Content Analysis (Item Set G)

| Direction &Type | Sentiment | Dimension (Number of Items) | Selected Items |
|---|---|---|---|
| ATB & General | Positive | Affective (10) | Self-tracking is like a religion.<br>It is interesting to document everything.<br>I feel guilty/bad when I do not self-track.<br>Measuring motivates me.<br>Self-tracking feels like an accomplishment.<br>I am happy to see when I reach my goal and I see that through self-tracking.<br>Self-tracking helps me to track interesting aspects such as expenses or my weight.<br>I need orientation in order to know when something is good for me.<br>Self-tracking supports stability.<br>I only have good experiences with self-tracking. |
| | | Cognitive (10) | Self-tracking helps me to reach my goals.<br>Self-tracking helps me to show others how sportive I am /proves how sportive I am.<br>Self-tracking helps me to control myself<br>Self-tracking helps me to learn things.<br>It is easier for me to fulfil my goals with facts and numbers on my performance (quantification)<br>Self-tracking helps me how much money I spend on what.<br>Self-tracking helps me to make things visible.<br>Self-tracking helps me to be disciplined.<br>I can act more conscious through self-tracking.<br>I have identified a problem that can be solved by measurements. |
| | | Conative (10) | Self-tracking helps us to improve room climate.<br>I do self-tracking in other domains of life.<br>I get training incentives from self-tracking.<br>Self-tracking helps to get into a success loop because I know that I reached my goals.<br>Self-tracking helps to remember.<br>In order to investigate how I can be more physical active, I use self-tracking. |

| Direction &Type | Sentiment | Dimension (Number of Items) | Selected Items |
|---|---|---|---|
| | | | Self-tracking helps for self-observation.<br>Self-tracking motivates me to change things (healthier lifestyle, more activities, mindfulness)<br>Self-tracking helps to be aware of things.<br>Self-tracking helps to be preventive. |
| | Negative | Affective (10) | I do not need self-tracking because I am fit and I feel good.<br>Self-tracking does not provide any pleasure.<br>It is strange to collect data about yourself.<br>Self-tracking distracts me (from my walking technique).<br>Self-tracking only produces data in order to patronize me/giving me disadvantages.<br>I am afraid of other using my self-tracked data.<br>I prefer individual support of a person when I want to change something in my life.<br>Self-tracking demotivates/frustrates me.<br>I prefer to listen to by body feeling.<br>I do not like noting things. |
| | | Cognitive (10) | I do not have time for tracking.<br>Fun/pleasure is much more rewarding than self-tracking.<br>I do not have a goal to reach so I do not need self-tracking.<br>I do not have the expertise to analyze data about my personal behavior.<br>I want to spend my time on other things than self-tracking.<br>Self-tracking does not help me to solve my problems.<br>When you self-track you take yourself too serious.<br>I do not see any benefits in self-tracking.<br>Some things are not measurable.<br>Without numbers and information, I know when something is good for me |
| | | Conative (2) | I do not have ambitions when playing sports.<br>Self-tracking does not help me to learn new things. |

After having derived items and reduced them to a long list of items, the next subsection presents the content validation that helps to refine the selected items.

### 6.2.3 Content Validation

Initially, content validity is established in a qualitative and non-empirical manner. With the help of the analyzed literature in the domain specification (see Subsection 6.2.1, p. 125), the formulation of the items is reviewed and checked. Furthermore, previously developed attitude constructs (see Appendix 9.2, p. 180) helped to assess the content of the items. Then, the focus lies on a quantitative and empirical validation. For that reason, 32 experts helped to validate both attitude item sets (A and G). Following the explanations of Subsection 6.1.3, p. 117, the detailed approach consists of three major rounds: (1) the content pretest, (2) the content pilot test, and (3) the content validation. The results of each round are explained for each item set as follows.

Overall, the **pretest** (steps 1-3, Figure 46, p. 120) mostly results in modifications of the items. For the direct, adjective evaluations (item set A, Table 30, p. 127), the first round of content analysis resulted in the deletion of one item (“Self-tracking is only money making”) because it was difficult to understand and strongly related to technology. Moreover, 18 items were retained and 23 were modified due to suggestions of the participants, as well as to deliberations of the researcher. For the indirect, general evaluations (item set G,

Table 31, p. 128) the first round of content analysis also resulted in the deletion of one item (“Self-tracking helps us to improve the room climate”) because it was difficult to understand and was considered to be too specific in terms of the domain (room climate). Moreover, 31 items were retained and 20 were modified due to suggestions of the participants, as well as to deliberations of the researcher. All results led to an adjustment of both item sets, which can be seen in more detail in Table 55, p. 214 (item set A1[42]) and in Table 56, p. 215 (item set G1).

In the next round, the **pilot test** (steps 4-6, Figure 46, p. 120), participants evaluated the modified item sets (A1 and G1) resulting from the pretest. The results of the pilot-test helped to improve the content of the items in two ways. On the one hand, the chosen dimensions for each item were confirmed or rejected by the participants because they sorted each item to one of the three possible dimensions (affective, cognitive, conative). On the other hand, the relevancy of each item to measure attitudes toward self-tracking was assessed. As a result of the dimension validation of the direct, adjective items (item set A1, Table 55, p. 214) the dimension of 11 items needed to be

[42] The number helps to differentiate the resulting item set of each round: A1 is the item set A after round 1, A2 represents the item set A after round 2, and A3 is the item set A after round 3.

reconsidered, as they differed from the initially allocated dimension. For nine items, the reconsideration is almost always accompanied by a reformulation or specification of an item. Moreover, the reconsideration also led to the generation of a new item. Furthermore, five items were marked for potential deletion after the third round of the content validation. All in all, the participants evaluated over 70% of all items from item set A1 as being relevant to measuring attitudes toward self-tracking. Consequently, these items were not modified and were definitively retained. Table 57 (p. 217) summarizes all modifications per item for item set A1, which results in the item set A2. In contrast, the evaluation of the second item set (item set G1, Table 56, p. 215) led to a reconsideration of the initially allocated dimensions of 19 items. Moreover, the reconsideration engenders a reformulation of seven items and a creation of one new item. Moreover, nine items were marked for a potential deletion after the third round of the content validation. All in all, the participants evaluated over 60% of all items as being relevant to measuring attitudes toward self-tracking. Consequently, these items were not modified and were definitively retained. Table 58 (p. 219) summarizes all modifications per item for item set G1, which results in the item set G2.

In the final round, the **content validation** (step 7-9, Figure 46, p. 120), attitude and self-tracking experts evaluate the item sets that resulted from the second round: A2 and G2. As the pilot test, the content validation fulfills two main goals: dimension validation and relevancy evaluation of each item. Surprisingly, two participants preferred to give additional verbal feedback when going through the survey. On this account, cognitive testing enabled receiving direct feedback on the understanding of the questionnaire with a thinking-aloud technique (Streiner et al. 2015). This helps to identify possible misunderstandings and to receive in-depth feedback. Moreover, most participants (especially senior researchers and doctoral candidates from psychology) concentrated on improving the formulation of the items in order to avoid any confusion. Their formulation improvements mostly concerned the following aspects listed by Streiner (2015): interpretability, reading level (replace difficult by easy words, reword, and shorten sentences), ambiguity (refocus items on the participant herself, specify context of private activities, reclaim activity-specific items to general ones), jargon, double-barreled questions (separate items that measure two aspects at the same time), and value-laden words (negative or positive connotations, for example, for the items regarding expertise and religion). All items were reviewed according to these aspects by the researcher as well.

Overall, the third and major round of validation resulted in the final decision for retainment or deletion of an item. For the item set A2, 29 items were retained, from which over 62% were modified. Considering the deletion of 13 items and the generation of 9 new items, the final item set A3 results in 38 items. For the item set G2, 24 items were retained, from which over 67% were modified. Considering the deletion of 21 items and the generation of 3 new items, the final item set G3 results in 27 items. Due to the fact that the participants were not aware of the separation of direct, adjective and indirect, general items, the modifications and newly generated items led to a mixture of indirect, general items within the direct, adjective item set, and vice versa. For that reason, in a final step, the items were reviewed and slightly reorganized (for all details see Appendix 9.6.5, p. 218. Table 32 shows the final categorization for each item set.

**Table 32.** Item Sets A3 and G3 After Round 3

| Type | Sentiment | Dimension | Final Item |
|---|---|---|---|
| Item Set A3 | Positive | Affective | Self-tracking feels rewarding. |
| | | | Self-tracking is cool. |
| | | | Self-tracking is fun. |
| | | | Self-tracking makes me feel proud of my progress. |
| | | | Self-tracking pushes me. |
| | | | Self-tracking satisfies my curiosity about aspects of my private life. |
| | | Cognitive | Self-tracking allows me to see personal progress. |
| | | | Self-tracking helps me to avoid future problems beforehand. |
| | | | Self-tracking helps me to be aware aspects about my private life. |
| | | | Self-tracking helps me to be aware of aspects in my life. |
| | | | Self-tracking helps me to be disciplined. |
| | | | Self-tracking helps me to be preventive regarding a specific problem. |
| | | | Self-tracking helps me to control important aspects about myself. |
| | | | Self-tracking helps me to get into a success loop because I know that I reached my goals. |
| | | | Self-tracking helps me to monitor my private activities. |
| | | | Self-tracking helps me to reach my goals. |
| | | | Self-tracking helps me to track interesting aspects about my private life. |

| Type | Sentiment | Dimension | Final Item |
|---|---|---|---|
| | | | Self-tracking helps to observe myself and my private activities. |
| | | | Self-tracking is easy. |
| | Negative | Affective | Self-tracking demotivates me. |
| | | | Self-tracking distracts me from the actual experience. |
| | | | Self-tracking entails risks as others could misuse my data |
| | | | Self-tracking is annoying. |
| | | | Self-tracking is frustrating. |
| | | Cognitive | Self-tracking distracts me from other aspects. |
| | | | Self-tracking does not provide me any pleasure. |
| | | | Self-tracking does not solve current problems in my private life. |
| | | | Self-tracking is too competitive for me. |
| | | | Self-tracking is too time-consuming for me. |
| Item Set G3 | Positive | Affective | I am happy when I see through self-tracking that I reach my goals. |
| | | | I feel bad when I do not self-track. |
| | | | I like obtaining a more tangible result of my performance through self-tracking. |
| | | | I like to keep track of my private life with notes. |
| | | | I like to obtain more information about my private activities through self-tracking. |
| | | | I like to see my progress in private activities through self-tracking. |
| | | | If I am interested in something, I would self-track every day. |
| | | | Measuring myself motivates me. |
| | | | The process of self-tracking feels like an accomplishment. |
| | | Conative | I like to note things, so I do not forget anything. |
| | | | I write down aspects of my private life. |
| | | | In order to investigate how I can become better, I can use self-tracking. |
| | | Cognitive | I can act more consciously through self-tracking. |
| | | | I get inducements for my private life from self-tracking. |
| | | | I think I get inducements for my private life from self-tracking. |
| | | | It is easier for me to reach my goals with facts and numbers. |
| | Negative | Affective | I am afraid that others use my self-tracking data. |
| | | | I dislike that self-tracking makes me aware of problems. |
| | | | I dislike self-tracking. |
| | | | I doubt that self-tracking would be beneficial for my already satisfied life. |
| | | | I feel no need to self-track because I know what is good for me without any collected data. |
| | | | I feel no need to self-track. |
| | | | I like to spend my time on other things than self-tracking. |
| | | | It feels strange to me to collect data about myself. |
| | | | It is unpleasant to find out things about my private life. |
| | | | It stresses me when I forget to self-track myself. |
| | | | Not being able to see a progress frustrates me. |
| | | Cognitive | I do not see any benefits in self-tracking. |

Consequently, to the content validation and the following refinement, the next subsection draws the relationship between the items and the construct attitude toward self-tracking, required for statistical validation.

### 6.2.4 Model Specification

According to Subsection 6.1.4 (p. 122) the main task of this section consists of determining the relationship between the items and several characteristics of the construct: the dimensions (multi- or unidimensional), the continuity (continuous or categorial), and the direction (causal or effect).

The domain specification (Subsection 6.2.1, p. 125) defines the attitude-toward-self-tracking construct as **multi-dimensional**. For that reason, attitude toward self-tracking is a first-order construct and each dimension (affective, cognitive, conative) with the different items represents a second-order construct (Karahanna et al. 1999). According to the literature (Bollen 2001), in general, attitude typically is a **continuous construct**. As a consequence, the affective, cognitive, and conative dimensions are also continuous constructs. However, as the domain specification suggests a measurement of the items on a seven-point Likert-type evaluation scale, the items are rather categorial. According to Table 32, p. 130, the dimensions show multiple items.

The determination of the **directional** relationship between the items and the second-order constructs (reflective or formative) particularly reverts to the vast literature on attitudes. Eagly and Chaiken (1998) refer to affective, cognitive, and conative levels as responses (as effects of the attitude) as well as processes that impact the attitude through learning (see Figure 48). Most scholars consider attitude items as responses to a stimulus (mediated by attitudes), hence, the construct is rather specified as reflective (Eagly and Chaiken 1998, p. 11–12). This perspective takes into consideration the following definitions:

- Cognitive responses refer to “perceptual responses and verbal statements of beliefs”;
- Affective responses refer to “sympathetic nervous responses and verbal statements of affect”;
- Behavioral responses are “overt actions and verbal statements concerning behavior.”

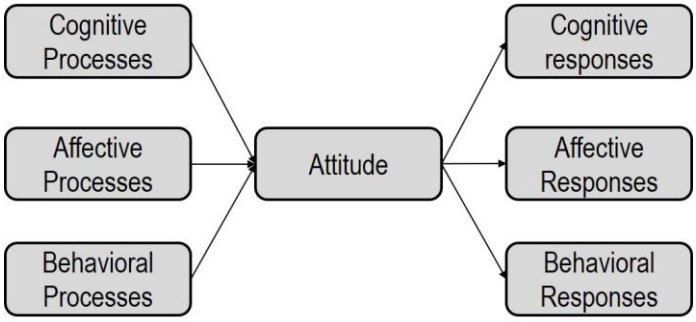



**Figure 48.** Antecedents and Responses of Attitudes (Eagly and Chaiken 1998, p. 10-15)

The literature review on attitude constructs (Appendix 9.2, p. 180) shows that the reflective models (Bhattacherjee and Premkumar 2004, Bhattacherjee and Sanford 2006, Hsieh et al. 2008, Kari and Makkonen 2014, Limayem and Hirt 2003, Zhang 2007) dominate in comparison to formative attitudes (Karahanna et al. 1999, Sambamurthy and Chin 1994). All the other articles did not even indicate the type of measures used. On this account, both measurement models are adequate to describe the direction of the second- and first-order constructs. This is also in line with the results of the interviews and the distinction between the two item sets that were generated from the data. Individuals are not directly aware that they actually engage in self-tracking or what self-tracking really is. They have not already generated an attitude. In contrast, a self-tracking attitude is often formed with general items on cognitive, affective, and conative attitudes for self-tracking activities.

As a result, it can be theorized that the two attitudes toward self-tracking samples should be employed in different situations and, therefore, require different measurements. On the one hand, novice or non-users have not already formed a direct attitude toward self-tracking. However, attitudes can be inferred from related processes. Such processes encompass activities that indirectly include self-tracking activities (e.g., noting gas consumption of a private vehicle) or are related to self-tracking (e.g., goal reaching, problem awareness). Due to the fact that such processes do not always share a common cause (Hair et al. 2017), a formative measurement model of the attitude construct is suggested. So, affective, cognitive, and conative processes determine attitudes (Fishbein and Ajzen 1975). On the other hand, for individuals who are aware of their attitudes toward self-tracking because they already consciously engage in it, a reflective measurement allows assessing the extent of the attitudes toward self-tracking. Appendix 9.6.6 (p. 221) explains in detail the assessment of the relationship between each construct and item in more detail. As a result, the measurement model in Figure 49 can be drawn. It serves as a first step for statistical validation and gives a detailed conceptualization for other scholars who might want to use the constructed instrument.

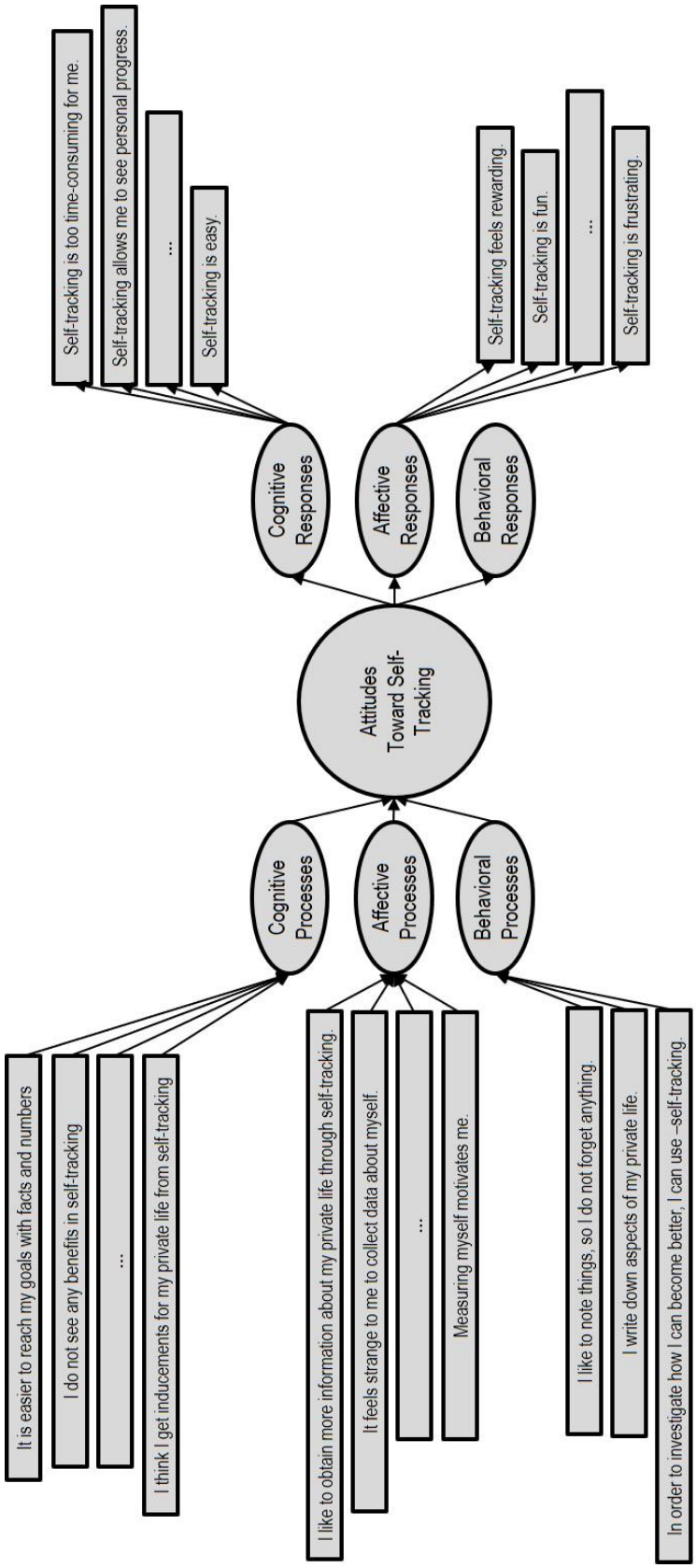



**Figure 49.** Final Measurement Model Including a Selection of the Item Sets (A and G) as a Formative and a Reflective Model (First- and Second-Order Construct)

After having defined the measurement model, two out of three stages of the construct development are completed, and the data is now ready for statistical validation, which will be a part of future work. Consequently, the next step regards the limitations of the obtained results, so the results can be discussed.

## 6.3 Limitations

The construct development described above underlies different limitations. First, the multifaceted construct development engenders methodological issues. Second, the application of the construct is limited. Identifying the limitations helps to endeavor to reduce them, notably as the construction process is still going on.

First, methodological issues of construct development encompass issues such as reliability, transparency, and replicability. This is due to the large amount of qualitative work and the small sample sizes, which result in highly subjective insights. This issue notably exists for the literature reviews (see the major limitations and measures to reduce them in Section 4.4, p. 88), the interviews, item generation, and content validation.

For the interviews, efforts to minimize the limitation of subjectivity consisted of increasing transparency by audiotaping and transcribing the interviews. Moreover, objectivity was increased by different individuals analyzing the interviews in three iterations and according to a specific set of rules. Furthermore, the generalization of the key findings is restricted because the sample is not representative. Even though it could be enlarged, the focus lies in diverse perspectives on attitudes toward self-tracking instead of one-sided thoughts, opinions, and feelings. Additionally, systematic flaws such as social desirability, the Hawthorne effect, self-presentation, self-disclosure, and participation biases must also be considered. The third-person technique was applied to overcome social desirability and self-presentation, for example, as individuals concentrated on reporting the opinions of peers or family members.

For the item generation and selection, subjectivity again plays a major role as it was managed by one person. On this account, a classification system was elaborated to analyze the 392 items in a structured way and to select adequate items for content validation. For the content validation, different rounds helped to decrease subjective evaluation and provided recommendations to modify or delete items (Ali et al. 2014). Obviously, the selection of the participants limits the results to a certain extent. Overall, the process of item generation and content validation was reported in detail to ensure transparency. This may also help to partially replicate the results.

For the model specification, the underlying theoretical assumptions represent a limitation. The allocation of items to formative or reflective items is explained in detail, but should be checked for misspecifications within statistical validation (Hair et al. 2017). The underlying assumptions of the mental experiments from Bollen (2001) are subject to subjective assessments. Furthermore, it is unclear if the formative items are really not interchangeable and if the temporal precedence is correctly interpreted (Edwards and Bagozzi 2000, p. 159). This should be done with a test for intercorrelations between the items. This also confirms or rejects the non-interchangeability of the formative items. Other possible tests for misspecifications are provided by the literature.

Second, in general, concerning the application of the attitude-toward-self-tracking construct, several limitations exist.

To begin, the final set of items A of the direct, adjective (or reflective) items does not contain behavioral items. This does not completely fulfill the goals to include the tripartite view in the new attitude construct. As a result, the item set A does not include the often neglected behavioral component (Rosenberg and Hovland 1960). This limits the application within research where all three dimensions are needed (at least for the reflective item set). The missing component might reflect a limitation of the interviews or a response bias of the experts who evaluated the item set (Streiner et al. 2015).

Then, another possible problem consists of a long and complex construct, because individuals tend to systematically answer surveys just to complete them without paying particular attention to the questions and appropriately selecting their answers. For example, for a Likert-type evaluation scale, such issues are called answer tendencies, choosing neutral positions, or random answers. To that end, the construct development focuses on keeping the set of items short and simple.

Furthermore, issues such as social desirability are less problematic for the attitude toward self-tracking. In comparison to attitudes on other aspects (e.g., toward the protection of the environment or abortion), attitudes toward self-tracking are less socially critical. Additionally, self-tracking does not explicitly represent illegal, immoral, or embarrassing aspects. Concerning the issue of self-

presentation, the selected form of an anonymous online survey situation with self-reports should delimit self-presentation biases.

Moreover, framing effects (depending on the formulation of the items, e.g., positive or negative, individuals are nudged to a specific answer) impact these items (DeVellis 2012). According to DeVellis (2012), the so-called acquiescence, affirmation, or agreement bias describes a person's "tendency to agree with items irrespective of their content" (DeVellis 2012, p. 83). This falsifies the real evaluation and therefore interpretability of the results. In order to minimize the risk of agreement bias, both positively and negatively worded items were included in the final construct. Facing the problem that individuals completing the survey might become confused, reducing the number of negative items after the statistical validation is suggested. An affirmation bias can be detected during statistical validation.

In order to account for biases such as subjectivity of self-reported data, a combined objective testing of implicit attitudes might be applied (Weinert et al. 2015). Complementary tests for implicit attitudes might be considered for future research.

Finally, as attitudes are subject to change over time, the construct instruction makes sure that the participant only considers current attitudes. This was highlighted in the final instruction text.

In light of the above-mentioned limitations, the next section discusses the results and clarifies the contributions to literature and practice.

## 6.4 Discussion

The final section of this chapter discusses the findings and describes contributions to the literature and implications for practice.

Chapter 6 investigates how attitudes toward self-tracking can be measured in a technology-acceptance context. On this account, it develops a first version of a construct that helps to measure attitudes toward self-tracking with the help of a survey. In accordance with proposed approaches from senior IS scholars, the first two stages of construct development are realized (see Figure 44, p. 112). Interviews, literature reviews, and three rounds of content validation provide valuable insights for the domain specification and instrument development. The last stage (statistical validation) remains for future work. As a result, two sets of items were obtained that can be used by scholars to assess the attitude toward self-tracking of non-trackers or experienced trackers, regarding their private activities. The item sets contribute to literature and practice in various ways.

The **domain specification** largely follows theoretical assumptions and conceptualizations from attitude literature. The definition of attitudes toward self-tracking combines the definition of attitudes with the definition of self-tracking originating from the self-tracking stages of Li et al. (2010). On this account, the dissertation does not aim to artificially create a new construct but enhances the attitude construct and adapts it to the content domain of self-tracking. Furthermore, the domain specification also differentiates the attitude-toward-self-tracking construct from other attitude scales through the conceptualization of the tripartite view of attitudes. This includes the typically used cognitive and affective components, but adds conative ones. Moreover, the chapter attempts to include a general perspective on attitudes toward self-tracking and clearly describes what the construct actually measures. This helps other scholars to clearly decide whether the construct is useful for their research.

In addition, the analysis of the open interviews resulted in 392 items, a large number for the attitude construct. The analysis of the interview transcripts was conducted in three rounds by three distinct individuals to decrease subjectivity. However, the **item generation/derivation** was conducted by one researcher only. In order to obtain a manageable item set for content analysis, the 392 items were categorized according to the type of attitude (indirect and direct attitudes), the sentiment (positive and negative), and the dimensions (affective, cognitive, conative). The categories were derived from typical properties of attitudes identified in Subsection 2.4.1 (p. 22). As a result of the categorization, a rule set helped to transparently select distinct items from the different dimensions, and two item sets were derived. The two item sets attempt to unite item sets that are formulated similarly. One item set involves direct, adjective evaluations (item set A) and a second one typically assesses items with indirect, general evaluations (item set G).

Through three rounds of **content validation**, 32 individuals (academic experts and individuals from the content domain) evaluated the understandability and relevancy of the items with regard to the

intended measurement (attitudes toward self-tracking). Even though the sample sizes of each round are rather small, they just follow typical examples from the IS literature (see Appendix 9.6.1, p. 208). The evaluation reduced item set A from 42 to 29 and item set G from 53 to 24.

Finally, the chapter presents theoretical assumptions for a relationship between the items and the constructs. With the help of defined rule sets, each item is evaluated and **measurement models** for each item set are drawn.

In terms of the **contributions** of this chapter to the literature of self-tracking research, the constructs have the potential to help to better understand contradictory usage behavior (especially discontinuance) within IS research on self-tracking. To this end, Chapter 6 follows the call from Sjöklint et al. (2015), who highlight the need of a better understanding of usage behavior of self-tracking appliances. Furthermore, the application context of self-tracking appliances is mostly private, which requires an update of traditional IS theories and models (see Section 2.1, p. 5). After statistical validation, the constructs can be used within traditional explanatory models (see Appendix 9.1, p. 175) in order to improve the explanatory power. This extends previous research and explains empirical results in Section 5.6 (p. 107) that show traditional models' failure to explain the usage of self-tracking appliances. Following other scholars (Kroenung and Eckhardt 2011b, Lunney et al. 2016), attitudes help to better capture longitudinal approaches that are required when investigating continuous intentions and behavior (Hsieh et al. 2008, Kim and Malhotra 2005, Sun and Zhang 2006).

Second, the attitude-toward-self-tracking constructs provide helpful instruments for various domains, as they are currently formulated in a general way. They can be adapted to different self-tracking domains such as weight monitoring, health-related issues, trainings, expenses, or energy consumption.

Some examples are the following:

- "Self-tracking satisfies my curiosity about my gas consumption;"
- "Self-tracking, e.g., stepping on a scale, is frustrating;"
- "I write down my emotions I feel during the day;"
- "It is easier to lose weight with facts and numbers."

Third, the detailed consideration of the properties of attitudes led to different levels of distinctions for each item (type, sentiment, component). This resulted in items representing all aspects of the tripartite view of attitudes. For that reason, after statistical validation, scholars can measure each dimension (cognitive, affective, conative) discretely. This contributes to current literature that investigates the influence of attitudes (cognitive or affective) on behavioral intention and behavior of volitional systems (Kroenung and Eckhardt 2011a, 2015). This does not apply to item set A, as it does not include behavioral items after the content validation.

Fourth, the intermediate results from the interviews extend current qualitative knowledge that mainly concentrates on active self-trackers (Choe et al. 2014, Gimpel et al. 2013, Rooksby et al. 2014). The interviews of this chapter also include interviews with non-trackers who have stopped tracking one or more self-tracking activities. This complements prior knowledge and gives a more complete picture about the self-tracking phenomenon. For example, the categorization of types of self-trackers in Section 6.2 (p. 123) extends previous analysis and shows that self-tracking is not only driven by curiosity as suggested by Baumgart and Wiewiorra (2016).

Concerning practice, the first item set needs to be statistically validated first. As a next step, practitioners from marketing or system developers can employ the construct to better understand potential users. The construct has the potential to increase the understanding of preferences for different features of a system, and software designers and developers can improve their software and hardware applications. Until then, the qualitative insights already provide first insights into different opinions about motivations to engage in self-tracking. On this account, strategic or operational decisions can be made.

In summary, this chapter comprehensively describes the development of two constructs to assess self-tracking attitudes. Literature reviews and exploratory interviews with 24 individuals helped to specify the domain of the construct and provide input for the item generation. From 392 items, two

item sets were derived. As a result of a categorization and selection process, the item sets were refined. Another 32 individuals helped to check the content validity of both item sets, which led to a refinement of the items and the item sets. On this account, item set A contains 29 items and item set G counts 24 items. With this final version of the item sets, a measurement model including item sets was specified (one reflective and the other formative). The last stage of empirical validation in construct development will be performed as future work. On this account, the next section summarizes the overall contribution to theory and practice of the chapters of the dissertation.

# 7 Overall Contributions and Conclusion

The dissertation theoretically and practically contributes to research streams of IS research within the private context of IS use (see Figure 50) by answering the research questions derived in Chapter 2 (p. 5).

Chapter 3 (p. 33) provides quantitative insights into the extent of IS research on the private context, in comparison to the professional context. After having identified that IS research on the private context is increasing but still sparse, the remainder of the dissertation contributes to that research. On this account, Chapter 4 (p. 67) zooms in on a specific field of IS applications in the private context; accordingly, a literature review provides an overview of the research on self-tracking. The literature review maps a research agenda, identifying research gaps for future research. It shows that both a knowledge void and a methodological void exist, especially in regard to one of the most prominent IS themes: technology acceptance along the IS life cycle. As a result, the succeeding chapters focus on filling the void. Chapter 5 (p. 95) concentrates on the first part of the IS life cycle in order to empirically assess the predictive power of traditional IS models with respect to adoption and continuance. As the models show weak explanation, especially for continuous-usage intention and behavior, Chapter 6 (p. 111) aims at developing a research instrument to improve the predictive power of explanatory models for future research.

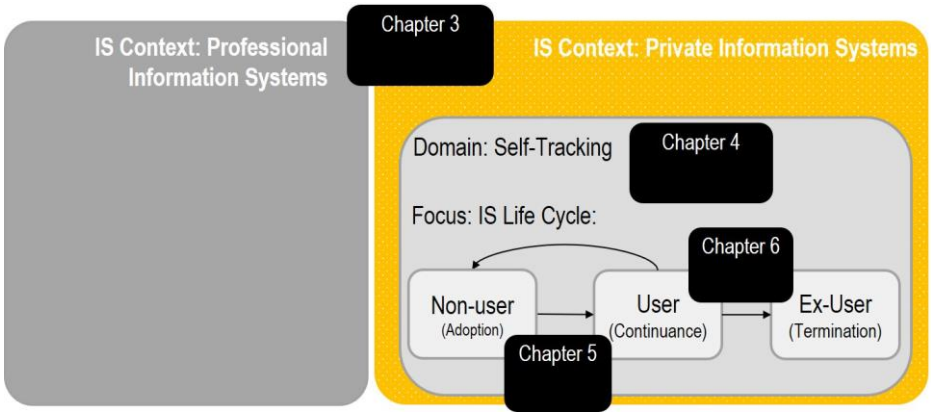



**Figure 50.** Research Framework and Chapters of the Dissertation

Section 7.1 summarizes the main contributions to theory and Section 7.2 (p. 141) presents the main contributions to practice.

## 7.1 Summary of the Theoretical Contribution

First, in terms of the implications of the results for the status quo investigations (Chapter 3 and 4), especially Chapter 3 contributes to “identity construction within the IS discipline” (Sidorova et al. 2008, p. 468) by investigating IS contexts and their evolution over time. The dissertation follows Galliers et al. (2012) and takes a critical standpoint to assess the nature of the discipline, examining the extent to which the increasing ubiquity of IS in daily life is reflected in the top outlets of the community (e.g., EJIS, MISQ, and JAIS). The dissertation goes beyond the typical differentiations (e.g., volitional/mandatory IS) and distinguishes the context of IS usage. Thus, the work contributes to the discussion about boundaries or the legitimization of IS (Agarwal and Lucas 2005, Benbasat and Zmud 2003), offering a new angle on the boundaries of IS research. This may offer “another perspective of IS, which accepts a fluid and contingent notion” (Bernroider et al. 2013, p. 75) that takes into account the increasing relevance of psychology and social science within IS research.

Second, the bibliometric study in Chapter 3 extends previous attempts by scholars to quantify the extent of purely professional research within IS research (Gaß et al. 2015, Glass et al. 2004, Sidorova et al. 2008). In contrast to these attempts, Chapter 3 does not focus on the unit of analysis (e.g., individuals or groups), but rather on the context, as suggested by Middleton et al. (2014), Tarafdar et al. (2015b), and Vodanovich et al. (2010). In addition, it updates prior results (Glass et al. 2004, Sidorova et al. 2008) on the extent of articles concentrating on the professional context, with current data that distinguish the professional from the private context.

Third, the research is one of the first attempts to describe the intellectual structure (i.e., research method, core topics, cumulative tradition and typical authors, or journal nationality) of PIS. Prior

work (Baskerville 2011a, Brenner and Kolbe 1995, Crowston et al. 2010, Kolbe and Brenner 1995) mostly pays particular attention to discussing the relevancy of the private context for IS research or conceptualizing PIS. In contrast, the bibliometric study of Chapter 3 addresses the current diversity and maturity of PIS research, in terms of aspects of the intellectual structure, including research methods, author nationality, thematic contents, and knowledge utilization (Bernroider et al. 2013, Córdoba et al. 2012). Accordingly, it helps to guide other scholars in better focusing their research on PIS – e.g., increasing heterogeneity of research methods (Chen and Hirschheim 2004, Córdoba et al. 2012, Dwivedi and Kuljis 2008, Paré et al. 2015, Rowe 2012, Williams et al. 2009). Diversifying the research methods employed leads to more robust results that various research methods could validate.

Fourth, the findings of Chapter 4 contribute in a similar way by presenting an overview of IS, HCI, and psychology research in the field of self-tracking. The literature review on self-tracking enlarges prior literature reviews on the subject matter (Ayobi et al. 2016, Kersten-van Dijk et al. 2017, de Moya and Pallud 2017) in various ways. It includes more recent articles, a larger number of articles from various disciplines, a longer time period, and a different analysis method. This leads to ascertaining a research agenda to streamline future research.

Fifth, the literature reviews of Chapter 3 and 4 encourage other scholars to engage in research on the private use of IS – for instance emerging technologies such as “embedded systems, mobile applications, ‘smart’ infrastructures, … augmented reality, or robotics” that support “social activity, leisure, community, and nation building” (Beath et al. 2013, p. ii) – and notably, self-tracking appliances. The literature reviews show that these topics belong to IS research and directly provide prior literature for different research streams. Moreover, the insights help scholars to make an informed choice about target journals for the dissemination of their work, and editors may reconsider their acceptance or review guidelines with quantitative information on the current status of PIS at hand (depending on a journals’ aims and vision).

Sixth, Chapter 3 contributes to the research from a methodological point of view. The dissertation provides a new categorization scheme related to research methods. In contrast to most studies that use a large variety of categorization schemes (Alavi et al. 1989, Holz et al. 2006, Jenkins 1985, Müller et al. 2016, Vessey et al. 2002), the dissertation at hand develops a more unified scheme that considers various distinctions (e.g., research designs, approaches, and methods) that other scholars often use in a very heterogeneous way. The unified scheme (see Appendix 9.3.2, p. 190) increases comparability between different studies and ensures including a wide spectrum of employed research methods.

Seventh, Chapters 5 and 6 concentrate on contributing to empirical knowledge on usage behavior of self-tracking appliances. This adds to prior literature on self-tracking usage behavior, which is strongly dominated by qualitative insights (Choe et al. 2014, Rooksby et al. 2014). Chapter 5 represents one of the rare studies that quantitatively validate an explanatory model paying particular attention to usage behavior for self-tracking applications (Buchwald et al. 2015). In comparison to Pfeiffer et al. (2016), the dissertation tests the original UTAUT models before integrating any other constructs.

Eighth, Chapter 5 is one of the few studies that does not concentrate on health or fitness but on a rather neglected self-tracking domain: energy and water consumption while showering. This represents a new perspective on self-tracking for IS research and integrates insights from energy-consumption literature with IS research. Considering the rise of smart-home appliances, the empirical insights lay important groundwork for technology acceptance in this domain. Additionally, the empirical study also considers continuous-usage intention and self-reported use in the context of a longitudinal study: two phases of data collection before and one month after the usage phase of the new smartphone app. This extends prior work – e.g., the Baumgart and Wiewiorra (2016) investigation, which only assesses self-reported usage behavior for one point in time.

Finally, Chapter 6 addresses the problem of contradictory insights discovered in the research agenda of Chapter 4, regarding the empirical results for technology acceptance of self-tracking appliances. In this sense, Buchwald et al. (2015) conceptualizes an explanatory model that focuses on the phases of continuance and discontinuance in the IS life cycle. They include various constructs from different models and theories, in order to better explain continuance and discontinuance. In contrast, following recent IS research (Bhattacherjee et al. 2018, Kroenung and Eckhardt 2011b), the dissertation seizes the often neglected construct of attitudes in order to extend

typical explanatory models from the IS discipline. As a result, Chapter 6 develops a specific attitude construct that contributes to self-tracking research. It offers a possibility for easily assessing attitudes toward self-tracking, based on self-reports in surveys typically used in IS research. In addition, the construct can be used in various models.

## 7.2 Summary of the Practical Contribution

The results of the dissertation are of strategic relevance for practitioners who should "deal with emerging technologies likely to have strategic impact" (Gable 2010, p. 7, Galliers et al. 2012). As Lee (2016, p. 2) states, "the IT strategy outside of a company is also critical, as it relates to public policy." In this sense, he calls for more research on the impact of "IT strategy on society, and vice versa," which the dissertation at hand addresses. The increasing relevancy of IS use in the private context, notably with respect to self-tracking, requires companies to rethink their business models.

First, companies may update business models in terms of value creation, value proposition, earnings, resources, and/or interactions. As an example, the changing business models of insurance companies serve as an illustration. Due to increased availability and consumer interest in fitness trackers, insurance starts to rethink business models in terms of the mission to the customer (Paluch and Tuzovic 2017). Instead of only delivering services in the event of damage or loss, they have evolved into the role of preventive caretakers. Requiring policy owners to wear fitness trackers in order to ensure their physical activity, U.S. insurer John Hancock wants to promote a healthier lifestyle that avoids as much as possible any health-related damages (Humphries 2018). Furthermore, increasing usage of IS for private activities (e.g., communication, entertainment) enables companies with completely new business models, such as Facebook, Netflix, or Google, to gain importance in the market. More innovations in service industries can be imagined (Maglio 2015, Medina-Borja 2015). Considering an increase in PIS, notably self-tracking that includes holistic data collection, traditional companies and startups may profit from the dissertation's insights for their strategic decisions. Such future strategic decisions may already incorporate the insights identified in this dissertation when reconsidering business models that involve PIS users. As seen in Chapter 5, IS applications in the private context differ from the professional context. This requires more academic effort to evaluate and adjust knowledge on various levels. On this account, the dissertation indirectly motivates more research on such emergent technologies employed in the private context. In turn, more scholars engaging in research potentially provide more insights that help to inform practitioners on various levels.

Second, the evolution of business models often leads to increased data collection that is no longer in the hands of the user, resulting in reluctance or backfiring reactions due to issues such as privacy. As Brenner and Kolbe (1995) predict, we are living in an information society where data has become very valuable and information (indirectly through advertisements or data sales) or digital products generate revenue. Compared to their view, society has already begun to solve many challenges related to policy making (e.g., online shopping). However, as the systematic literature review identifies, self-tracking does not always lead to positive behavior such as improvements; self-tracking may also incite negative reactions that harm an individual. For example, self-tracking motivates anorexic patients to be even stricter toward their food intake. Moreover, privacy and data security play a vital role for mainstream adoption, on both the individual and the legislative levels.

Third, in order to positively impact adoption and continuous-usage intention, service and product providers should concentrate on three aspects discovered in the field study reported in Chapter 5. The results of applying the UTAUT model show that hedonic aspects, performance expectancy, and facilitating conditions play a vital role in understanding self-tracking intentions. On this account, it is relevant to include functions and features that make the self-tracking experience a fun one. Then, the perceived usefulness and extrinsic motivation are especially relevant for continuous usage. In accordance with Baumgart and Wiewiorra (2016), in the self-tracking domain, some individuals are properly targeted by focusing on certain goals or communicating the product value, paying particular attention to goal achievement, induced by the self-tracking appliance. Finally, also facilitating conditions (ease of use) show impact on behavioral intentions.

Finally, having increasing numbers of employees using a wide range of IS in their private life also affects companies in different ways. To begin, companies must rethink IT management as employees bring their own devices to work. This implies technological issues, as the employees might ask to integrate their devices with the company network (e.g., to use Wi-Fi). Moreover, this

also engenders the disappearance of the boundaries between private and professional life. Employees start to write text messages or track their food intake behavior at the work place. At home, they are also connected with work issues through increased mobile availability or home office possibilities. This aspect also touches topics such as performance within the firm (Baskerville 2011b). In addition, the new technological know-how acquired through an increased usage of IS in the private lives of employees can lead to a situation where an employee wants more liberty in deciding which IS he or she will use (e.g., laptop, smartphone). Such freedom of choice engenders difficulties for companies in many ways. One example relates to procurement of technologies that are more cost intensive when different suppliers are needed. Furthermore, IT departments must increase their knowledge in order to ensure the integration of different technologies (e.g., Apple products and Windows products) in a complex network of devices.

## 7.3 Conclusion

The main goals of the dissertation were to investigate the status quo of PIS, especially self-tracking, in IS research and the way individuals use self-tracking appliances.

Through a quantitative bibliometric study, the dissertation establishes an increasing but still small number of IS articles (7% of over 1,700 articles from IS outlets) that report studying PIS. The findings indicate that the IS community does not quite reflect the trend of the practice, where PIS rapidly becomes relevant and ubiquitous for individuals in various application domains. In order to follow the increasing importance of PIS in practice, IS research should reinforce research activities. Moreover, considering further aspects of the intellectual structure of PIS (e.g., research methods, topics), research efforts are less diversified than the level of diversification of research in all contexts together. As a result, the limited research inhibits companies gaining better customer insights and private individuals from empowerment with respect to their daily decision-making. Nevertheless, IS research is uniquely equipped to contribute to research on PIS because the discipline unites a large body of knowledge on IS with various other research disciplines, such as social psychology, which are relevant to research questions in the private context. In this sense, the dissertation focuses on a specific field of application of PIS (self-tracking) and identifies current research questions in this field. The qualitative investigation of over 100 articles provides a research agenda that correctly propagates existing knowledge and streamlines future research. Moreover, the dissertation directly addresses selected issues within the research agenda and empirically examines contradictory results from adoption research studies on self-tracking appliances. To this end, typical knowledge from IS research is applied in a field study with over 700 participants. The application of traditional IS-adoption models assesses the explanatory power by showing that the applied traditional model fails to explain continuous usage and self-reported usage of self-tracking applications. In order to improve such models, the dissertation reverts to a theoretical concept that was neglected in IS research due to the center of attention on organizational contexts, namely, attitudes. For this reason, the dissertation aims at updating traditional IS adoption models in order to improve explanatory power for PIS. To this end, a first version of a measurement instrument is developed that measures an individual's attitude toward self-tracking. Over 50 participants provide insights for the development of an instrument that is supposed to increase predictive power, which is still to be investigated statistically.

Future research encompasses many directions. To begin, future research-on-research should take into consideration the distinction between private and professional contexts. This could serve as a more reliable basis for contributing to the discussion on philosophical foundations of the discipline. Further aspects should also include the blurring boundaries between the private and organizational contexts (e.g., home-office, bring-your-own device). Further work on the relevancy of the private context in IS research may provide more quantitative results, include more scientific outlets, and consider more years. Machine-learning procedures could be used to explore automation of the cumbersome manual-categorization process with respect to the context categorization or the research methods. To this end, the results of the bibliometric study of this dissertation may serve as grounded theory for such automatic data analysis. Further research in the field of self-tracking might explore various directions with a focus on increasing empirical and quantitative work, large-scale investigations, and applying more interdisciplinary theoretical knowledge. Further systematic literature reviews should be enlarged with respect to various aspects, e.g., outlets and disciplines. Additionally, it should be repeated in several intervals, such as every 5 or 10 years. This offers valuable insights that can be compared to the results of the dissertation. Furthermore, additional continuance and discontinuance research should differentiate not only hedonic and volitional

systems, but also the context (organizational and private) with respect to the application of explanatory models. The results of the dissertation suggest that an adaptation of traditional IS models might improve the explanatory power of continuance and discontinuance models. With respect to the fact that traditional IS models originate from organizational contexts, further theoretical IS knowledge should be reviewed in order to better integrate knowledge on human behavior from other disciplines, such as sociology or social psychology. Such theoretical knowledge may consider developing new scales that better explain human behavior with respect to IS in the private context. On this account, future research should statistically and empirically test the developed attitude toward self-tracking constructs found in the dissertation.

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# 9 Appendix

## 9.1 Technology Usage Models

### 9.1.1 Theory of Planned Behavior and Theory of Reasoned Action

Ajzen and Fishbein (1975) introduce the theory of reasoned action (TRA) (Figure 51) in order to explain behavior of fully functioning individuals from a social-psychological standpoint. Assuming that a person voluntarily decides to proceed with a behavior, the intention to perform the behavior is a strong determinant for that behavior (Ajzen 1991). In turn, the intention of performing a specific behavior is impacted by the so-called behavioral dispositions, attitude toward the behavior and subjective norm (see the light grey boxes in Figure 51). The definition of attitudes can be found in Section 2.4 (p. 21). The subjective norm "refers to the perceived social pressure to perform or not to perform the behavior" (Ajzen 1991, p. 188). So, the constructs represent beliefs of an individual about what his/her entourage expects of him/her as part of a social group.

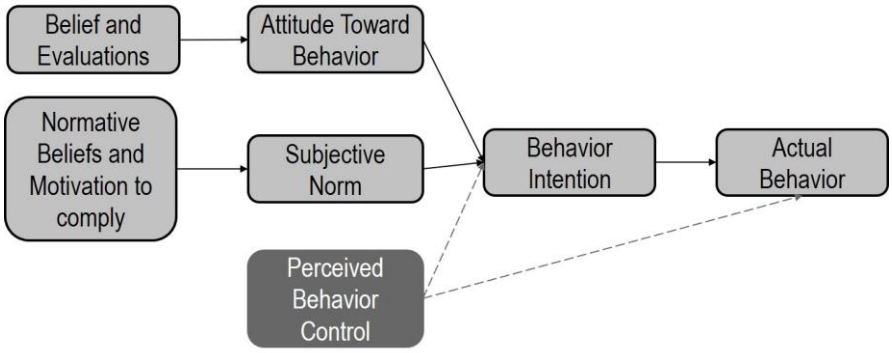



**Figure 51.** Theory of Reasoned Action and Theory of Planned Behavior Amended from Fishbein and Ajzen (1975, p. 334) and Ajzen (1991, p. 182)

Updating TRA, Ajzen (1985, 1991) adds to the typical TRA motivational factors (attitude, subjective norm, intention) an ability-related aspect: perceived behavior control. It encompasses factors such as "time, money, skills, cooperation of others" (Ajzen 1991, p. 182), which describe "people's actual control over the behavior" (Ajzen 1991, p. 182). Moreover, following social-psychological theory, it is vital to differentiate between the actual control and the perceived control by an individual. On this account, the updated model is called theory of planned behavior (TPB), depicted in Figure 51. It consists of the motivational variables in the grey boxes and the behavior control in the dark grey box.

### 9.1.2 Technology Acceptance Model

The technology acceptance model (TAM), depicted in Figure 52, is the most popular explanatory model used within IS research. It is based on TRA and especially adapted to model the adoption of IS. TAM posits that beliefs towards the usage of an information system influence a persons' attitudes towards the usage of an Information system. Such beliefs consist of perceived usefulness and perceived ease of use. They address cognitive and affective determinants. In turn, attitudes determine the behavioral intention to use a system which translates into actual usage (Davis 1989, Davis et al. 1989).

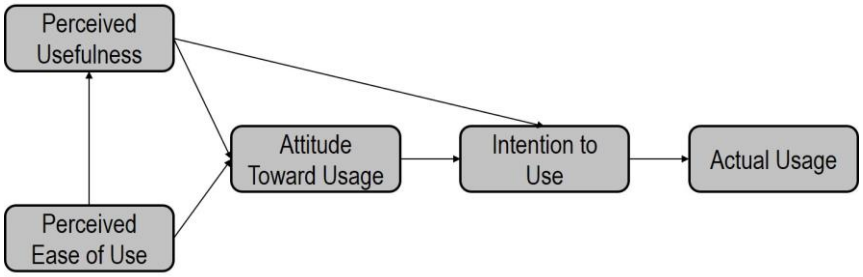



**Figure 52.** Technology Acceptance Model (Davis 1989, p. 985)

The belief of perceived usefulness refers to "the prospective user's subjective probability … [of] using a specific application" (Davis 1989, Davis et al. 1989, p. 985). Perceived ease of use is

defined as the “degree to which the prospective user expects the target system to be free of effort” (Davis et al. 1989, p. 985).

Further refinements of TAM (TAM2, TAM3) added more determinants to the original model. First, within TAM2 from Venkatesh and Davis (2000), social norms (as in TRA), image, and voluntariness influence perceived usefulness and usage intention. Image refers to “the degree to which the use of an innovation is perceived to enhance one’s … status in one’s social system” (Moore and Benbasat 1991, p. 195). Social norms are moderated by voluntariness (see definition in Section 5.1, p. 96). If an individual chooses voluntarily or not to use a technology, the experience with the usage of an IS influences the impact of social norms. Novice users are more influenced by social norms than experienced ones. Second, so-called cognitive instrumental processes, such as job relevance, output quality, result demonstrability, and perceived ease of use, influence perceived usefulness. These factors play a role when an individual deliberates about whether the system helps him or her to complete a task. Venkatesh and Davis (2000, p. 188) define job relevance as “an individual’s perception regarding the degree to which the target system is applicable to his [or] her job.” Output quality defines “how well the system performs … tasks” (Venkatesh and Davis 2000, p. 191) of an individual. Result demonstrability refers to the “tangibility of the results of using the innovation” (Venkatesh and Davis 2000, p. 191).

For TAM3, Venkatesh and Bala (2008) basically extend TAM2 by determining more impact variables that influence perceived ease of use: computer self-efficacy, perceptions of external control, computer anxiety, computer playfulness, perceived enjoyment, and objective usability. The authors chose these constructs by consolidating the results of prior TAM studies. Computer self-efficacy is defined as “the degree to which an individual believes that he or she has the ability to perform a specific task/job using the computer” (Venkatesh and Bala 2008, p. 279). Perceptions of external control refer to an individual’s beliefs about the existence of “organizational and technical resources ... [that] support the use of the system” (Compeau et al. 1999, p. 145, Venkatesh and Bala 2008, p. 279). Computer anxiety describes one’s “apprehension, or even fear, when he or she is faced with the possibility of using computers” (Venkatesh et al. 2003, Venkatesh and Bala 2008, p. 279), whereas perceived enjoyment describes one’s perception of enjoyment “in its own right, aside from any performance consequences resulting from system use” (Venkatesh 2000, Venkatesh and Bala 2008, p. 279). Computer playfulness refers to “the degree of cognitive spontaneity in … computer interactions” (Venkatesh 2000, p. 351, Venkatesh and Bala 2008, p. 279). Finally, objective usability describes the “comparison of systems based on the actual level (rather than perceptions) of effort required to completing specific tasks” (Venkatesh and Bala 2008, p. 279). The complete TAM3 was originally tested in a solely organizational environment (four different company types) and at different points in time (after system training, one month after the implementation, and three months after implementation).

### 9.1.3 Model of Adoption of Technology in Households

As Venkatesh (2000, p. 350–351), Venkatesh and Bala (2008, p. 279), and Venkatesh and Brown (2001) claim, there is little research on understanding the adoption of PCs in homes. They recognize the increasing role of household members within e-commerce and the shift to vendors of consumers with increasing revenue they can spend on IS.

Interestingly, Venkatesh and Brown (2005) consider the household as an organization-like institution. On this account, they transfer insights from their empirical study of households to companies. Figure 53 depicts their model of adoption of technology in households (MATH) that is based on TPB and helps to explain adoption of IS in households. Independent variables encompass attitudes, normative beliefs, and control beliefs.

Attitudes are mostly represented by attitudinal or hedonic outcomes. Venkatesh and Brown (2001) and Brown and Venkatesh (2005) underline the hedonic must-have aspect of IS for entertainment that is added to utilitarian aspects that “enhance … the effectiveness of household activities” (Venkatesh and Brown 2001, p. 82). Additionally, social outcomes such as social recognition play a role.

Normative beliefs describe such social influences, and they have been widely used within early technology-adoption models. Even though there are conflicting empirical results on the influence of social norms within technology adoption, studies show a certain normative orientation in households, by family and friends or secondary sources (e.g., newspaper).

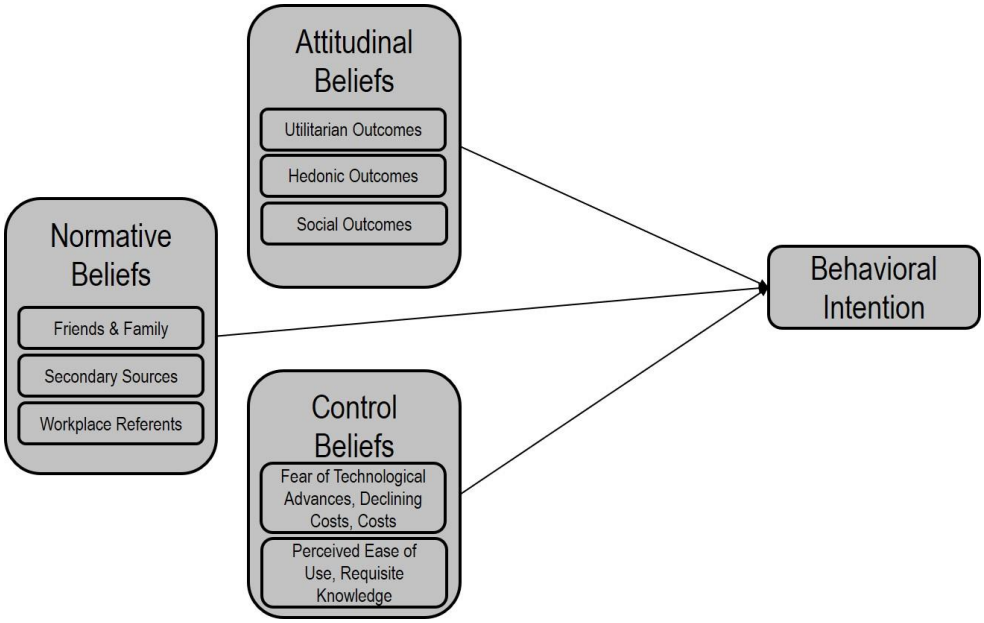



**Figure 53.** Model of Adoption of Technology in Households Amended from Brown and Venkatesh (2005, p. 405)

Finally, control beliefs embrace adoption constraints, ranging from price to perceived ease of use. Venkatesh and Brown (2001) invoke marketing literature showing that early adopters are generally better educated. For that reason, they are exposed to IS earlier than late adopters.

In the first empirical study of Venkatesh and Brown (2001), attitudinal and normative beliefs are strong predictors for PC purchase decisions. Yet, normative and control beliefs are better predictors in the case of non-adoption. In a later study, Brown and Venkatesh (2001) integrate the household life-cycle model into the MATH model. The life-cycle model defines 12 stages of family status, from bachelors under 35 to older couples or bachelors aged 65 or older. The family status is defined by marital status, age, and parental status. Brown and Venkatesh (2001) argue that in each stage of the life cycle, the adoption of IS underlies different variables of influence. To integrate this distinction, they include additional moderator variables (age, marital status and cohabitation, youngest child's age, and income) in the MATH model. Concerning the explanatory power of the model, the integration of the family life-cycle stages increases it by almost 25 percentage points.

Interestingly, attitudinal beliefs were significant for all life cycles and became more so with increasing age. In families, the utility of an IS for children played a more crucial role than for families without children. Work-related utility was relevant with increasing age but declined after a certain age. Venkatesh and Brown (2001) interpreted this in parallel with an adult's career: the perceived importance of work decreases for older adults, and thus work-related utility is less crucial. Furthermore, for young families, the status outcome plays a vital role in technology adoption. Moreover, moderators for normative beliefs are the age and number of adults in the household, so, depending on those factors, the adoption of IS in a household is more or less dependent on normative beliefs in general. Depending on income, social influences become less important. Only for single parents do their workplace referents play an important role, possibly because they represent closer friends and peers than would be the case for families with both parents, in which the tie to the partner is stronger. Finally, control beliefs played a vital role in the later phases of the family life cycle. This notably refers to fear of technology and cost-related aspects. Yet, the control beliefs appeared to be less impactful with higher income.

### 9.1.4 Unified Theory of Acceptance and Use of Technology

Please see Section 5.1, p. 96.

### 9.1.5 Post-Acceptance Model of IS Continuance

According to Bhattacherjee (2001), IS continuance is comparable to repurchase decisions, so he adapts the ECT from decision-making theory to IT continuance to understand why users choose to continue using a specific IS. IS continuance refers to the "existence of a post-acceptance stage

when IS use transcends conscious behavior and becomes part of normal routine activity" (Bhattacherjee 2001, p. 352). Subsection 2.2.2 (p. 16) also refers to ECT.

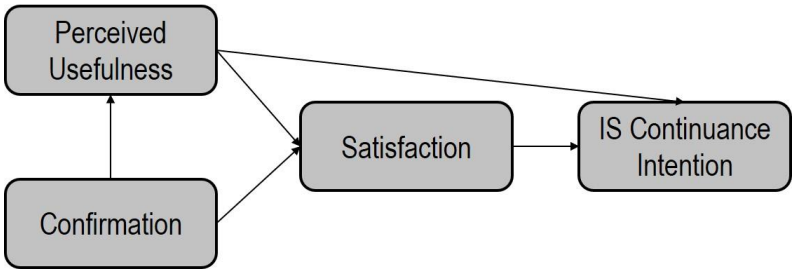



**Figure 54.** Post-Acceptance Model of IS Continuance (Bhattacherjee 2001, p. 356)

Figure 54 depicts the resulting model that explains the formation of IS-continuance intentions impacted by satisfaction. An empirical validation of this model was conducted with customers of online banking applications. Satisfaction results from the confirmation of certain expectations that existed before employing a product or service. During a first period of usage, prior expectations might be confirmed, leading to a certain degree of satisfaction. As a result, Bhattacherjee (2001, p. 352) refers to satisfaction as an affect and attitude, which is defined as "positive(satisfied), indifferent, or negative(dissatisfied) feeling." The ex-post perceived usefulness represents the ex-post expectations of an individual. The definition refers to "users' perceptions of the expected benefits of [the system] … use" (Bhattacherjee 2001, p. 355). Finally, the confirmation is defined by "users' perception of the congruence between expectation of [a system's] use and its actual performance" (Bhattacherjee 2001, p. 359).

### 9.1.6 Two-Stage Theoretical Model of Cognition Change

In order to understand the temporal change in a user's beliefs and attitudes, Bhattacherjee and Premkumar (2004) develop the two-stage model shown in Figure 55 and validate it in two longitudinal studies. Participants in both studies represent graduate and undergraduate students who used computer-based training software and a rapid prototyping software. This describes a work-related context.

As perceived usefulness (as a belief) and attitudes have been shown to be salient in acceptance literature and stable predictors for the dependent variables over time, both factors were chosen for the model. Furthermore, according to expectation-disconfirmation theory (EDT), disconfirmation influences usefulness and satisfaction, which impact attitudes.

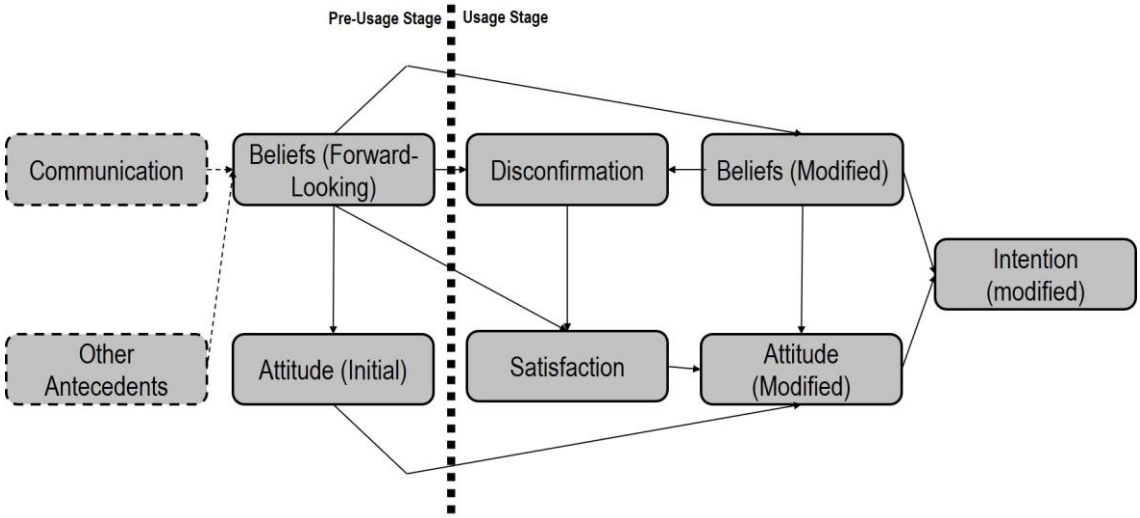



**Figure 55.** Two-Stage Theoretical Model of Cognition Change (Bhattacherjee and Premkumar 2004, p. 234)

Changed attitudes or beliefs can be seen as an additional function for predicting intentions. For that reason, the modified beliefs and attitudes are integrated with the model and distinguished with a time mark (pre-usage and usage stage).

Pre-usage beliefs may be influenced by information communicated before the start of the usage stage, e.g., IT features; or by other factors, e.g., personal innovativeness.

### 9.1.7 Proposed Integrated Temporal Model of Belief and Attitude Change

Xu et al. (2017) update the two-stage model of Bhattacherjee and Premkumar (2004) for a hedonic-usage context. For that reason, they choose three waves for data collection and include enjoyment among the influencing factors, as Figure 56 shows. Xu et al. (2017) state that a hedonic IS is characterized by a technology encompassing clearly hedonic features, e.g., iPads.

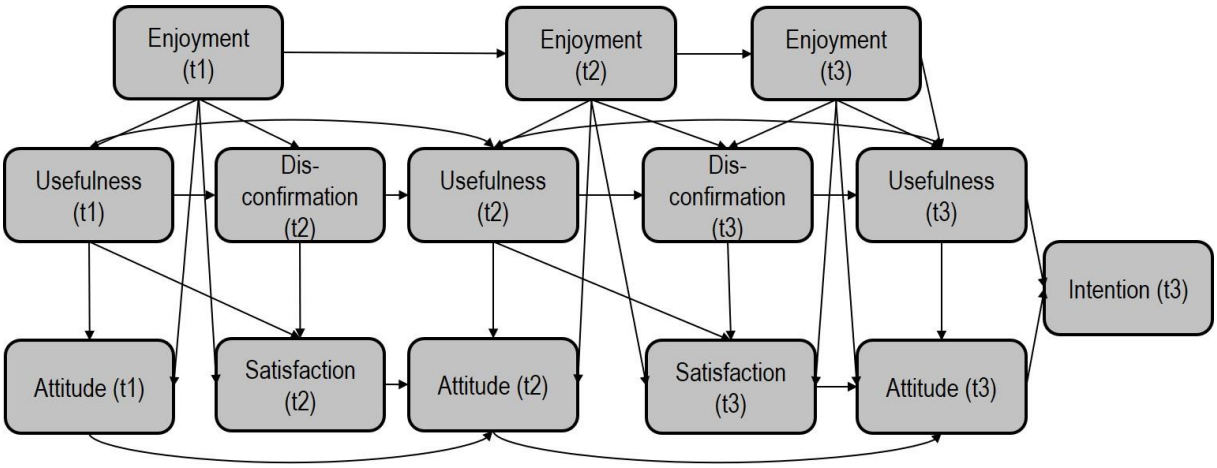



**Figure 56.** Proposed Integrated Temporal Model of Belief and Attitude Change (Xu et al. 2017, p. 115)

With participants (students) who accomplish a specific task with an e-textbook, a sketchbook, or a calculator app, the model was validated in a classroom environment. Xu et al. (2017) argue that due to motivational theory, extrinsic and intrinsic aspects motivate usage. In the model, extrinsic motivation is covered by the construct of perceived usefulness. In contrast, intrinsic motivation is missing from the model. Focusing on the hedonic IS usage context, Xu et al. (2017, p. 118) follow other scholars and include enjoyment as perceived ease of use in the model, defined as the extent to which "the activity of using a system [… is] enjoyable on its own right, apart from any performance consequences that may be anticipated." In fact, perceived enjoyment appears to be a stronger predictor for satisfaction (in the initial and the post-usage phases) and attitude (in the initial and pre-usage phase).

### 9.1.8 A Unified Model of IT Continuance

Bhattacherjee and Lin (2014) strive to bring together the small amount of research done on IT continuance. For that reason, they include habits, affective/emotional reactions, in the model of continuance behavior to understand the interplay. They confirmed their model (Figure 57) as a work system for insurance employees in two waves (one month in between). Yet, usage was volitional, as employees could also choose to use paper documents, transferred to the system by office staff, for the IT-supported process.

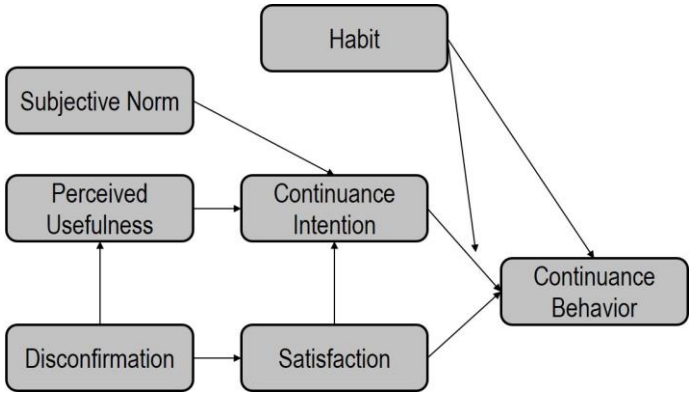



**Figure 57.** Unified Model of IT Continuance (Bhattacherjee and Lin 2014, p. 365)

Based on TRA and TPB, perceived usefulness and subjective norm are included in the model. Perceived ease of use must be shown to wear off within IS continuance. System usage lowers the learning barriers significantly; thus, perceived ease of use does not influence continuance behavior any more, especially for utilitarian usage.

Again, an effective component induced from prior IS usage is included in IT continuance: satisfaction. It is seen as "experiential response to IT usage" (Bhattacherjee and Lin 2014, p. 366) and impacts intentions and behavior directly. In contrast to Bhattacherjee (2001), the unified model considers disconfirmation (not confirmation), as scholars realize that the issue with continuance is that individuals are not satisfied and therefore consider discontinuance. So, "disconfirmation is measured as a difference score or a perceived difference between pre-usage expectations and performance" (Bhattacherjee and Lin 2014, p. 3) and can be positive or negative. Additionally, habit is included in the model, as IS research has shown its influence on intentions (Bhattacherjee and Lin 2014, p. 4). Habit refers to "a well-learned action sequence, originally intentional, that may be repeated as it was learned without conscious intention, when triggered by environmental cues in a stable context" (Limayem et al. 2007, p. 711, Ortiz de Guinea and Markus 2009, p. 434).

### 9.1.9 Discontinuance Intention Model

According to social cognitive theory, several drivers impact (e.g., guilt, self-efficacy) and inhibit (e.g., addiction, habit, satisfaction) individuals intending to discontinue hedonic IS usage. Figure 58 shows such drivers that notably represent personal and situational factors: addiction, habit, satisfaction, self-efficacy, and guilt.

Guilt is "a self-conscious unpleasant moral emotion that stems from contrasting one's behavior or intended behavior with accepted social and self-values" (Turel 2015, p. 435). People who realize that they cannot keep up with their expectations or beliefs will change their guilt-producing behavior, e.g., spending too much time with a system. Especially when addiction leads to system usage, it can be associated with guilt-feelings. If individuals spend too much time on a website, e.g., Facebook, even though they know it contradicts their beliefs, they feel guilty, which might strengthen the intention to discontinue the system. Furthermore, the perceived ability to achieve a certain goal strengthens the "conscious regulation of one's choice and effort" (Turel 2015, p. 435). With low self-efficacy, individuals tend to engage in stopping goal-attainment, which leads to disengagement with a certain behavior.

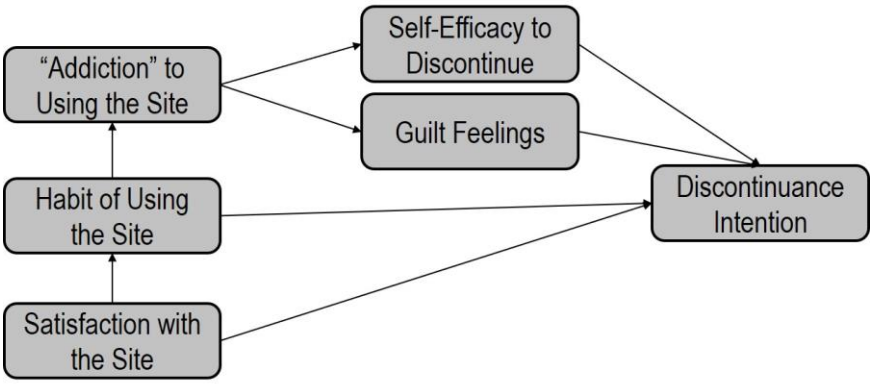



**Figure 58.** Discontinuance Intention Model (Turel 2015, p. 437)

Moreover, habits describe behaviors that are "acquired through repetition and learning", driven "through inertia, in parallel to cognitive processes" (Turel 2015, p. 436). Habit inhibits discontinuance intention as individuals do not sufficiently reflect on habituated system usage. Finally, satisfaction refers to "a positive affective state that emerges from cognitively contrasting one's expectations with observed performance" (Turel 2015, p. 436). Satisfaction resulting from pleasant system usage lowers motivation to discontinue. The model was tested with business students regarding Facebook usage and helped to explain discontinuance intentions of individuals.

## 9.2 Overview of Existing Attitude Constructs

Table 33 and Table 34 contain direct adjective evaluations and indirect, general evaluations expressing an attitude toward an object or a behavior. The list was enlarged from work by Zhang and Sun (2009), located with a backward search[43] in March 2018, from meta-studies concerning the usage of attitudes within IS research:

[43] Please see Section 4.1 (p. 68) for more details and a definition.

- Yang and Yoo (2004): The first three Google Scholar result pages from 2014;
- Swanson (1982): The first six Google Scholar result pages with no time-limit;
- Robey (1979): The first seven Google Scholar result pages with no time-limit.

### 9.2.1 Attitude Scales with Direct, Adjective Evaluations

**Table 33.** Attitude Scales with Direct, Adjective Evaluations

| Author(s) | ATB/ATO | Context (Professional/ Private) | Dimensions | Origin[44] | Evaluation Scale | Items | Opposing Poles/Ends of Evaluation Scales |
|---|---|---|---|---|---|---|---|
| Agag and El-Masry (2016) | ATB | Professional/ Private (to participate in an online community) | None | Algesheimer et al. (2005), Casalo et al. (2010) Cheng et al. (2006), Hsu et al. (2006) | Five-point Likert-type | I think participating in this online travel community would be good for me. | |
| | | | | | | I think participating in this online travel community would be beneficial for me. | |
| Argawal and Prasad (1999) | ATB | Professional | None | Ajzen and Fishbein (1980) | Seven-point Likert-type | I like using __. | |
| | | | | | | __ is fun to use. | |
| | | | | | | I dislike using __. (reverse) | |
| | | | | | | __ provides an attractive working environment. | |
| Al-Hujran et al. (2015) | ATB | Professional/ Private (e-government adoption and use) | None | Taylor andTodd (1995) | Five-point Likert-type | Using the e-government portal and/or Ministry's website(s) to access government services is a good idea | |
| | | | | | | I like the use of e-government portal and/or Ministry's website(s) to access government services | |
| | | | | | | Using the e-government portal and/or Ministry's website(s) to access government services would be pleasant | |
| Al-Gahtani and King (1999) | ATB | Professional (spreadsheets) | None | Davis (1993) | Five-point semantic differential | All things considered, my using spreadsheets in accomplishing various tasks in industry was: | bad // good |
| | | | | | | | wise // foolish |
| | | | | | | | favorable // unfavorable |
| | | | | | | | beneficial // harmful |
| | | | | | | | positive // negative |
| Bhattacherjee and Premkumar (2004) | ATB | Professional (CBT=computer based tutorial and RAD software=rapid application development) | None | Davis et al. (1989), Karahanna et al. (1999), Taylor andTodd (1995), Venkatesh and Davis (2000) | Four-point Likert-type | All things considered, using CBT is a ... Idea. | bad // good |
| | | | | | | | wise // foolish |
| | | | | | | | positive // negative |
| | | | | | | I have an __ attitude towards CBT use. | extremely positive // extremely negative |
| Bhattacherjee and Sanford (2006) | ATB | Professional (document management system in public administration) | None | Taylor andTodd (1995) | Four-point semantic differential | Using DMS in my job is a __ idea. | bad // good |
| | | | | | | Using DMS in my job is a __ idea. | wise // foolish |
| | | | | | | Using DMS in my job will be __. | pleasant // unpleasant |
| | | | | | | Overall, I __ the idea of using DMS in my job. | like // dislike |
| Bock et al. (2005) | ATB | Professional (sharing one's knowledge) | None | Fishbein and Ajzen (1975), Price and Mueller (1986), Robinson and Shaver (1973) | Five-point Likert-type | My knowledge sharing with other organizational members is a(n) ... move | good |
| | | | | | | | harmful |
| | | | | | | | enjoyable |
| | | | | | | | valuable (to me) |
| | | | | | | | wise |
| | ATB | | | | | | good |

[44] Please refer to the article for further bibliographic information.

| Author(s) | ATB/ATO | Context (Professional/ Private) | Dimensions | Origin[44] | Evaluation Scale | Items | Opposing Poles/Ends of Evaluation Scales |
|---|---|---|---|---|---|---|---|
| Bock and Kim (2001) | | Professional (sharing one's knowledge) | None | Fishbein and Ajzen (1975), Price and Mueller (1986), Robinson and Shaver (1973) | Five-point Likert-type | My knowledge sharing with other organizational members is... | pleasant<br>valuable (to me)<br>wise |
| Brown et al. (2004) | ATB | Professional/ Private (CMC computer-based systems that enable individuals to communicate) | None | developed | Seven-point Likert-type | I like sending messages with email.<br>I look forward to using email.<br>I dislike using email. | |
| Casimir et al. (2012) | ATB | Professional (sharing one's knowledge) | None | no information | no information | I think it is a good idea to share my knowledge with other members of my organization.<br>I enjoy sharing my knowledge with other members of my organization.<br>My knowledge sharing with other organizational members is valuable to me.<br>My knowledge sharing with other organizational members is a wise move. | |
| Chau and Hu (2001) | ATB | Professional (physicians) | None | Taylor and Todd (1995) | Seven-point Likert-type | Using telemedicine technology in patient care and management is a good idea.<br>Using telemedicine technology in patient care and management is unpleasant.<br>Using telemedicine technology is beneficial to my patient care and management. | |
| Davis (1985) | ATB | Professional (electronic mail in the job) | None | Fishbein and Ajzen (1980) | Nine-point semantic differential | All things considered, my using electronic mail in my job is: | bad // good<br>wise // foolish<br>favorable // unfavorable<br>positive // negative<br>beneficial // harmful |
| Galletta et al. (2004) | ATO | Professional (business students, web shops) | None | Shneiderman (1998), Chin et al. (1988) | Nine-point semantic differential | Overall reactions to the site | wonderful // terrible<br>satisfying // frustrating<br>stimulating // dull<br>easy // difficult<br>inadequate design // adequate design<br>flexible // rigid<br>easy to explore // difficult to explore |
| Harrison et al. (1997) | ATB | Professional | None | Ajzen and Fishbein (1980), Fishbein and Ajzen (1975), Ajzen (1991) | Seven-point Likert-type | Your firm using __ within the next 6 months would be... | bad // good<br>helpful // harmful<br>positive // negative<br>effective // ineffective<br>wise // foolish |
| Hiltz and Johnson (1990) | ATO | Professional/ Private (attitude towards computers/conferencing systems) | None | Zoltan (1982) | No specified Semantic differential | No information | stimulating // dull<br>fun // dreary<br>reliable // unreliable<br>desirable // undesirable<br>effective // ineffective<br>easy // difficult<br>unthreatening // threating<br>demanding // obliging |
| | | Professional/ Private (attitude towards alternative media) | | | No specified Likert-type | I waste too much time trying to reach people on the telephone.<br>I spend too much time in meetings.<br>Using the mails for communication is frustrating. | |

| Author(s) | ATB/ATO | Context (Professional/ Private) | Dimensions | Origin[44] | Evaluation Scale | Items | Opposing Poles/Ends of Evaluation Scales |
|---|---|---|---|---|---|---|---|
| Hong et al. (2004) | ATB | Professional/ Private (attitude towards using the website, university students) | None | Ajzen and Fishbein (1980) | Ten-point semantic differential | I would dislike/like using a website built on this model to perform similar shopping activities. | |
| | | | | | | Using a website built on this model to perform similar shopping activities would be pleasant/unpleasant. | |
| Hsieh et al. (2008) | ATB | Private (households) | None | Ajzen (1991), Ajzen and Madden (1986) | Seven-point Likert-type | All things considered, using the Internet TV is... | extremely positive // extremely negative |
| | | | | | | | extremely good // extremely good |
| | | | | | | | extremely helpful // extremely harmful |
| Karahanna et al. (1999) | ATB | Professional (Windows at work) | None | Ajzen and Fishbein (1980) | no information | All things considered, adopting Windows in my job within the next six months would be ... | extremely positive // extremely negative |
| | | | | | | | extremely good // extremely good |
| | | | | | | | extremely beneficial // extremely harmful |
| Kari and Makkonen (2014) | ATB | Private (consumers) | Overall, experiential, instrumental | Fishbein and Ajzen (2010), Taylor and Todd (1995) | Seven-point semantic differential | I think that the idea of me using console-based exergames as a part of my exercise in the next six months is... | bad // good |
| | | | | | | | pleasant // unpleasant |
| | | | | | | | useful // useless |
| Kwok and Gao (2005) | ATB | Professional (students in projects) | None | Ajzen and Fishbein (1980) | Seven-point Likert-type | I think that knowledge sharing is _ to my study. | beneficial // harmful |
| | | | | | | My feeling toward knowledge sharing is _. | favorable // unfavorable |
| | | | | | | I the idea of knowledge sharing during study. | like // dislike |
| Lee et al. (2005) | ATB | Professional/ Private (students' acceptance of an Internet-based learning medium) | None | Davis et al. (1989) | Seven-point semantic differential | The idea of using ILM is: | very bad // very good |
| | | | | | | | very foolish to very wise |
| | | | | | | Using ILM would be: | very pleasant // very unpleasant |
| | | | | | | Using ILM is an idea: I ... | dislike very much // like very much |
| Liébana-Cabanillas et al. (2015) | ATB | Professional/ Private (QR mobile payment) | None | Oh et al. (2003), van der Heijden (2003), Yang and Yoo (2004), Schierz et al. (2010) | Seven-point Likert-type | The use of QR mobile payments is a good idea. | |
| | | | | | | The use of QR mobile payments is convenient. | |
| | | | | | | The use of QR mobile payments is beneficial. | |
| | | | | | | The use of QR mobile payments is interesting. | |
| Limayem and Hirt (2003) | ATB | Professional/ Private (internet-based communication tool) | None | Fishbein and Ajzen (1975), Triandis (1980), Agarwal and Prasad (1999), Taylor and Todd (1995) | Five-point Likert-type | The use of WebBoard is smart. | |
| | | | | | | The use of WebBoard is enjoyable. | |
| | | | | | | The use of WebBoard is boring. | |
| | | | | | | The use of WebBoard is pleasant. | |
| Hassanein and Head (2007) | ATB | Private (consumers) | None | van der Heijden (2001, 2003) | no information | I would have positive feelings towards buying a product from this site | |
| | | | | | | The thought of buying a product from this website is appealing to me | |
| | | | | | | It would be a good idea to buy a product from this website | |
| Malhotra and Galletta (2005) | ATB | Professional (communication, collaboration, coordination system, volitional use) | None | Davis (1986), Davis (1989) | | All things considered, my use of [the system] is a(n) ___ idea. | wise // foolish |
| | | | | | | | positive // negative |
| | | | | | | | beneficial // harmful |
| | | | | | | | bad // good |

| Author(s) | ATB/ATO | Context (Professional/ Private) | Dimensions | Origin[44] | Evaluation Scale | Items | Opposing Poles/Ends of Evaluation Scales |
|---|---|---|---|---|---|---|---|
| Mathieson (1991) | ATB | Professional (business students solve a task) | None | Davis (1989) | Seven-point Likert-type | I think it would be __ to use [the spreadsheet] rather than my calculator for the assignment. | very bad // very good |
| | | | | | | In my opinion it would be __ to use [the spreadsheet] rather than my calculator for the assignment. | very desirable // very undesirably |
| | | | | | | It would be __ for me to use [the spreadsheet] rather than my calculator for the assignment. | much better // much worse |
| Moon and Kim (2001) | ATB | Professional/ Private (business students) | None | Davis (1986), Davis (1989), Davis et al. (1989), Davis et al. (1992) | Seven-point semantic differential | All things considered, my using World-Wide-Web in my tasks is a(n)____ idea. | |
| | | | | | | Using WWW is a ___ idea. | bad // good |
| | | | | | | | wise // foolish |
| | | | | | | | pleasant // unpleasant |
| | | | | | | | positive // negative |
| Rana et al. (2016) | ATB | Professional/ Private (e-District system=public services to citizen) | None | Davis et al. (1989), Fishbein and Ajzen (2003) | Seven-point Likert-type | Using the e-District system is a good idea | |
| | | | | | | Using the e-District system is a wise idea | |
| | | | | | | I like the idea of using the e-District system | |
| Sambamurthy and Chin (1994) | ATB | Professional/ Private (students, group attitude towards use of group decision support systems / SAMM=software added meeting management) | Perceived ease of use | AldagandPower (), Davis () | no information | I felt frustrated by the SAMM system (reverse scaled). | |
| | | | | | | Using the SAMM system was fun. | |
| | | | | | | While using the SAMM system, I felt comfortable. | |
| | | | | | | I enjoyed using the SAMM system. | |
| | | | | | | On the whole, I felt very comfortable with the SAMM system and .81 would be willing to use it again. | |
| | | | Perceived usefulness | | | I am not in favor of computer-aided meetings, because it is just another step toward depersonalization of meetings (reverse scaled). | |
| | | | | | | Using a computer system for meetings seems like a good idea to me. | |
| | | | | | | Even otherwise interesting meetings might be boring when conducted with computer-mediated support (reverse scaled). | |
| | | | | | | The SAMM system was more of a hindrance in the process of our meeting. | |
| Shih et al. (2015) | ATB | Professional/ Private (e-WOM =word-of-mouth, online communication concerning personal experiences with a product or a firm among users or consumers) | Cognitive attitude | Yang and Yoo (2004) | Five-point Likert-type | It is ...to access the electronic word-of-mouth posted on the online discussion forum. | very wise // very foolish |
| | | | | | | | very beneficial // very harmful |
| | | | | | | | very valuable // very worthless |
| | | | Affective attitude | | | It is ...to access the electronic word-of-mouth posted on the online discussion forum. | very like // very dislike |
| | | | | | | | very happy // very annoyed |
| | | | | | | | very bad // very good |
| Teo et al. (2003) | ATO | Private (online store for a new computer system) | No information | Baker and Churchill (1977) | Seven-point Likert-type | Please indicate on the scale the extent to which you agree with the descriptions | Interesting // Boring |
| | | | | | | | very enjoyable // not enjoyable |
| | | | | | | | like // dislike |

| Author(s) | ATB/ATO | Context (Professional/ Private) | Dimensions | Origin[44] | Evaluation Scale | Items | Opposing Poles/Ends of Evaluation Scales |
|---|---|---|---|---|---|---|---|
| | | | | | | that match the attitude you have towards the Web site. | |
| van Heijden et al. (2003) | ATB | Professional/ Private (students' acceptance of a web-site) | None | Ajzen and Fishbein (1980), DeVellis (1991) | Seven-point Likert-type | The idea of using this website to buy a product of service is appealing. | |
| | | | | | | I like the idea of buying a product or service on this website. | |
| | | | | | | Using this website to buy a product or service at this store would be a good idea. | |
| Viswanath and Goldhaber (2003) | ATB | Private (consumers) | None | Ajzen and Fishbein (1980), Davis (1993) | Semantic differential | Buying a cellular phone would be a bad decision. | |
| | | | | | | Buying a cellular phone would be foolish. | |
| | | | | | | Buying a cellular phone would be unfavorable. | |
| | | | | | | Buying a cellular phone would have harmful consequences in my life. | |
| | | | | | | Buying a cellular phone would have negative consequences in my life. | |
| Wixom and Todd (2005) | ATB | Professional | None | no information | Seven-point Likert-type | Using data warehouse predefined reporting software is | very enjoyable // not enjoyable |
| | | | | | | Overall, using data warehouse predefined reporting software is a __ experience | pleasant // unpleasant |
| | | | | | | My attitude towards using data warehouse predefined reporting software is | very favorable // very unfavorable |
| Yang and Yoo (2004) | ATB | Professional | Affective attitude | Davis (1989), Crites et al. (1994) | Seven-point semantic differential | Using a spreadsheet software makes me feel ___: | happy // annoyed |
| | | | | | | | positive // negative |
| | | | | | | | bad // good |
| | | | Cognitive attitude | | | A spreadsheet software is a(n) ___ instrument in performing my tasks: | wise // foolish |
| | | | | | | | beneficial // harmful |
| | | | | | | | valuable // worthless |
| Zhang (2007), Zhang and Sun (2009) | ATO | Professional/ Private (course management system for students) | None | Crites et al. (1994) | Five-point Likert-type | I think ~ is desirable | |
| | | | | | | Ilike~ | |
| | | | | | | In general, ~ is good | |
| | | | | | | In general, I am positive about ~ | |
| | ATB | | | | | Using ~ is pleasant | |
| | | | | | | Using ~ is valuable | |
| | | | | | | Using ~ is desirable | |
| | | | | | | Using ~ is interesting | |

### 9.2.2 Attitude Scales with Indirect, General Evaluations

**Table 34.** Attitude Scales with Indirect, General Evaluations

| Author(s) | Origin[45] | Construct name | Context (Professional/ Private) | Evaluation Scale | Dimensions | Items |
|---|---|---|---|---|---|---|
| Al-Khaldi and Al-Jabri (1998) | Chambre and Cook (1985), Igbaria (1993) | Computer Attitude Scale | Professional (Business Students, PC usage) | Five-point Likert-type | Anxiety | Computers do not scare me at all. (reversed) |
| | | | | | | Working with a computer would make me very nervous. |
| | | | | | | I do not feel threatened when others talk about computers. (reversed) |
| | | | | | | I feel aggressive and hostile toward computers. |
| | | | | | | It wouldn't bother me at all to take computer courses. (reversed) |
| | | | | | | Computers make me feel uncomfortable |
| | | | | | | I would feel at ease in a computer class (reversed) |
| | | | | | | I get a sinking feeling when I think of trying to use a computer. |
| | | | | | | I would feel comfortable working with a computer. (reversed) |

[45] Please refer to the article for further bibliographic information.

| Author(s) | Origin[45] | Construct name | Context (Professional/ Private) | Eval-uation Scale | Dimensions | Items |
|---|---|---|---|---|---|---|
| | | | | | | Computers make me feel uneasy and confused. |
| | Gressard and Loyd (1986), Loyd and Loyd (1985) | | | | confidence | I am no good with computers. (reversed) |
| | | | | | | Generally, I would feel OK about trying a new problem on the computer. |
| | | | | | | I don't think I would do advanced computer work. (reversed) |
| | | | | | | I am sure I could do work with computers. |
| | | | | | | I am not the type to do well with computers. (reversed) |
| | | | | | | ! am sure I could learn a computer language. |
| | | | | | | I think using a computer would be very hard for me. (reversed) |
| | | | | | | I could get good grades in computer courses. |
| | | | | | | I do not think I could handle a computer course. (reversed) |
| | | | | | | I have a lot of self-confidence when it comes to working with computers. |
| | Thompson et al. (1991) | | | | liking | I would like working with computers. |
| | | | | | | The challenge of solving problems with computers does not appeal to me. (reversed) |
| | | | | | | I think working with computers would be enjoyable and stimulating. |
| | | | | | | Figuring out computer problems does not appeal to me. (reversed) |
| | | | | | | When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer. |
| | | | | | | I don't understand how some people can stand so much time working with computers and seem to enjoy it (reversed). |
| | | | | | | Once I start to work with the computer, I would find it hard to stop. |
| | | | | | | I will do as little work with computers as possible. (reversed) |
| | | | | | | If a problem was left unresolved in a computer class, I would continue to think about it afterward. |
| | | | | | | I do not enjoy talking with others about computers. (reversed) |
| | Thompson et al. (1991) who, in turn, based their work on Cheney (1984), Pavri (1988), and Raymond (1985) | | | | Use-fulness | I will use computers in many ways in my life. |
| | | | | | | Learning about computers is a waste of time. (reversed) |
| | | | | | | Learning about computers is worthwhile. |
| | | | | | | I'll need a firm mastery of computers for my future work. |
| | | | | | | I expect to have little use for computers in my daily life. (reversed) |
| | | | | | | I can't think of any way that I will use computers in my career. (reversed) |
| | | | | | | Knowing how to work with computers will increase my job possibilities. |
| | | | | | | Anything that a computer can be used for, I can do just as well some other way. (reversed) |
| | | | | | | It is important to me to do well in computer classes. |
| | | | | | | Working with computers will not be important to me in my life's work. (reversed) |
| Compeau and Higgins (1995), Compeau et al. (1999) | Loyd and Gressard (1984) | Affect / Computer Attitude Scale | Professional (knowledge workers) | Five-point Likert-type | anxiety | see Al-Khalid & Al-Jabri |
| | | | | | liking | see Al-Khalid & Al-Jabri |
| | | | | | Con-fidence | see Al-Khalid & Al-Jabri |
| | | | | | Affect | I like working with computers. |
| | | | | | | I look forwards to those aspects of my job that require me to use a computer. |
| | | | | | | Once I start to work with the computer, I find it hard to stop. |
| | | | | | | Using a computer is frustrating for me. (Reverse) |
| | | | | | | I get bored quickly when working on a computer. (Reverse) |
| Harrison and Rainer (1992) | Nickell and Pinto (1987) | Computer Attitude Scale | Professional (University Personnel, Computers) | Five-point Likert-type | none | Soon our lives will be controlled by computers. |
| | | | | | | Computers turn people into just another number. |
| | | | | | | Computers are lessening the importance of too many jobs now done by humans. |
| | | | | | | People are becoming slaves to computers. |
| | | | | | | Computers are dehumanizing to society. |
| | | | | | | The overuse of computers may be harmful and damaging to humans. |
| | | | | | | Soon our world will be completely run by computers. |
| | | | | | | Computers will replace the need for working human beings. |
| | | | | | | Computers will never replace human life. |
| | | | | | | Computers are bringing us into a bright new era. |
| | | | | | | The use of computers is enhancing our standard of living. |
| | | | | | | Life will be easier and faster with computers. |
| | | | | | | Computers are fast and efficient means of getting information. |
| | | | | | | There are unlimited possibilities for many of the good things we enjoy. |
| | | | | | | Computers can eliminate a lot of tedious work for people. |
| | | | | | | Computers make me uncomfortable because I don't understand them. |
| | | | | | | I feel intimidated by computers. |
| | | | | | | Computers intimidate me because they seem so complex. |
| | | | | | | Computers are difficult to understand and frustrating to work with. |

| Author(s) | Origin[45] | Construct name | Context (Professional/ Private) | Eval-uation Scale | Dimensions | Items |
|---|---|---|---|---|---|---|
| Igbaria and Chakrabarti (1990) | Raub (1981), Reece and Gable (1982), Swanson (1986), Howard (1986), Howard and Smith (1986), Igbaria and Parasuraman (1989) | Attitude towards Microcomputers | Professional (Business Students) | Five-point Likert-type | cognitive, affective, behavioral | Using a microcomputer helps me make better decisions by giving me access to higher quality information. |
| | | | | | | Using a microcomputer would result in a tendency to overdesign a simple task. |
| | | | | | | Using a microcomputer exposes me to vulnerability of computer breakdown and loss of data. |
| | | | | | | Using a microcomputer allows me to be more innovative by providing the opportunities for more creative analyses and outputs. |
| | | | | | | Using a microcomputer gives me the opportunity to enhance my managerial image. |
| | | | | | | Using a microcomputer improves my productivity on the job. |
| | | | | | | Using a microcomputer gives me more opportunities to obtain the information that I need. |
| | | | | | | Using a microcomputer can take up too much of my time in performing tasks. |
| | | | | | | Using a microcomputer would involve too much time doing mechanical operations (e.g., programming, inputting data) to allow sufficient time for managerial analysis. |
| | | | | | | Using a microcomputer allows me to access, store and retrieve information easily without difficulties. |
| Joyce and Kirakowski (2015) | Weiser (2000), Tsai et al. (2001), Durndell and Haag (2002), Zhang (2007) | Internet Attitude Scale | Professional/Private | Five-point Likert-type | Internet Affect | I feel bewildered by the Internet. |
| | | | | | | I feel intimidated by the Internet. |
| | | | | | | I feel overwhelmed by the Internet. |
| | | | | | | The Internet makes me feel anxious. |
| | | | | | | The Internet makes me feel uncomfortable. |
| | | | | | | The Internet does not threaten me. |
| | | | | | | I feel at ease using the Internet. |
| | | | | | | I feel disheartened at the thought of using the Internet. |
| | | | | | | The Internet makes me feel annoyed. |
| | | | | | Inter-net Exhilaration | The thought of going on the Internet is exciting to me. |
| | | | | | | I would like to stay on the Internet for as long as I can. |
| | | | | | | The idea of going on the Internet gives me a thrill. |
| | | | | | Social Benefit of the Inter-net | The Internet makes a great contribution to human life. |
| | | | | | | The use of the Internet is enhancing our standard of living. |
| | | | | | | The Internet is bringing us into a bright new era. |
| | | | | | | The Internet makes a positive contribution towards society. |
| | | | | | | The Internet is responsible for many of the good things we enjoy. |
| | | | | | | The Internet makes life more efficient. |
| | | | | | Inter-net Detriment | Using the Internet is harmful to people. |
| | | | | | | The Internet is dehumanising to society. |
| | | | | | | Using the Internet can cause health problems. |
| Nickell and Pinto (1986) | Self-developed | Computer Attitude Scale | Professional/Private | Five-point Likert-type | | Computers will never replace human life. |
| | | | | | | Computers make me uncomfortable because I don't understand them. (reverse) |
| | | | | | | People are becoming slaves to computers. (reverse) |
| | | | | | | Computers are responsible for many of the good things we enjoy. |
| | | | | | | Soon our lives will be controlled by computers. (reverse) |
| | | | | | | I feel intimidated by computers. (reverse) |
| | | | | | | There are unlimited possibilities of computer applications that haven't even been thought of yet. |
| | | | | | | The overuse of computers may be harmful and damaging to humans. |
| | | | | | | Computers are dehumanizing to society. (reverse) |
| | | | | | | Computers can eliminate a lot of tedious work for people. |
| | | | | | | The use of computers is enhancing our standard of living. |
| | | | | | | Computers turn people into just another number. (reverse) |
| | | | | | | Computers are lessening the importance of too many jobs now done by humans. (reverse) |
| | | | | | | Computers are a fast and efficient means of gaining information. |
| | | | | | | Computers intimidate me because they seem so complex. (reverse) |
| | | | | | | Computers will replace the need for working human beings, |
| | | | | | | Computers are bringing us into a bright new era. |
| | | | | | | Soon our world will be completely run by computers. (reverse) |
| | | | | | | Life will be easier and faster with computers. |
| | | | | | | Computers are difficult to understand and frustrating to work with. (reverse) |
| | | | | | | Soon our lives will be controlled by computers. |

| Author(s) | Origin[45] | Construct name | Context (Professional/ Private) | Eval-uation Scale | Dimensions | Items |
|---|---|---|---|---|---|---|
| Rainer and Miller (1996) | Nickell and Pinto (1987), Harrison and Rainer (1992) | Computer Attitude Scale | Professional/Private | no information | Negative attitudes | Computers turn people into just another number. |
| | | | | | | Computers are lessening the importance of too many jobs now done by humans. |
| | | | | | | People are becoming slaves to computers. |
| | | | | | | Computers are dehumanizing to society. |
| | | | | | | The overuse of computers may be harmful and damaging to humans. |
| | | | | | | Soon our world will be completely run by computers. |
| | | | | | | Computers will replace the need for working human beings. |
| | | | | | positive attitudes | Computers are bringing us into a bright new era. |
| | | | | | | The use of computers is enhancing our standard of living. |
| | | | | | | Life will be easier and faster with computers. |
| | | | | | | Computers are a fast and efficient means of gaining information. |
| | | | | | | There are unlimited possibilities of computer applications that haven't even been thought of yet. |
| | | | | | | Computers are responsible for many of the good things we enjoy. |
| | | | | | | Computers can eliminate a lot of tedious work for people. |
| | | | | | Feelings of Intimidation | Computers make me uncomfortable because I don't understand them. |
| | | | | | | I feel intimidated by computers. |
| | | | | | | Computers intimidate me because they seem so complex. |
| | | | | | | Computers are difficult to understand and frustrating to work with. |
| | | | | | | Computers will never replace human life. |
| Thompson et al. (1991, 1994) | Howard (1985) | Affect towards PC Use | Professional (Manufacturing Organization, PC usage) | Five-point Likert-type | affect | PCs make work more interesting. |
| | | | | | | Working with a PC is fun. |
| | | | | | | PCs are okay for some jobs but not the kind of job I want. |
| | | | | | cognitive components: complexity | Using a PC takes too much time from my normal duties. |
| | | | | | | Working with PCs is so complicated, it is difficult to understand what is going on. |
| | | | | | | Using a PC involves too much time doing mechanical operations (e.g., data input). |
| | | | | | | It takes too long to learn how to use a PC to make it wo th the effort. |
| | | | | | cognitive components: job fit | Use of a PC will have no effect on the performance of my job (reverse scored). |
| | | | | | | Use of a PC can decrease the time needed for my important job responsibilities. |
| | | | | | | Use of a PC can significantly increase the quality of output of my job. |
| | | | | | | Use of a PC can increase the effectiveness of performing job tasks (e.g., analysis). |
| | | | | | | A PC can increase the quantity of output for same amount of effort. |
| | | | | | | Considering all tasks, the general extent to which use of PC could assist on job. |
| | | | | | cognitive components: long-term consequences | Use of a PC will increase the level of challenge on my job. |
| | | | | | | Use of a PC will increase the opportunity for preferred future job assignments. |
| | | | | | | Use of a PC will increase the amount of variety on my job. |
| | | | | | | Use of a PC will increase the opportunity for more meaningful work |
| | | | | | | Use of a PC will increase the flexibility of changing jobs. |
| | | | | | | Use of a PC will increase the opportunity to gain job security |
| Thong and Yap (1995) | Moore and Benbasat (1991) | CEO Attitude Towards Adoption of IT | Professional (Small Businesses, PC usage) | Five-point Likert-type | | Computers increase the productivity of my employees |
| | | | | | | My employees find computers easy to use |
| | | | | | | I have seen what other small companies have achieved with computers |
| Voermans and van Veldhoven (2007) | developed | Attitude towards E-HRM | Professional | Seven-point Likert | no dimensions | Electronic HRM is an improvement for the organization in general. |
| | | | | | | Item 2 unknown |
| | | | | | | Item 3 unknown |
| | | | | | | Item 4 unknown |
| | | | | | | Item 5 unknown |
| Webster et al. (1990), Webster and Martocchio (1992) | Zoltan and Chapanis (1982), Webster et al. (1990), Shaft | Computer Attitude Scale | Professional/ Private (Business students, Micro-computer usage) | Seven-point semantic differential | General Attitudes | stimulating-dull |
| | | | | | | adaptable-unadaptable |
| | | | | | | conventional-unusual |
| | | | | | | fun-dreary |
| | | | | | | noisy-quit |
| | | | | | | predictable-haphazard |
| | | | | | | easy-difficult |
| | | | | | | personalizing-depersonalizing |
| | | | | | | complicated-simple |
| | | | | | | weak-powerful |
| | | | | | | formal-informal |

| Author(s) | Origin[45] | Construct name | Context (Professional/ Private) | Eval-uation Scale | Dimensions | Items |
|---|---|---|---|---|---|---|
| | | | | | | organized-disorganized |
| | | | | | | hindering-helpful |
| | | | | | | demanding-obliging |
| | | | | | | intelligent-simpleminded |
| | | | | | | cooperative-obstinate |
| | | | | | | precise-inexact |
| | | | | | | affordable-costly |
| | | | | | | desirable-undesirable |
| | | | | | | patient-impatient |
| | | | | | | systematic-random |
| | | | | | | dependable-undependable |
| | | | | | | flexible-rigid |
| | | | | | | disgusting-pleasing |
| | | | | | | threating-unthreatening |
| | | | | | | trustworthy-untrustworthy |
| | | | | | | challenging-mundane |
| | | | | | | clear-confusing |
| | | | | | | frustrating-satisfying |
| | | | | | | effective-ineffective |
| | | | | | | infallible-fallible |
| | | | | | | personal-impersonal |
| | | | | | | bossy-obedient |
| | | | | | | cold-warm |
| | | | | | | dominant-submissive |
| | | | | | | efficient-inefficient |
| | | | | | | enjoyable-unpleasant |
| | | | | | | fast-flow |
| | | | | | | humanizing-dehumanizing |
| | | | | | | forgiving-unforgiving |
| | | | | | | reliable-unreliable |
| | | | | Five-point Likert-type | General Statements | Computers can simplify complex problems. |
| | | | | | | Computers' capabilities for speed are often overestimated. |
| | | | | | | The benefits of computers outweigh their monetary costs. |
| | | | | | | Proficiency in computer work requires mastering a special computer language. |
| | | | | | | I would like a computer to accept ordinary English statements. |
| | | | | | | Computers are nothing more than arithmetic devices. |
| | | | | | | The limitations of computers lie not in the machine, but in man. |
| | | | | | | Computer systems are highly standardized. |
| | | | | | | Good typing skills are necessary for computer work. |
| | | | | | | I would like a computer to generate sociable chit-chat before I begin using it. |
| | | | | | | I would like to use a computer system. |
| | | | | | | Computer courses should be taught in high school |
| | | | | | | The computers' capacity for artificial intelligence is frightening. |
| | | | | | | Computers would be helpful in my line of work. |
| | | | | | | Computer languages are simple to understand. |
| | | | | | | I would like to have a computer in my home. |
| | | | | | | Computers are smarter than people. |
| | | | | | | I would like a computer to accept the jargon of my profession. |
| | | | | | | You can unintentionally wipe out a computer's memory. |
| | | | | | | I would enjoy learning about the basics of computers and their abilities. |
| | | | | | | Most computer systems will not accept spelling errors. |
| | | | | | | Short of physical violence, you cannot damage a computer. |
| | | | | | | Society relies too heavily on computers. |

## 9.3 Additional Information for the Bibliometric Study on Private Use of IS

### 9.3.1 Development of the Categorization for the IS Usage Contexts

Ferstl and Sinz (2013) and Avison and Elliot (2006) distinguish three major IS domains: IS in businesses, in public authorities, and in households. This is also related to the distinction suggested by Wu and Lu (2013, p. 155) for IS adoption research; namely, that (1) hedonic IS are used at "home for fun and relaxation," and (2) utilitarian IS are "used in a work or education environment to improve job or school performance." Research related to IS topics within one of the three domains from Ferstl and Sinz (2013) and Avison and Elliot (2006) defines the first three categories of the

categorization: IS usage for professional reasons (B), IS within a governmental context (G), and PIS for consumers (C). Yet, in many cases, IS research investigates relations between those entities, e.g., between two or more companies (B2B) or between companies and consumers (B2C). Such a lens of categorization has been adopted by many scholars; for instance, in the e-commerce context (Datta 2011, Kim et al. 2005, Oliveira and Joia 2005, Whinston et al. 2005, Zhu et al. 2015). This leads to eight different subcategories that contain the major entities (B, C, G) or interactions between them related to IS usage. In addition, the category "other" was created to contain, for instance, meta-studies on research in the IS discipline or editorials (as this study). In line with Alavi et al. (1989), in case the reviewers could not assign an article to a single category, they also had the possibility of assigning it to more than one subcategory (called multiples). A special rule was introduced for articles on e-health/health-care services and for articles on e-learning: Depending on the country, e-health/health-care services and education services may be provided by the state or by corporate organizations. Going into the country-specific legislative details would be beyond the scope of the analysis; for the sake of simplicity, those articles were allocated to both G2C and B2C. Table 35 presents the different categories, descriptions, and an exemplary article. The adequate subcategory is mainly defined based on the **type of artifact** and **sample composition.** Regarding the artifact, an article on an Enterprise Resource Planning system is assigned to the professional category, whereas articles on virtual social worlds or fitness trackers are more likely to cover aspects of PIS usage. The sample studied serves as another indicator, with managers and employees representing the professional world, in contrast to private individuals like gamers or elderly residents.

**Table 35.** Description and Examples for the Nine Subcategories

| Category | Description and explanation |
|---|---|
| B | Articles that discuss intra-organizational IS issues (such as software development or IT service management, see Spottke et al. (2015)). For example, Wu et al. (2015) consider the impact of alignment on organizational performance. For that end, they survey business and IT managers of a firm. Difficult cases may treat outsourcing topics. Yet, depending the focus of the article, it is allocated to this category. For example, Sourenkowa and Louvieris (2005) focus on the decision-criteria within a firm that lead to an outsourcing decision. |
| G | Articles that analyze, for example, the introduction of IS within a public administration or the identification of value positions for public sector managers (Rose et al. 2015). Difficult cases integrate studies on user participation of public e-services where it is not clear what kind of users and services are of interest. Yet, the level of analysis and the system description shows that it encompasses services between public authorities and public employees (Holgersson et al. 2015). |
| C | Articles that focus on the IS usage in non-professional contexts, for instance of wearables such as fitness trackers or Google Glass. IS help private users to enhance their lives. Exemplary articles study for example IS adoption at home (Brown and Venkatesh 2005) or continued IS usage of Facebook users (consumers) (Hoehle et al. 2015). Difficult cases consider articles that are framed from an organizational perspective, yet, the system of interest as well as empirical insights from participants originate from a purely private context (Kaba 2015). |
| B2B | When commercial transactions between businesses, e.g., "between a manufacturer and a wholesaler, or between a wholesaler and a retailer" (Nemat 2011, p. 100) are in the scope of investigation – for instance in a computer-mediated supply chain or e-commerce context. For example, Malhotra et al. (2005) examine forms of partnership within supply chains with a theoretical lens on partner-enabled market knowledge creation Thus, the partnership (inter-organizational relationship) is of special interest. Difficult cases, for example only reveal in the full text that an article treating the domain of knowledge sharing and social networks is mainly concerned with inter-managerial sharing (between different firms (Huang and DeSanctis 2005)). |
| B2C | Articles describing products and services offered by businesses to private consumers, examples encompass e-commerce or marketing and app ecosystems or consumer-driven innovation via platforms. Note that my categorization does not consider the direction of those relations (e.g., B2C vs. C2B). For example, Yi et al. (2015) study consumer's reactions to different product offerings in order to improve a firm's marketing strategy. For that reason, they proceed an experiment with real customers. Difficult cases encompass services offered from consumers to companies (e.g., within mobile application ecosystems). |
| G2C | Articles that analyze IS that support the communication between governments or public authorities and citizens (Nemat 2011). For example, this includes articles studying the adoption intention of citizens towards e-government initiatives (Carter and Bélanger 2005). |
| G2B | Articles discussing topics relevant for the interaction between businesses and public entities (Nemat 2011). For example, Tung and Rieck (2005), who study the adoption of organizations of e-government services. As a difficult example, Etudo and Roon (2015) develop methods that ease the integration of reporting standards for a firm's financial statement. |
| C2C | Articles that investigate IS supporting and involving private individuals and in which the focus is strictly on the interaction between the private individuals and not on a third-party intermediary (Nemat 2011). Depending on the level of analysis, topics such as social media, adoption, and sharing economy are included. Such articles always focus on the interaction between private users and not between private users and service providers, for example when the influence of user comments of a hotel room on other users is of interest (Abramova et al. 2015). |
| Other | Papers that cannot be allocated to any of those subcategories. Meta-reviews, editorials, and methodological articles that discuss general IS issues from a more philosophical perspective. |

### 9.3.2 Detailed Definition of the Classification for Research Methods

Besides the meta-categories of empirical and non-empirical introduced earlier, as well as qualitative and quantitative research methods, Table 36 presents the research methods used for the categorization. Some research methods are clearly defined and easier to distinguish. They

encompass case studies, field studies, or surveys. In contrast, other research methods are more difficult to distinguish, including design science and data analytics.

Concerning the latter type, finding a definition was more complex. Rather than inventing a new category, an existing category was chosen, namely, a combination of the non-empirical research method identified as "prototype", as used by Alavi et al. (1989), van Horn (1973), and Jenkins (1985) for cases of applications or software development; combined with the "field study" or "action research". This decision originates from the discussions within the community about similarities between design science and other research methods or epistemologies (Burstein and Gregor 1999, Iivari and Venable 2009, Järvinen 2007). Additionally, concerning the research methods that include "data analytics", "secondary data", "grounded theory", "big data", and "archival data" (Alavi et al. 1989, Holz et al. 2006, Jenkins 1985, Müller et al. 2016, Vessey et al. 2002), the goal was to bring together these categories that are basically quite similar but have a different connotation in various studies. Following Riedl and Rueckel (2011) and first experiences, the issue was approached by reconsidering a traditional and established research method before inventing a new artificial one. Considering the definitions of these similar categories, they all describe the (re)gathering of already (often automatically) collected data from a real-world setting (e.g., blog, twitter, stock prices, consumption readings). As the data has been gathered in an exploratory way without a primary experimental design, it reveals several aspects that describe a "field study" (Alavi et al. 1989, Cheon et al. 1993). In order to more precisely describe the non-empirical research methods, a variety of categories are used, notably, an enlarged understanding of the "conceptual" category. According to Alavi et al. (1989) and Chen and Hirschheim (2004), this category contains articles that develop frameworks, models, and work with theories. Insights from coding the first half in the first round (step 3 in Figure 13, p. 38) indicate that the category should also encompass conceptual work in the context of algorithm development or mathematical modeling.

**Table 36.** Classification Framework for Article Type

| Research Design/ Approach/ Method | Definitions |
|---|---|
| Empirical | Chen and Hirschheim (2004, p. 205): Research is based on "real data and observations".<br>Alavi et al. (1989, p. 365): Research that relies on "observation". |
| Non-empirical | Alavi et al. (1989, p. 365): Research "based on ideas, frameworks, and speculations" that "may contain some empirical observations or data but these will be in a secondary or supporting role only".<br>Chen and Hirschheim (2004, p. 205): It rather "develop[s] concepts and build[s] theory" |
| Quantitative | Harrison and Wells (2001, p. 5): Research that was "originally developed in natural science to study natural phenomena."<br>Chen and Hirschheim (2004, p. 205): Research "uses numerical analysis to illustrate the relationship among factors in the phenomenon studied."<br>Holz et al. (2006, p. 113): Research including "numerical data in order to explain, predict and/or control phenomena of interest." |
| Qualitative | Harrison and Wells (2001, p. 5): Research that "assists researchers to understand people and the social and cultural context within which they live." Results depend on "the nature of the event being investigated" because "valid inferences [are] drawn from the data in respect of generalization, association and causality."<br>Holz et al. (2006, p. 113): Research including an "extensive narrative data on many variables over an extended period of time, in a naturalistic setting, in order to gain insights not possible using other types of research."<br>Chen and Hirschheim (2004, p. 205): Research that "emphasizes on the description and understanding of the situation behind the factors". |
| Case Study | Cheon et al. (1993, p. 111): Research "examining a single organization or part of an organization with no experimental design or controls."<br>Alavi et al. (1989, p. 374): Research uses "no variable manipulation, usually no pre-defined relationships among the variables of interest, no experimental design or controls, exploratory in nature".<br>Chen and Hirschheim (2004, p. 206): "with a single site or a few sites over a certain period of time are located in this category" including various "sources of evidence"<br>Jenkins (1985, p. 105): Research where "a particular subject, group of subjects or organization is observed by the researcher without intervening in any way. No independent variables are manipulated, no control is exercised over intervening variables and no dependent variables are measured. The case study attempts to capture and communicate the reality of a particular environment at a point in time." |
| Field Study | Cheon et al. (1993, p. 111): Research "examining several or more organizations with experimental design but without experimental control."<br>Alavi et al. (1989, p. 374): Research uses "no manipulation, measure[s] independend and dependent variables [in a] natural setting or environment."<br>Jenkins (1985, p. 105): Research where no independent variables are manipulated, "but dependent variables are systematically measured. The study is conducted in a natural setting using human subjects."<br>**Including the following research methods distinguished by other scholars and during the categorization:**<br>*Grounded Theory: Aims at "develop[ing] theory from data, qualitative methods for data gathering (Holz et al. 2006, p. 112, Vessey et al. 2002)<br>* Field studies with automatic observations (Big Data, Secondary Data, User-generated Content, Data-driven): Data, generated by users directly or indirectly in the real-world (field). Yet, beforehand there is no intention for any data collection. The data was collected automatically by a service or platform through normal operation (e.g., twitter with twits)<br>Explorative data analysis is "a data-driven search for statistical insights and models" (Holz et al. 2006, p. 112) |

| Research Design/ Approach/ Method | Definitions |
|---|---|
| Action Research | Harrison and Wells (2001, p. 5): Research where the "researchers and people being researched participate jointly in the research."<br>Chen and Hirschheim (2004, p. 206): Research that is "often embodied as a case study, [which] … distinguishes itself in that the researchers are an integral part of the phenomenon under study. This researchers' input often influences the outcomes of the phenomenon and his/her role could change from researcher to subject". |
| Ethnography | Harrison and Wells (2001, p. 5–6): Research that studies "culture and social context" that "attempts to understand the meaning of phenomena that participants at a site assign to them. The researcher does not enter the site with pre-defined concepts and does not assume the data collected to be factual. Rather than interpreting the data from a theoretical or a researcher's point of view, the data is interpreted through the meaning assigned by on-site participants."<br>Holz et al. (2006, p. 112): Research "including an information gathering technique whereby work is studied 'as it actually happens in its real-world setting'."<br>**Including the following research methods distinguished by other scholars:**<br>*Protocol Analysis: Research "that uses 'think aloud' methods to 'observe' a problem-solving situation."(Vessey et al. 2002, p. 144) Thinking aloud consists of asking(users to work on typical tasks and to verbalize their task performance and thought process" (Holz et al. 2006, p. 114)).<br>*System Evaluation/Usability testing: Research that "determines whether a system meets a predetermined, quantifiable level of usability for specific types of user carrying out specific tasks." (Holz et al. 2006, p. 114).<br>*Cognitive Walkthrough: "a form and task-based methodology, whereby a task is evaluated by completing a set of forms, each form comprising several evaluation steps. Each step, in turn, is designed to address underlying theoretical concepts through a list of questions to be asked about the interface." (Holz et al. 2006, p. 111). |
| Laboratory and Field Experiments | Cheon et al. (1993, p. 111): A "laboratory experiment studying computer-organizational problems with an experimental design and high degree of control."<br>Harrison and Wells (2001, p. 5): Research with "stringent controls over data collection … [which]suffer from an artificial environment."<br>Jenkins (1985, p. 104): Field experiments describes "research that takes place in a 'natural setting.' The researcher manipulates the independent variables while trying to control the most important intervening variables. The researcher then measures the effects of the independent variables on the dependent variables by systematic observation of human subjects." Laboratory experiments describe research in which "the researcher manipulates the independent variables on the dependent variables. Human subjects are commonly used in a laboratory setting."<br>Alavi et al. (1989, p. 373) and Chen and Hirschheim (2004, p. 206): Laboratory experiments "include studies that take place with a designed, controlled environment and usually involve special treatments of different groups to contrast the precise relationships among variables". In contrast, field experiments "are conducted in a real-world setting". |
| Survey/Opinion Research | Alavi et al. (1989, p. 374): Research in "an exploratory field study [that] does not test relationships between variables".<br>Harrison and Wells (2001, p. 15): It represents a "snapshots of practices, situations or views at a particular point in time, undertaken using questionnaires or (structured) interviews, from which inferences may be made."<br>Chen and Hirschheim (2004, p. 206): Research that "gather[s] data by means of questionnaires".<br>Jenkins (1985, p. 105): Research "to gather data on attitudes, opinions, impressions and beliefs of human subjects. This is accomplished by asking them (e.g., questionnaires, interviews). This methodology allows testing of a priori hypotheses and offers an iterative approach to the generation of hypotheses."<br>**Including the following research methods distinguished by other scholars and during the categorization:**<br>*Interviews: "an information gathering technique whereby people are posed questions by an interviewer; these interviews may be structured or unstructured." (Holz et al. 2006, p. 112)<br>*Questionnaire;<br>*Conjoint Analysis;<br>*Expert interviews/Delphi. |
| Literature Review | Holz et al. (2006, p. 113): Research that "requires the investigator to analyze the results of papers and other documents that are publicly available."<br>See Section 4.1 (p. 68) |
| Literature Analysis | Differs from Literature Reviews mainly in their quantitative nature. Only facts and figures are summarized and analyzed in form of a meta-analysis with mainly quantitative results.<br>**Including the following research methods distinguished by other scholars:**<br>*Bibliometric Study: See Section 3.1 (p. 34);<br>*Scientometric Analysis: See Section 3.1 (p. 34); |
| Prototype | Holz et al. (2006, p. 113): Research that concerns "building 'scale models" of MIS and exercising them within a laboratory setting." |
| Tutorial | Hamilton and Ives (1982b, p.340) "rely on secondary sources or the author's experience to support conclusions" |
| Opinion | Alavi et al. (1989, p. 372–373): Research that "give[s] advice and guidance for practice/research, in the form of rules and recommendations, steps or procedures to be followed, hints and warnings. [They m]ay be supported by examples and applications" or "describe the author's experience in some relevant context".<br>**Including the following research methods distinguished by other scholars:**<br>*Book Review/Commentary: A scholar's comment on any matter or a book.<br>*Keynote: An article that represents the keynote of the conference.<br>*Essay: An article on a specific issue.<br>*Conference/Panel Report: A summary of a conference's achievements or the content of a panel of a conference.<br>*Philosophical Research: Research that represent a "purely mental pursuit. The researcher thinks and logically reasons causal relationships. The process is intellectual and the aim is for the flow of logic to be explicit, replicable and testable by other ." (Jenkins 1985, p. 106) |
| Conceptual | Alavi et al. (1989, p. 372): Research encompasses models that are "schematic representation of MIS-related behavior, activity, organization, method, structure, or process" and frameworks "defining the content and scope of MIS and provide directions for MIS research".<br>**Including the following research methods distinguished by other scholars:**<br>*Math-modelling/Conceptual analysis/Mathematical: Math modeling "site with pre-defined concepts and does not assume the data collected to be factual. Rather than interpreting the data from a theoretical or a researcher's point of view, the data is interpreted through the meaning assigned by on-site participants." (Jenkins 1985, p. 104) Conceptual analysis "utilizes mathematical techniques." (Holz et al. 2006, p. 111) Mathematical modeling is "one approach to providing understanding comes by offering a |

| Research Design/ Approach/ Method | Definitions |
|---|---|
| | model of [an] IT issue in mathematics, and then exploring the model … sometimes the model is explored … by simulation, or by expressing the model in code and executing it on case studies." (Holz et al. 2006, p. 113)<br>*Algorithmic analysis: Research concerning "a broader computational complexity theory, which provides theoretical estimates for the resources needed by any algorithm which solves a given computational problem." (Holz et al. 2006, p. 111)<br>*Big data analysis: Research that consists of "statistical modeling of large, diverse, and dynamic data sets of user-generated content" utilizing "big data sources and advanced analytics." (Müller et al. 2016, p. 289) |
| Simulation | Jenkins (1985, p. 104): Research that creates a "model to mirror a segment of the 'real world'. Human subjects are exposed to this model and their responses are recorded. The researcher completely determines the nature and timing of … events."<br>Harrison and Wells (2001, p. 15): A research that copies the "behaviour of a system that would otherwise be difficult to study analytically." |
| Other | All articles that do not use a specific research method or where the research method cannot be allocated to one or more methods named above (Alavi et al. 1989).<br>**Including the following research methods distinguished during the categorization:**<br>*Errata/Corrigendum: An article or note that publishes a correction about an article.<br>*Call for Papers: An article that explains more details about a call for papers of a journal. It introduces the thematic content of the call for papers.<br>*Epitaph: An article that commemorates a deceased scholar.<br>*Editorial/Special Section Introduction: An article that introduces a special section or issue of a journal.<br>*Technical articles (method or instrument development): |

### 9.3.3 Additional Information for the Assessment of Nationality

**Table 37.** Grouping of Countries per Continent for the Origin of First Authors Affiliation

| Continent | Countries | Continent (Continued) | Countries (Continued) | Continent (Continued) | Countries (Continued) |
|---|---|---|---|---|---|
| Africa | Egypt<br>Ivory Coast<br>Morocco<br>South Africa | Asia (continued) | Japan<br>Malaysia<br>Pakistan<br>Qatar<br>Republic of Korea<br>Russia<br>Saudi-Arabia<br>Singapore<br>South Korea<br>Taiwan<br>Thailand<br>Vietnam | Europe (continued) | France<br>Germany<br>Greece<br>Ireland<br>Italy<br>Liechtenstein<br>Norway<br>Poland<br>Portugal<br>Scotland<br>Slovenia<br>Spain<br>Sweden<br>Switzerland<br>The Netherlands<br>Turkey<br>United Kingdom |
| Australia | Australia<br>New Zealand | | | | |
| North America | Canada<br>United States of America | | | | |
| South America | Brazil<br>Jamaica<br>Mexico | | | | |
| Asia | China<br>Hong Kong<br>India<br>Indonesia<br>Israel | Europe | Austria<br>Belgium<br>Cyprus<br>Denmark<br>Finland | | |

### 9.3.4 Data Overview of Characteristics of Articles of the Private Context

**Table 38.** Detailed Results for the Shares of Articles per Context and Outlet – Final Consensus after Three Rounds of Coding

| | | Other | Multiple | Organizational | Both | Private |
|---|---|---|---|---|---|---|
| EJIS | 1995 | 29% | 0% | 71% | 0% | 0% |
| EJIS | 2005 | 55% | 0% | 44% | 0% | 2% |
| EJIS | 2015 | 20% | 0% | 54% | 7% | 20% |
| | | | | | | |
| ISJ | 1995 | 36% | 0% | 50% | 14% | 0% |
| ISJ | 2005 | 41% | 0% | 55% | 0% | 5% |
| ISJ | 2015 | 34% | 0% | 41% | 14% | 10% |
| | | | | | | |
| ISR | 1995 | 22% | 0% | 50% | 17% | 11% |
| ISR | 2005 | 28% | 0% | 59% | 10% | 3% |
| ISR | 2015 | 4% | 0% | 77% | 8% | 10% |
| | | | | | | |
| JIT | 1995 | 25% | 0% | 75% | 0% | 0% |

| | | Other | Multiple | Organizational | Both | Private |
|---|---|---|---|---|---|---|
| JIT | 2005 | 0% | 0% | 95% | 5% | 0% |
| JIT | 2015 | 32% | 0% | 56% | 12% | 0% |
| | | | | | | |
| JMIS | 1995 | 15% | 0% | 76% | 5% | 5% |
| JMIS | 2005 | 14% | 0% | 71% | 10% | 4% |
| JMIS | 2015 | 18% | 0% | 56% | 21% | 5% |
| | | | | | | |
| JSIS | 1995 | 37% | 0% | 63% | 0% | 0% |
| JSIS | 2005 | 9% | 0% | 82% | 5% | 5% |
| JSIS | 2015 | 19% | 0% | 71% | 5% | 5% |
| | | | | | | |
| JAIS | 2005 | 36% | 0% | 43% | 14% | 7% |
| JAIS | 2015 | 16% | 0% | 35% | 32% | 16% |
| | | | | | | |
| MISQ | 1995 | 4% | 0% | 92% | 4% | 0% |
| MISQ | 2005 | 4% | 0% | 89% | 4% | 4% |
| MISQ | 2015 | 9% | 0% | 67% | 9% | 14% |
| | | | | | | |
| ECIS | 1995 | 8% | 0% | 89% | 2% | 1% |
| ECIS | 2005 | 9% | 0% | 75% | 11% | 5% |
| ECIS | 2015 | 5% | 0% | 72% | 15% | 8% |
| | | | | | | |
| ICIS | 1995 | 7% | 0% | 77% | 16% | 0% |
| ICIS | 2005 | 11% | 0% | 71% | 14% | 5% |
| ICIS | 2015 | 6% | 0% | 62% | 20% | 12% |

**Table 39.** Absolute Number of Articles per Year and Outlet of Articles on the Private Use of IS

| Journal | Year | Private Articles | All articles |
|---|---|---|---|
| EJIS | 1995 | 0 | 21 |
| EJIS | 2005 | 1 | 66 |
| EJIS | 2015 | 8 | 41 |
| | | | |
| ISJ | 1995 | 0 | 22 |
| ISJ | 2005 | 1 | 22 |
| ISJ | 2015 | 3 | 29 |
| | | | |
| ISR | 1995 | 2 | 18 |
| ISR | 2005 | 1 | 29 |
| ISR | 2015 | 5 | 48 |
| | | | |
| JIT | 1995 | 0 | 32 |
| JIT | 2005 | 0 | 21 |
| JIT | 2015 | 0 | 34 |
| | | | |
| JMIS | 1995 | 2 | 41 |
| JMIS | 2005 | 2 | 49 |
| JMIS | 2015 | 3 | 57 |
| | | | |
| JSIS | 1995 | 0 | 30 |
| JSIS | 2005 | 1 | 22 |
| JSIS | 2015 | 1 | 21 |
| | | | |
| JAIS | 1995 | 0 | 0 |
| JAIS | 2005 | 1 | 14 |
| JAIS | 2015 | 5 | 31 |
| | | | |
| MISQ | 1995 | 0 | 24 |
| MISQ | 2005 | 1 | 28 |
| MISQ | 2015 | 6 | 43 |
| | | | |
| ECIS | 1995 | 1 | 104 |
| ECIS | 2005 | 8 | 160 |
| ECIS | 2015 | 22 | 286 |
| | | | |
| ICIS | 1995 | 0 | 44 |
| ICIS | 2005 | 4 | 85 |
| ICIS | 2015 | 41 | 344 |
| Total | | 119 | 1,766 |

| Year | Total Number of All Private Articles for all Outlets |
|---|---|
| 1995 | 5 |
| 2005 | 20 |
| 2015 | 94 |

**Table 40.** Absolute Number of Articles per Outlet, Research Method and Year for the PIS Use Context for Journals (A) and Conferences (B)

| A | | | | |
|---|---|---|---|---|
| **Outlet** | **1995** | **2005** | **2015** | **Total** |
| EJIS | 0 | 2 | 16 | 18 |
| Conceptual | 0 | 1 | 8 | 9 |
| Experiment | 0 | 1 | 1 | 2 |
| Survey | 0 | 0 | 7 | 7 |
| ISJ | 0 | 2 | 5 | 7 |
| Conceptual | 0 | 1 | 2 | 3 |
| Ethnography | 0 | 0 | 1 | 1 |
| Experiment | 0 | 0 | 1 | 1 |
| Survey | 0 | 1 | 1 | 2 |
| ISR | 2 | 2 | 12 | 16 |
| Conceptual | 0 | 1 | 4 | 5 |
| Field Study | 0 | 0 | 4 | 4 |
| Survey | 2 | 1 | 2 | 5 |
| Experiment | 0 | 0 | 2 | 2 |
| JMIS | 3 | 4 | 5 | 12 |
| Conceptual | 1 | 2 | 2 | 5 |
| Experiment | 2 | 2 | 0 | 4 |
| Survey | 0 | 0 | 3 | 3 |
| JSIS | 0 | 2 | 1 | 3 |
| Case Study | 0 | 0 | 1 | 1 |
| Conceptual | 0 | 1 | 0 | 1 |
| Survey | 0 | 1 | 0 | 1 |
| JAIS | 0 | 2 | 9 | 11 |
| Case Study | 0 | 0 | 1 | 1 |
| Conceptual | 0 | 1 | 4 | 5 |
| Experiment | 0 | 0 | 1 | 1 |
| Survey | 0 | 1 | 3 | 4 |
| MISQ | 0 | 2 | 11 | 13 |
| Conceptual | 0 | 1 | 3 | 4 |
| Field Study | 0 | 0 | 4 | 4 |
| Literature Review | 0 | 0 | 1 | 1 |
| Other | 0 | 0 | 1 | 1 |
| Survey | 0 | 1 | 2 | 3 |

| B | | | | |
|---|---|---|---|---|
| **Outlet** | **1995** | **2005** | **2015** | **Total** |
| ECIS | 1 | 13 | 31 | 45 |
| Case Study | 0 | 0 | 1 | 1 |
| Conceptual | 0 | 4 | 8 | 12 |
| Experiment | 0 | 1 | 7 | 8 |
| Field Study | 0 | 1 | 6 | 7 |
| Literature Review | 0 | 1 | 0 | 1 |
| Other | 1 | 0 | 0 | 1 |
| Prototype | 0 | 0 | 1 | 1 |
| Survey | 0 | 6 | 8 | 14 |
| ICIS | 0 | 7 | 64 | 73 |
| Case Study | 0 | 0 | 2 | 2 |
| Conceptual | 0 | 3 | 25 | 28 |
| Ethnography | 0 | 0 | 1 | 1 |
| Experiment | 0 | 0 | 8 | 8 |
| Field Study | 0 | 1 | 18 | 19 |
| Literature Review | 0 | 0 | 1 | 1 |
| Opinion | 0 | 1 | 0 | 1 |
| Other | 0 | 0 | 1 | 1 |
| Prototype | 0 | 0 | 1 | 1 |
| Simulation | 0 | 1 | 0 | 1 |
| Survey | 0 | 1 | 9 | 10 |

**Table 41.** Most Productive Authors in the Private Context with Two or More Articles (and their Outlets)

| Authors | Chosen Outlets | # of Publications | Authors | Chosen Outlets | # of Publications |
|---|---|---|---|---|---|
| Susan A. Brown | Total | 3 | Netta Iivari | Total | 2 |
| | EJIS | 1 | | ECIS | 1 |
| | MISQ | 1 | | ICIS | 1 |
| | ICIS | 1 | Hans van der Heijden | Total | 2 |
| Viswanath Venkatesh | Total | 3 | | ECIS | 2 |
| | EJIS | 1 | Prasanta Bhattacharya | Total | 2 |
| | MISQ | 2 | | ECIS | 1 |
| Morgan M Shepherd | Total | 2 | | ICIS | 1 |
| | JMIS | 2 | Hartmut Hoehle | Total | 2 |
| Andrew B. Whinston | Total | 2 | | EJIS | 1 |
| | ICIS | 2 | | MISQ | 1 |
| Robert O. Briggs | Total | 2 | Sabine Matook | Total | 2 |
| | JMIS | 2 | | EJIS | 1 |
| Bruce A Reinig | Total | 2 | | JMIS | 1 |
| | JMIS | 2 | Jay F Nunamaker Jr | Total | 2 |
| Arto Lanamäki | Total | 2 | | JMIS | 2 |
| | ECIS | 1 | Shan Ling Pan | Total | 2 |
| | ICIS | 1 | | JAIS | 1 |
| Chao-Min Chiu | Total | 2 | | ICIS | 1 |
| | EJIS | 1 | Jeffrey V. Nickerson | Total | 2 |
| | JAIS | 1 | | ICIS | 2 |
| Peter Buxmann | Total | 2 | Sven Laumer | Total | 2 |
| | ISR | 1 | | EJIS | 1 |
| | ECIS | 1 | | ISJ | 1 |
| Christian Maier | Total | 2 | Jenine Beekhuyzen | Total | 2 |
| | EJIS | 1 | | ISJ | 1 |
| | ISJ | 1 | | ICIS | 1 |
| Samer Faraj | Total | 2 | Tim Weitzel | Total | 2 |

| Authors | Chosen Outlets | # of Publications | Authors | Chosen Outlets | # of Publications |
|---|---|---|---|---|---|
| | ISR | 1 | | EJIS | 1 |
| | MISQ | 1 | | ISJ | 1 |
| De Liu | Total | 2 | Tuan Q. Phan | Total | 2 |
| | MISQ | 1 | | ECIS | 1 |
| | ICIS | 1 | | ICIS | 1 |
| Tawfiq Alashoor | Total | 2 | Yulin Fang | Total | 2 |
| | ICIS | 2 | | EJIS | 1 |
| Gee-Woo Bock | Total | 2 | | ICIS | 1 |
| | JAIS | 1 | Jerome Yen | Total | 2 |
| | ECIS | 1 | | JMIS | 2 |
| Mikko Rajanen | Total | 2 | Lee Xian Yap | Total | 2 |
| | ECIS | 1 | | JAIS | 1 |
| | ICIS | 1 | | ECIS | 1 |
| Hanna Krasnova | Total | 2 | Lutz M. Kolbe | Total | 2 |
| | ISR | 1 | | ECIS | 1 |
| | ECIS | 1 | | ICIS | 1 |

**Table 42.** Most Productive Authors in the Private Context per Journals (A) and Conferences (B)

A

| Most Productive Authors for Journals | # of Articles of the Private Context |
|---|---|
| Viswanath Venkatesh | 3 |
| Samer Faraj | 2 |
| Robert O. Briggs | 2 |
| Bruce A Reinig | 2 |
| Sven Laumer | 2 |
| Chao-Min Chiu | 2 |
| Sabine Matook | 2 |
| Christian Maier | 2 |
| Susan A. Brown | 2 |
| Hartmut Hoehle | 2 |
| Tim Weitzel | 2 |
| Jay F Nunamaker Jr | 2 |
| Morgan M Shepherd | 2 |
| Jerome Yen | 2 |

B

| Most Productive Authors for Conferences | # of Articles of the Private Context |
|---|---|
| Prasanta Bhattacharya | 2 |
| Mikko Rajanen | 2 |
| Tuan Q. Phan | 2 |
| Andrew B. Whinston | 2 |
| Netta Iivari | 2 |
| Arto Lanamäki | 2 |
| Tawfiq Alashoor | 2 |
| Hans van der Heijden | 2 |
| Jeffrey V. Nickerson | 2 |
| Lutz M. Kolbe | 2 |

**Table 43.** Overview of the Number of Authors and Publications per Outlet for the Private Context

| Outlet and Year | # of Publications | # of Authors | Cooperativity index |
|---|---|---|---|
| European Journal of Information Systems | 9 | 25 | 2,8 |
| 2005 | 1 | 3 | 3,0 |
| 2015 | 8 | 22 | 2,8 |
| Information Systems Journal | 4 | 15 | 3,8 |
| 2005 | 1 | 3 | 3,0 |
| 2015 | 3 | 12 | 4,0 |
| Information Systems Research | 8 | 27 | 3,4 |
| 1995 | 2 | 6 | 3,0 |
| 2005 | 1 | 3 | 3,0 |
| 2015 | 5 | 18 | 3,6 |
| Journal of Management Information Systems | 7 | 25 | 3,6 |
| 1995 | 2 | 10 | 5,0 |
| 2005 | 2 | 7 | 3,5 |
| 2015 | 3 | 8 | 2,7 |
| Journal of Strategic Information Systems | 2 | 5 | 2,5 |
| 2005 | 1 | 3 | 3,0 |
| 2015 | 1 | 2 | 2,0 |
| Journal of the Association for Information Systems | 6 | 20 | 3,3 |
| 2005 | 1 | 3 | 3,0 |
| 2015 | 5 | 17 | 3,4 |
| MIS Quarterly | 7 | 20 | 2,9 |
| 2005 | 1 | 2 | 2,0 |
| 2015 | 6 | 18 | 3,0 |
| Proceedings of the European Conference on Information Systems (ECIS) | 31 | 83 | 2,7 |
| 1995 | 1 | 2 | 2,0 |
| 2005 | 8 | 22 | 2,8 |
| 2015 | 22 | 59 | 2,7 |
| Proceedings of the International Conference on Information Systems (ICIS) | 45 | 135 | 3,0 |
| 2005 | 4 | 14 | 3,5 |
| 2015 | 41 | 121 | 3,0 |
| **Total** | **119** | **355** | **3,0** |

**Table 44.** Overview of the Number of Authors and Publications per Outlet for all Contexts

| Outlet and Year | # of Publications | # of Authors | Cooperativity index |
|---|---|---|---|
| European Journal of Information Systems | 128 | 256 | 2,0 |
| 1995 | 21 | 38 | 1,8 |
| 2005 | 66 | 116 | 1,8 |
| 2015 | 41 | 102 | 2,5 |
| Information Systems Journal | 73 | 172 | 2,4 |
| 1995 | 22 | 40 | 1,8 |
| 2005 | 22 | 51 | 2,3 |
| 2015 | 29 | 81 | 2,8 |
| Information Systems Research | 95 | 240 | 2,5 |
| 1995 | 18 | 38 | 2,1 |
| 2005 | 29 | 65 | 2,2 |
| 2015 | 48 | 137 | 2,9 |
| Journal of Information Technology | 87 | 181 | 2,1 |
| 1995 | 32 | 56 | 1,8 |
| 2005 | 21 | 47 | 2,2 |
| 2015 | 34 | 78 | 2,3 |
| Journal of Management Information Systems | 147 | 377 | 2,6 |
| 1995 | 41 | 99 | 2,4 |
| 2005 | 49 | 124 | 2,5 |
| 2015 | 57 | 154 | 2,7 |
| Journal of Strategic Information Systems | 73 | 149 | 2,0 |
| 1995 | 30 | 46 | 1,5 |
| 2005 | 22 | 49 | 2,2 |
| 2015 | 21 | 54 | 2,6 |
| Journal of the Association for Information Systems | 45 | 130 | 2,9 |
| 2005 | 14 | 36 | 2,6 |
| 2015 | 31 | 94 | 3,0 |
| MIS Quarterly | 95 | 248 | 2,6 |
| 1995 | 24 | 63 | 2,6 |
| 2005 | 28 | 66 | 2,4 |
| 2015 | 43 | 119 | 2,8 |
| Proceedings of the European Conference on Information Systems (ECIS) | 550 | 1402 | 2,5 |
| 1995 | 104 | 229 | 2,2 |
| 2005 | 160 | 395 | 2,5 |

| Outlet and Year | # of Publications | # of Authors | Cooperativity index |
|---|---|---|---|
| 2015 | 286 | 778 | 2,7 |
| Proceedings of the International Conference on Information Systems (ICIS) | 473 | 1300 | 2,7 |
| 1995 | 44 | 99 | 2,3 |
| 2005 | 85 | 236 | 2,8 |
| 2015 | 344 | 965 | 2,8 |
| **Total** | **1,766** | **4,455** | **2,5** |

**Table 45.** Google Scholar Citations – Collected in 2016 – for Articles in the Private Use of IS Context (A) and for the Full Sample (B)

| A | | | |
|---|---|---|---|
| Citations for Articles of the Private Context (**2016**) | | | |
| **Year** | **# of Articles** | **Mean # of Citations per Article** | **Max # of Citations** |
| 1995 | 5 | 1501 | 6975 |
| 2005 | 20 | 150 | 771 |
| 2015 | 94 | 5 | 66 |
| **Total** | **119** | **92** | **6,975** |

| B | | | |
|---|---|---|---|
| Citations for Articles for all Contexts (**2016**) | | | |
| **Year** | **# of Articles** | **Mean # of Citations per Article** | **Max # of Citations** |
| 1995 | 333 | 177 | 6975 |
| 2005 | 496 | 104 | 3768 |
| 2015 | 930 | 3 | 188 |
| **Total** | **1,759**[46] | **65** | **6,975** |

**Table 46.** Mean Number of BoE References per Research Design – for Articles in the Private Use of IS Context (A) and for the Full Sample (B)

| A | | | |
|---|---|---|---|
| References for Private Context | | | |
| **Research Design** | **Mean #References per Article** | **Mean #BoE References per Article** | **Mean BoE-Ratio** |
| Both | 75 | 14 | 17% |
| Empirical | 54 | 6 | 12% |
| Non-Empirical | 68 | 15 | 14% |
| **Total** | **67** | **11** | **15%** |

| B | | | |
|---|---|---|---|
| References for all Contexts | | | |
| **Mean #References per Article** | **Mean #References per Article** | **Mean #BoE References per Article** | **Mean BoE-Ratio** |
| Both | 63 | 11 | 16% |
| Empirical | 47 | 7 | 14% |
| Non-Empirical | 36 | 6 | 16% |
| **Total** | **50** | **8** | **15%** |

**Table 47.** Mean Number of BoE References per Research Approach – for Articles in the Private Use of IS Context (A) and for the Full Sample (B)

| A | | | |
|---|---|---|---|
| References for Private Context | | | |
| **Research Approach** | **Mean #References per Article** | **Mean #BoE references per Article** | **Mean BoE-Ratio** |
| Both | 74 | 13 | 17% |
| Qualitative | 70 | 11 | 14% |
| Quantitative | 52 | 6 | 11% |
| **Total** | **67** | **11** | **15%** |

| B | | | |
|---|---|---|---|
| References for all Contexts | | | |
| **Research Approach** | **Mean #References per Article** | **Mean #BoE references per Article** | **Mean BoE-Ratio** |
| Both | 63 | 11 | 16% |
| Qualitative | 42 | 6 | 15% |
| Quantitative | 51 | 7 | 13% |
| **Total** | **50** | **8** | **15%** |

[46] This sample size is smaller than the usual number of articles for the full sample because in the course of a more current data analysis, four articles were identified which were missing in the sample of 2016 and another four articles just have not been checked for Google Scholar citations. As Google Scholar citations change very quickly, the data could not be retraced afterwards.

## 9.4 Detailed Information for the Literature Review

### 9.4.1 Additional Graphs for the Bibliometric Study

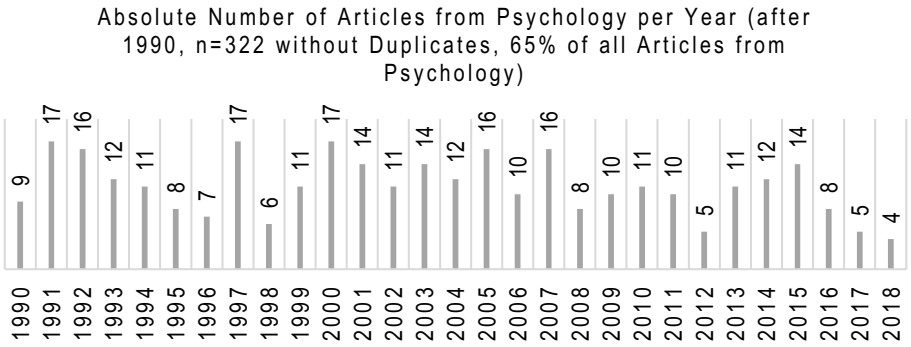



**Figure 59.** Absolute Number of Articles from Psychology per Year from 1990 on – Without Duplicates

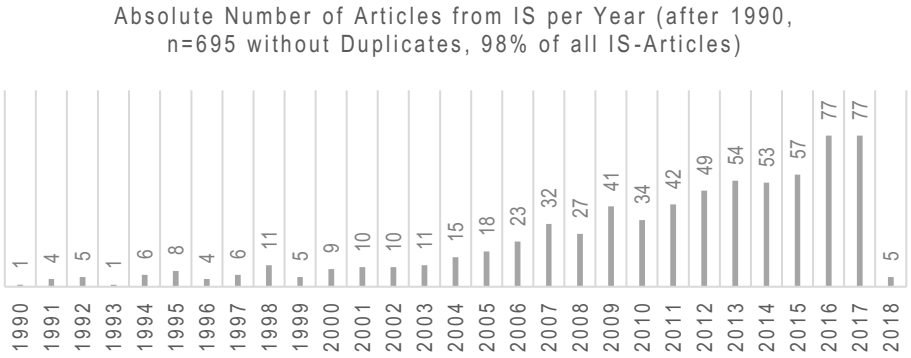



**Figure 60.** Absolute Number Articles from IS per Year from 1990 on – Without Duplicates

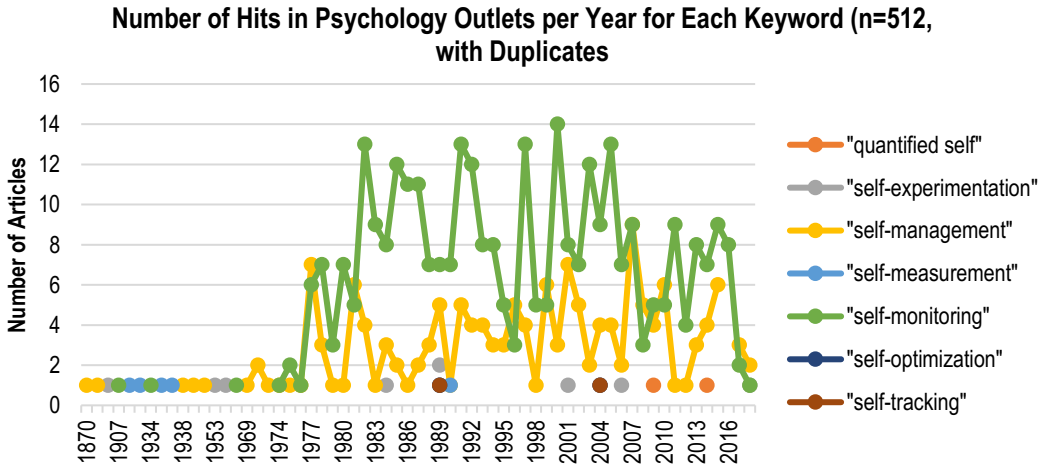



**Figure 61.** Evolution of the Number of Hits in Psychology Outlets per Year for Each Keyword

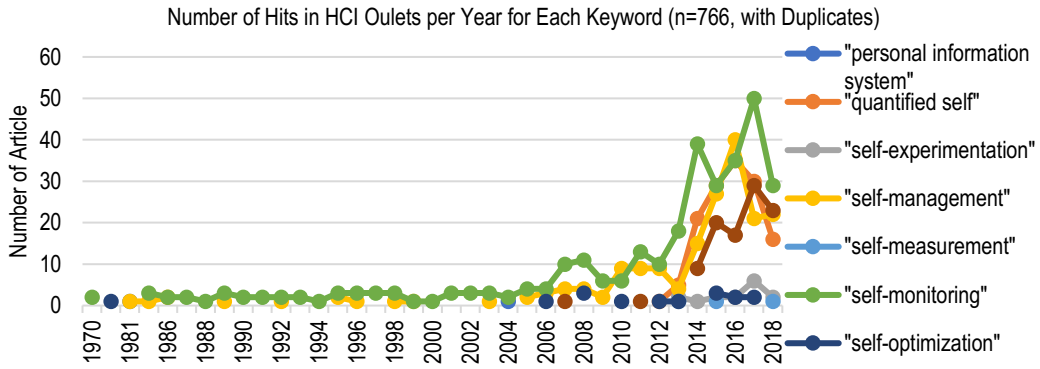



**Figure 62.** Evolution of the Number of Hits in HCI Oulets per Year for Each Keyword

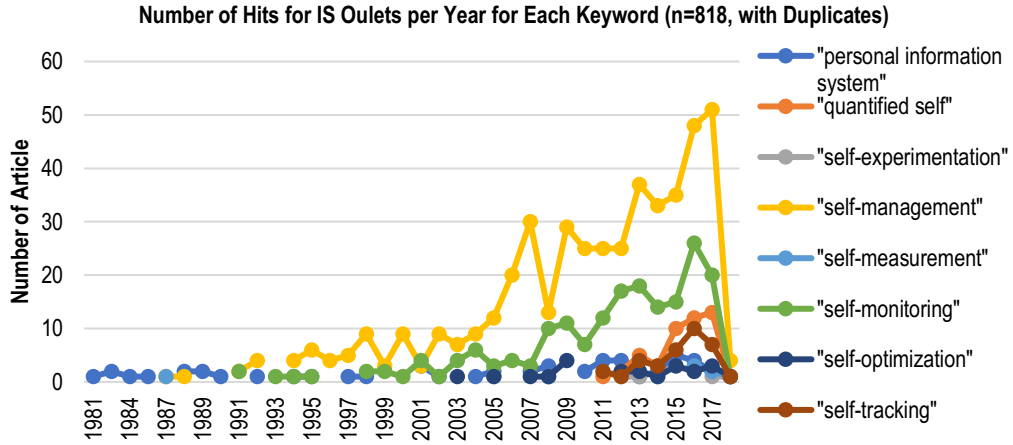



**Figure 63.** Evolution of the Number of Hits for IS Outlets per Year for Each Keyword

### 9.4.2 IS Research Themes According to Sidorova et al. (2008)

In IS research, different approaches exist that define a holistic set of typical IS research themes used in IS articles. For example, Barki et al. (1988) define a classification scheme that was reused for years and decades later by Alavi et al. (1989), Glass et al. (2004), or Vessey et al. (2002, 2005). The first level of their classification scheme encompasses the following IS research themes:

- Reference Disciplines;
- External Environment;
- Technological Environment;
- Organizational Environment;
- IS Management;
- IS Development and Operations;
- IS Usage;
- Information Systems;
- IS Education and Research.

An updated and very detailed version can be found in Barki et al. (1993), which served for the keyword-selection process of the journal MISQ (Vessey et al. 2005). Table 48 depicts the themes of the first and second level. For example, the first level encompasses “reference discipline”, “IS management”, or “IS development and operations”. Themes of the first level “reference discipline” are e.g., “behavioral science”, “computer science”, or “social science”.

**Table 48.** Research Themes in IS Research (Barki et al. 1993, p.211)

| | | |
|---|---|---|
| **Reference Discipline**<br>• Behavioral Science<br>• Computer Science<br>• Decision Theory<br>• Information Theory<br>• Organizational Theory<br>• Management Theory<br>• Systems Theory<br>• Research<br>• Social Science<br>• Management Science<br>• Artificial Intelligence<br>• Economic Theory<br>• Ergonomics<br>• Political Science<br>• Psychology | **IS Management**<br>• Data Resource Management<br>• Personnel Resource Management<br>• Hardware Resource Management<br>• Software Resource Management<br>• IS Project Management<br>• IS Planning<br>• Organizing IS<br>• IS Staffing<br>• IS Evaluation<br>• IS Control<br>• IS Security<br>• IS Management Issues | **IS Development and Operations**<br>• IS Development Strategies<br>• IS Life Cycle activities<br>• IS Development Methods and Tools<br>• IS Implementation<br>• IS Operations |
| **Organizational Environment**<br>• Organizational Characteristics<br>• Organizational Functions<br>• Task Characteristics<br>• Organizational Dynamics | **IS Usage**<br>• Organizational Use of IS<br>• Users<br>• Type of IS Support<br>• Type of IS Access<br>• Type of Processing | **External Environment**<br>• Economic Environment<br>• Legal Environment<br>• Political Environment<br>• Social Environment |
| **Information Technology**<br>• Computer Systems<br>• Software | **Information Systems**<br>• Types of Information Systems<br>• IS Applications Areas<br>• Components of IS<br>• IS Characteristics | **IS Education and Research**<br>• IS Education<br>• IS Research<br>• IS Professional Societies<br>• History of IS |

Later, Ayanso et al. (2007) also analyzed IS research themes employed in IS journals. However, they chose to use ICIS tracks in order to analyze the range of topics of the selected articles. This analysis reveals that the traditional classification scheme from Barki et al. (1988) might be outdated, as it does not adequately represent ICIS theme tracks (e.g., design science, human-computer interaction). As the dissertation aims at taking into consideration a rather neglected research stream (PIS), the literature analysis uses a more recent classification, namely, the research areas[47] identified by Sidorova et al. (2008), combined with the research themes from Benbasat and Zmud (2003).

With a latent semantic analysis of abstracts, Sidorova et al. (2008) identify five major research areas: IT and (1) individuals, (2) groups, (3) organizations, (4) markets, and (5) IS Development. They mapped these research areas according to the top five research themes from Benbasat and Zmud (2003):

- IT Artifact;
- Impact;
- Usage;
- Capabilities;

[47] Also called research stream in the dissertation.

- Practices.

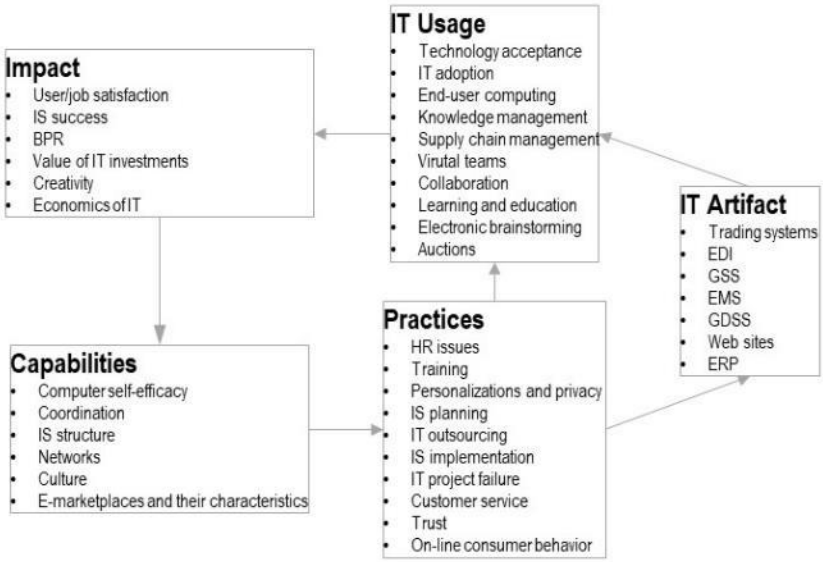



**Figure 64.** Exemplary Research Themes and Subthemes Amended from Sidorova et al. (2008, p. 479)

Benbasat and Zmud (2003) conceptualize the IS theme around the IT artifact as research on conceiving, constructing, and implementing such artifacts. Furthermore, usage, support, and evolvement and their impact or the impact of contexts on IT artifacts are studied. Additionally, there exist "managerial, methodological, and technological capabilities as well as … practices" (Benbasat and Zmud 2003, p. 186) that influence the development of IT artifacts or IT usage.

Sidorova et al. (2008) map research themes for each research area. They exemplify the research themes, e.g., IT usage for IT and individuals, groups, organizations, and markets. For IT and individuals, themes such as end-user computing or individual technology acceptance are considered. For IT and groups, themes such as collaboration or virtual teams are chosen. For IT and organizations, themes such as supply-chain management or knowledge management exemplify this area. For IT and markets, themes such as IT adoption and auctions are named as examples. Further examples are summarized in Figure 64.

For the dissertation, this combination of both IS research themes and the major research areas is chosen because it helps to differentiate at the level of analysis, and all themes cover a broad variety of topics.

## 9.5 Detailed Information on the Empirical Field Study

### 9.5.1 Overall Study Design

The overall study, which was the context for the UTAUT usage behavior study, was organized as a field experiment in order to examine the effect of the feedback intervention in the real world (i.e., not in an artificial setting in a laboratory). Participants were randomly assigned to two different groups, the so-called treatment group and the control group, which received group-specific devices. The devices handed out to the control group displayed only information on water temperature (i.e., no feedback on water or energy use). The devices given to the treatment group also displayed only water temperature during the first N*10 showers (referred to as baseline phase; N describes the number of household members using the shower), but thereafter automatically switched to feedback mode (the intervention phase). In the intervention phase, the devices provided the full set of real-time feedback on water and energy consumption.

This design is referred to as a randomized controlled trial with baseline phase. It allows investigation of changes in consumption once the intervention of interest (here, feedback on consumption) becomes active by observing the difference between baseline and intervention phase. Moreover, by observing the control group, the study design also enables subtraction of non-intervention related influences (such as changes in outdoor temperature or changes in behavior stemming from the feeling among participants of being monitored in a study). The study design is

illustrated in Figure 65. An online survey was conducted both at the beginning and at the end of the study.

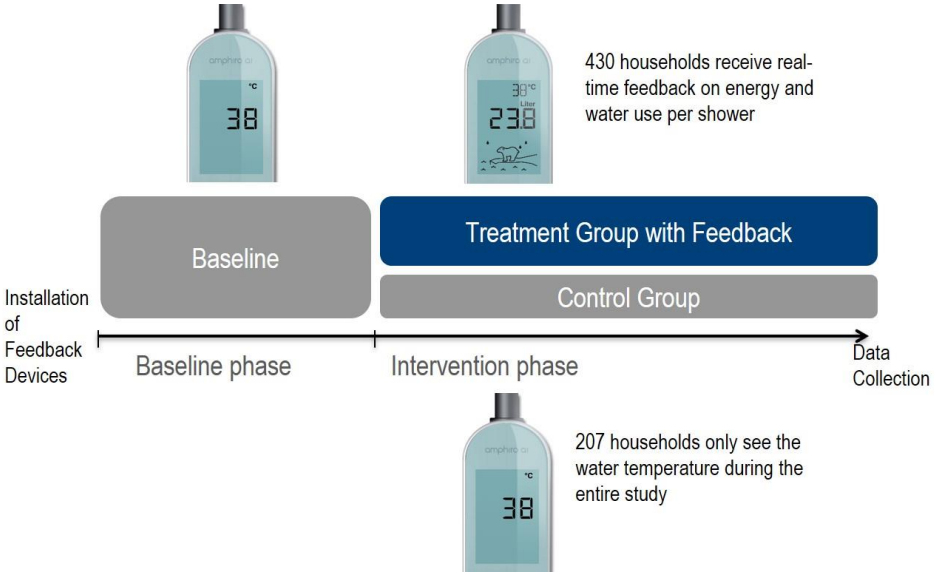



**Figure 65.** Overall Field Experiment Design with the Smart Shower Meter

After the baseline phase, the treatment group realizes a 20% energy saving per shower, which equals to 0.6 kWh. For more details, please see Staake et al. (2016).

# Studie Energieeffizienz: *Nachhaltig zu Hause – auch beim Duschen.*


**Mitmachen und testen**

**Senken Sie Ihren Energieverbrauch zu Hause und nehmen Sie an unserer Nachhaltigkeitsstudie teil. Warmwasser ist der zweitgrösste Posten beim Energiebedarf eines Haushaltes und wird vor allem beim Duschen verbraucht. Testen Sie Ihr Duschverhalten mit Hilfe einer intelligenten Duschanzeige.**

**Das Projekt**

- PWN untersucht gemeinsam mit Forschern mehrerer Universitäten, ob und wie viel Energie sich mithilfe einer intelligenten Duschanzeige sparen lässt.
- Melden Sie sich an und Sie erhalten kostenlos eine intelligente Duschanzeige, die Sie im Anschluss an die Studie behalten dürfen.
- Teilnahmeberechtigt sind alle Mitarbeiter von PWN. Die Anzahl intelligenter Duschanzeigen ist limitiert.
- Dauer des Studie: Anfang September bis Mitte November 2015 (2 Monate).

**Das Gerät**

- Die intelligente Duschanzeige misst den Energie- und Wasserverbrauch und zeigt Informationen zum Dusch- verhalten an.
- Das Gerät lässt sich einfach, ohne Werkzeuge und bauliche Massnahmen an den Duschschlauch montieren (und wieder ausbauen) – in Miet-wohnungen oder Eigenheimen.

**Voraussetzungen für eine Teilnahme**

- Dusche mit Handbrause (keine Regen-dusche).
- Einwilligung zur Aufzeichnung der Duschdaten und Auswertung in anony-misierter Form.
- Teilnahme an zwei Online-Umfragen (vor und nach dem Einbau des Gerätes). Diese beinhalten Fragen zum Haushalt, zu Ihrem Verhalten im Allgemeinen und zur Nutzung der Duschanzeige.
- Idealerweise der Besitz eines Smartphones (zum Hochladen der Daten am Ende der Studie)

**Deshalb sollten Sie mitmachen**

- Sie verstehen den Energieverbrauch beim Duschen besser und senken ihn idealerweise.
- Alle Daten werden anonymisiert und von den Hochschulen für Forschungs-zwecke verwendet. PWN hat keine Zugriff auf die Daten.

**Ablauf der Studie**

- Melden Sie sich hier an – die Registrierung erfordert nur wenige Angaben, um sich für die Teilnahme zu qualifizieren: http://www.surveygizmo.com/Registration.
- Nach Ausfüllen des Fragebogens erhalten Sie die intelligente Duschanzeige bei PWN.
- Sie montieren die Duschanzeige unkompliziert – auch ohne handwerkliches Geschick.
- Das Gerät zeigt Ihnen Informationen zu Ihrem Duschverhalten. Ihre Duschdaten werden während zwei Monaten auf dem Gerät aufgezeichnet.
- Sie stellen am Ende der Studie ganz einfach und bequem die aufgezeichneten Daten über eine Smartphone-App den Forschern zur Verfügung. Oder Sie bringen Ihre Duschanzeige Gerät zu einer Sammelstelle bei PWN, wo die Daten aus dem Gerät ausgelesen werden.
- Nach Studienende gehört das Gerät Ihnen und Sie können es behalten – und Ihren Energiebedarf langfristig senken.

Möchten Sie mehr erfahren? Schreiben Sie an pwn@amphiro.com

PWN · Otto-Friedrich-Universität Bamberg · universitätbonn Rheinische Friedrich-Wilhelms-Universität Bonn · ETH Zürich

**Figure 66.** Flyer for Participant Recruitment – Originally Formulated in German and Translated into Dutch

### 9.5.3 Survey Items Employed to Test the UTAUT Models

All items (except SRU1 and SRU2) were evaluated with a seven-point Likert-type evaluation scale.

Due to the specific application, small adaptations of wording, originating with Venkatesh et al. (2003, 2012), were needed. In a brainstorming session with other researchers, the specification of the original wording was chosen, as the items evaluated aspects of a completely new technology not considered for further observation by the participant. Self-tracking water consumption in the shower could only be measured with timers or by looking at the water meter for the complete house or apartment. Furthermore, it was important to precisely distinguish the smartphone app from the smart shower device. To that end, for example, the original sample response, "I know how to use this technology," was adapted to "I know how to install apps." Table 49 depicts the complete list of items used for the study.

**Table 49.** Item Formulations Used for the UTAUT-Study on Self-Tracking Appliances

| Construct – Item Number | Item in t1 | Item in t2 |
|---|---|---|
| Performance Expectancy – PE1 | I would find such a shower tracking app useful. | I found such a shower tracking app useful. |
| PE2 | Such an app could help me to keep an eye on my energy and water consumption. | The app helped me to keep an eye on my energy and water consumption. |
| Effort Expectancy 1 – EE1 | I think I would understand the visualized information provided by the app easily. | I think I understood the visualized information provided by the app easily. |
| EE2 | Learning how to use such an app would be easy for me. | Learning how to use such an app was easy for me. |
| Social Influence – SI1 | People who have an influence on me think that such an app is a cool innovation. | |
| SI2 | People who are important to me think that I should keep an eye on my energy and water consumption in the shower. | |
| Facilitating Conditions – FC1 | I have a smartphone on which apps can be installed. | |
| FC2 | I know how to install apps on my phone. | |
| Hedonic Motivation – HM1 | Using such an app would be fun. | Using such an app was fun. |
| HM2 | I think the information provided by such an app would be interesting. | I think the information provided by such an app is interesting. |
| Perceived Value – PV1 | Imagine the device and the app would together cost 79,90 EUR. The device and the app would be reasonably priced. | Imagine the device and the app would together cost 79,90 EUR. The device and the app are reasonably priced. |
| PV2 | I could imagine buying the device and the app for 79,90 EUR. | Assuming you did not have the device and the app any more: I could imagine buying the device and the app together for 79,90 EUR. |
| Habit – HA1 | I am currently using apps for tracking my personal activities (running, expenditures, nutrition, etc.). | |
| HA2 | I already actively monitor my water and energy consumption (when paying my bills, reading my electricity meter, using a cost control device, etc.). | I already actively monitor my water and energy consumption besides this app (when paying my bills, reading my electricity meter, using a cost control device, etc.). |
| Behavioral Intention – BI1 | I would try out such an app during the time of the study. | I do not intend to use the app during the next few months. |
| BI2 | If given the possibility, I intend to use such an app several times during the next few months. | I intend to use the app several times during the next few months. |
| Self-Reported Use – SRU1 | The app was not yet available at this time. | I used the app to see my/our consumption statistics. (never/a single time/2-3 times/4-7 times/more than 7 times) |
| SRU2 | | I used the app for the data transfer. (never/a single time/2-3 times/4-7 times/more than 7 times) |

### 9.5.4 Additional Data Analysis

**Table 50.** Results for Demographic Moderators to Predict Adoption Intention (Gender)

| Results/ | t1 | | | |
|---|---|---|---|---|
| | UTAUT1 | | UTAUT2 | |
| | Female | Male | Female | Male |
| Sample Size | 240 | 309 | 240 | 309 |
| $R^2$ (Adoption Intention) | 0.64 (F(3,235)=106.61, p<0.001) | 0.65 (F(4,304)=114.53, p<0.001) | 0.61 (F(6,233)=78.59, p<0.001) | 0.69 (F(6,302)=114.35, p<0.001) |
| FC | 0.153** | 0.273*** | 0.136** | 0.250*** |
| PE | 0.539*** | 0.411*** | 0.369*** | 0.232*** |
| EE | 0.232*** | 0.249*** | 0.172** | 0.167** |
| SI | (0.008) n.s. | (0.031) n.s. | (-0.022) n.s. | (-0.004) n.s. |
| HM | - | - | 0.287*** | 0.322*** |
| PV | - | - | (-0.018) n.s. | (0.045) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | | | |

**Table 51.** Results for Demographic Moderators to Predict Continuous Usage Intention (Gender)

| Results/ | t2 | | | |
|---|---|---|---|---|
| | UTAUT1 | | UTAUT2 | |
| | Female | Male | Female | Male |
| Sample Size | 119 | 141 | 116 | 141 |
| $R^2$ (Continuous Usage Intention) | 0.35 (F(4,114)=15.23, p<0.001) | 0.24 (F(4,136)=10.73, p<0.001) | 0.39 (F(6,109)=11.44, p<0.001) | 0.28 (F(6,134)=8.48, p<0.001) |
| FC | (0.039) n.s. | 0.130* | (0.046) n.s. | 0.156** |
| PE | 0.647*** | 0.494*** | 0.408** | 0.285** |
| EE | (-0.091) n.s. | (0.008) n.s. | (-0.157) n.s. | (-0.084) n.s. |
| SI | (-0.087) n.s. | (-0.096) n.s. | (-0.088) n.s. | (-0.139) n.s. |
| HM | - | - | 0.351** | 0.279* |
| PV | - | - | (0.014) n.s. | (0.123) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | | | |

**Table 52.** Results for Demographic Moderators to Predict Self-Reported Usage (Gender)

| Results/ | From Intentions to Usage | |
|---|---|---|
| | Female | Male |
| Sample Size | 101 | 113 |
| $R^2$ (Self-reported Usage) | 0.02 (F(2,98)=0.905, p<0.05) | 0.04 (F(2,110)=2.73, p<0.2) → n.s. |
| BI | (-0.081) n.s. | 0.248* |
| FC | (0.069) | (-0.130) |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | |

**Table 53.** Results for Demographic Moderators to Predict Self-Reported Usage (Age)

| Results | From Intentions to Usage | | | | | |
|---|---|---|---|---|---|---|
| | <20 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | 60+ |
| Sample Size | 1 | 34 | 75 | 52 | 32 | 20 |
| $R^2$ (Self-reported Usage) | - | 0.03 (F(2,31)=0.55, p<0.6) → n.s. | 0.04 (F(2,72)=1.60, p<0.3) → n.s. | 0.11 (F(2,49)=3.13, p<0.1) | 0.07 (F(2,29)=1.19, p<0.4) → n.s. | 0.08 (F(2,29)=1.19, p<0.5) → n.s. |
| BI | - | (-0.214) n.s. | (-0.061) n.s. | 0.294* | (0.361) n.s. | (0.286) n.s. |
| FC | | (0.050) n.s. | (-0.164) n.s. | (0.071) n.s. | (0.299) n.s. | (-0.007) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | | | | | |

**Table 54.** Results for Demographic Moderators to Predict Adoption Intention (Age) – UTAUT1

| Results | UTAUT1 – Adoption Intention | | | | | |
|---|---|---|---|---|---|---|
| | <20 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | 60+ |
| Sample Size | 2 | 67 | 146 | 144 | 112 | 78 |
| R² (Self-reported Usage) | - | 0.56 (F(4,62)=19.72, p<0.001) | 0.65 (F(4,141)=64.24, p<0.001) | 0.70 (F(4,139)=80.63, p<0.001) | 0.63 (F(4,107)=45.56, p<0.001) | 0.7 (F(4,73)=45.62, p<0.001) |
| FC<br>PE<br>EE<br>SI | - | (0.156*<br>(0.341**<br>0.418***<br>(-0.017) n.s. | 0.229***<br>0.519***<br>0.189**<br>(0.039) n.s. | 0.271***<br>0.296***<br>0.380***<br>0.015) n.s. | 0.226**<br>0.473***<br>0.209**<br>(0.048) n.s. | 0.190**<br>0.683***<br>0.084) n.s.<br>(-0.019) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | | | | | |

**Table 55.** Results for Demographic Moderators to Predict Adoption Intention (Age) – UTAUT2

| Results | UTAUT2 – Adoption Intention | | | | | |
|---|---|---|---|---|---|---|
| | <20 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | 60+ |
| Sample Size | 2 | 67 | 146 | 144 | 112 | 78 |
| R² (Self-reported Usage) | - | 0.56 (F(3,60)=12.83, p<0.001). | 0.66 (F(6,139)=45.66, p<0.001) | 0.74 (F(6,137)=66.29, p<0.001) | 0.07 (F(2,29)=1.19, p<0.4) → n.s. | 0.81 (F(6,71)=50.49, p<0.001) |
| FC<br>PE<br>EE<br>SI<br>HM<br>PV | - | 0.163*<br>0.341**<br>0.416**<br>(-0.029) n.s.<br>(-0.10) n.s.<br>(0.048) n.s. | 0.209**<br>0.397***<br>0.175**<br>(-0.004) n.s.<br>0.185**<br>(0.046) n.s. | 0.232***<br>(0.069) n.s.<br>0.278***<br>(-0.040) n.s.<br>0.407***<br>(0.036) n.s. | 0.215**<br>0.330**<br>0.150*<br>(0.063) n.s.<br>0.236**<br>(-0.044) n.s. | 0.123*<br>0.277**<br>(0.017) n.s.<br>(-0.072) n.s.<br>0.599***<br>(0.023) n.s.. |
| * p<0,1 –-** p<0,05 – *** p<0,001 – n.s. not significant | | | | | | |

**Table 56.** Results for Demographic Moderators to Predict Continuous Usage Intention (Age) – UTAUT1

| Results | UTAUT1 – Continuous Usage Intention | | | | | |
|---|---|---|---|---|---|---|
| | <20 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | 60+ |
| Sample Size | 1 | 39 | 90 | 65 | 42 | 23 |
| R² (Self-reported Usage) | - | 0.37 (F(4,34)=4.98, p<0.05) | 0.53 (F(4,85)=24.31, p<0.001) | 0.18 (F(4,60)=3.29, p<0.05) | 0.26 (F(4,37)=3.28, p<0.05) | 0.08 (F(2,29)=1.19, p<0.5) → n.s. |
| FC<br>PE<br>EE<br>SI | - | (-0.102) n.s.<br>0.580**<br>(0.109) n.s.<br>(-0.115) n.s. | 0.289***<br>0.719***<br>(-0.091) n.s.<br>-,011) n.s. | ,256**<br>(0.132) n.s.<br>(0.202) n.s.<br>(-0.010) n.s. | (-0.184) n.s.<br>0.582**<br>(0.026) n.s.<br>(-0.302* | (-0.083) n.s.<br>0.986**<br>(-0.169) n.s.<br>(-0.392) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | | | | | |

**Table 57.** Results for Demographic Moderators to Predict Continuous Usage Intention (Age) – UTAUT2

| Results | UTAUT2 – Continuous Usage Intention | | | | | |
|---|---|---|---|---|---|---|
| | <20 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | 60+ |
| Sample Size | 1 | 38 | 90 | 63 | 42 | 23 |
| R² (Self-reported Usage) | - | 0.42 (F(6,31)=3.79, p<0.05) | 0.50 (F(6,83)=15.95, p<0.001). | 0.15 (F(6,56)=2.82, p<0.05) | 0.07 (F(6,35)=3.78, p<0.05) | 0.32 (F(4,18)=2.15, p<0.2) → n.s. |
| FC<br>PE<br>EE<br>SI<br>HM<br>PV | - | (-0.055) n.s.<br>(0.382) n.s.<br>(0.039) n.s<br>(-0.128) n.s<br>(0.267) n.s<br>(0.169) n.s | 0.281**<br>0.675***<br>(-0.103) n.s.<br>(0.015) n.s.<br>(0.072) n.s.<br>(-0.021) n.s. | 0.219*<br>(-0.121) n.s.<br>(0.075) n.s.<br>(-0.103) n.s.<br>0.417*<br>(0.110) n.s. | (-0.125) n.s.<br>(0.444) n.s.<br>(-0.077) n.s.<br>-0.432*<br>(-0.038) n.s.<br>,494* | (0.212) n.s<br>(-0.042) n.s<br>(-0.487) n.s.<br>(-0.390) n.s.<br>(1.177) n.s<br>(0.151) n.s. |
| * p<0,1 – ** p<0,05 – *** p<0,001 – n.s. not significant | | | | | | |

## 9.6 Additional Information for the Content Validation

### 9.6.1 Overview of Content Validation Procedures within IS Literature

Table 58 summarizes the procedures of content validation of several articles from the AIS Library. It shows the author(s) of the article and the major sources they used for developing their content validity procedure. Then, the steps of the procedure are explained: first, the task of rating or sorting; then, the calculation follows, including a certain threshold or decision criterion for keeping or deleting an item; and finally, information about the sample size and the type of participants/experts, if available.

**Table 58.** Overview of Selected Articles and the Employed Procedures for Content Validation

| Authors<br><br>(Cited Primary Literature[48]) | Procedure<br><br>Step (1), Step (2), Step (3), … | Sample Size (Type)<br><br>$N_1$=Sample Size for Step 1, $N_{2R1}$= for Step 2 – Round 1 |
|---|---|---|
| Ali et al. (2011)<br><br>(Lawshe 1975) | (1) Assessing the appropriateness of the original survey instrument as a pretest;<br>(2) Gathering feedback on any difficulties concerning content and design as a pilot-test;<br>(3) Content validation: Rating the relevancy of each item according to Lawshe (1975) → As a result: Calculation of CVR with a threshold including ratings of category 2 and 3 for item retainment. | $N_1$=12 (academics, practitioners)<br>$N_2$= 10 (academics, practitioners)<br>$N_3$= 13 (academics) |
| Ali et al. (2014)<br><br>(Lawshe 1975) | (1) Pilot study: Rating of each item and the overall concept with a 3-point evaluation scale: 1=not relevant, 2=important (but not essential), 3=essential → As a result: Calculation of CVR with a threshold of 0.51 (including ratings of category 2 and 3) for each item and overall concept;<br>(2) Rating of each item and the overall concept → As a result: Calculation of CVR for each item and overall concept. | $N_1$= 5 (academics)<br>$N_2$= 11 (experts) |
| Bhattacherjee (2002)<br><br>(Segars and Grover 1998) | (1) Evaluating the wording and sorting cards to existing categories (Q-sorting); ranking items within each category→ as a result: calculation of agreement and inter-rater reliability. | $N_1$=6 (target population) |
| Choi et al. (2015):<br><br>(Moore and Benbasat 1991) | (1) Sorting cards and labelling of categories → As a result: Rewording or dropping of items;<br>(2) Sorting cards into predefined categories → As a result: Calculation of Inter-rater reliability with Lights Kappa and a threshold of 0.75;<br>(3) Pretest → As a result: Rewording of items. | $N_1$= 9 (PhD)<br>$N_2$= 3 (faculty members)<br>$N_3$= 20 (undergraduate students) |
| Choudrie and Dwivedi (2005)<br><br>(Lawshe 1975) | (1) Sorting items according to Lawshe (1975) → As a result: Calculating the CVR with a threshold 0.59 for item retainment;<br>(2) Testing the understanding in a pretest → As a result: Rewording and correcting typos;<br>(3) Pilot testing → As a result: Rewording and adapting the length and reliability. | $N_1$=12 (academics)<br>$N_2$= 20 (academics, target population, experts) |
| Dong et al. (2016)<br><br>(Anderson and Gerbing 1991; Hinkin and Tracey 1999; Moore and Benbasat 1991) | (1) Testing for wording and simplicity (also called Face validity) as a pretest;<br>(2) Sorting cards: judges sort cards with items to categories labelled by them in two rounds → As a result: Calculating item placement ratio and inter-rater reliability for item retainment;<br>(3) Sorting cards: judges sort cards to given and defined categories in two rounds → As a result: Calculating item placement ratio and inter-rater reliability for item retainment. | $N_1$=3 (academics)<br>$N_{2R1}$= 7 (practitioners, academics)<br>$N_{2R2}$=No information<br>$N_3$= No information |
| Hoehle and Venkatesh (2015)<br><br>(Anderson and Gerbing 1991; MacKenzie et al. 2011)(2011) | (1) Rating of items whether each captures the definition of different constructs with a seven-point Likert-type evaluation scale), subsets of items → As a result: Calculating a variance analysis (one-way ANOVA) to decide on item retainment;<br>(2) Sorting an item to one single corresponding construct definition → As a result: Calculating the proportion of respondents who assign items to their intended constructs and the substantive validity coefficient with a cut off at a threshold of 0.6 for items. | $N_1$= 4 (IS researchers, staff)<br>$N_2$= 318 (target population) |
| Karaiskos et al. (2009)<br><br>(Lawshe 1975) | (1) Rating the relevance of each item according to Lawshe (1975) → As a result: Calculation of CVR with a threshold of 0.31 including ratings of category 2 and 3) and CVI for each dimension. | $N_1$=33 (No information) |
| Lee and Cheung (2013)<br><br>(Moore and Benbasat 1991) | (1) Sorting cards in 2 rounds to classify each item to a corresponding dimension → As a result: Calculating of Cohen's Kappa with a threshold of 0.65 and item placement ratio. | $N_{1R1}$= 5 (experts)<br>$N_{1R2}$= 5 (experts) |
| Mikalef and Pateli (2016)<br><br>(Moore and Benbasat 1991; Lawshe 1975) | (1) Q-sorting → As a result: Calculating placement ratio;<br>(2) Sorting according to Lawshe (1975) → As a result: Calculation of CVR with a threshold of 0.78 for item retainment. | N=9 (No information) |
| Moore and Benbasat (1991) | (1) Evaluating the comprehensiveness and comprehensibility in a pretest; | $N_1$=No information<br>$N_{2R1}$= 4 (various university members) |

[48] Please refer to the article for further bibliographic information.

| Authors<br><br>(Cited Primary Literature[48]) | Procedure<br><br>Step (1), Step (2), Step (3), … | Sample Size (Type)<br><br>$N_1$=Sample Size for Step 1, $N_{2R1}$= for Step 2 – Round 1 |
|---|---|---|
| (Davis 1986, 1989) | (2) Sorting cards into categories and labelling them in two rounds → As a result: Calculating agreement, inter-rater reliability, and the overall-placement ratio with a threshold of greater than 0.65 for item retainment;<br>(3) Sorting items to definitions of the construct by judges in two rounds. | $N_{2R2}$=4<br>$N_{3R1}$=5<br>$N_{3R2}$=4 (academics from business) |
| Recker and Rosemann (2010)<br><br>(Sherif and Sherif 1967; Bailey and Pearson 1983) | (1) Identifying the domain substrata, i.e., a pretest for comprehensiveness and comprehensibility where experts sort items to categories and label those in two rounds → As a result: Calculating placement ratio and at a threshold of 0.44 a category is retained;<br>(2) Assessing the item correspondence to the definitions of the constructs for item identification at a seven-point evaluation scale → As a result: Calculating the ranking results with an average and ranking in order to select items for elimination;<br>(3) Reducing the item set (item revision) and improving the understanding with card sorting in four rounds with given and not given categories→ As a result: Calculating inter-rater reliability with a Kappa threshold of 0.6 for retaining categories and items. | $N_{1R1}$=4 (No information)<br>$N_{1R2}$=7 (No information)<br>$N_2$= $N_1$ (content domain experts)<br>$N_{3R1}$=16 (target population)<br>$N_{3R2}$= $N_{3R3}$=$N_{3R4}$=No information |
| Tojib and Sugianto (2006)<br><br>(Fehring 1987; Lynn 1986) | (1) Rating of importance of dimension definitions (with a 5-point evaluation scale: 1=not at all, 2=very little, 3=somewhat, 4=well, 5=very well) → As a result: Calculation of mean values → items over the threshold of 3 were retained;<br>(2) Ranking of the relevancy of each item for an assigned dimension (with a 5-point evaluation scale, the ratings were weighted, 0=for rating 1; 0.25=for rating 2; 0.5=for rating 3; 0.75=rating 4; 1=for rating 5) → as a result: all results were averaged and when the maximum value for the total score is 1 → item was retained or cut-off at a threshold of 0.5;<br>(3) Rating of each item and the complete instrument (with a four-point evaluation scale: 1=irrelevant, 2=somewhat relevant if profound rephrasing, 3=relevant with some adjustments, 4=very relevant) → as a result: the CVI (proportion of raters who rated it as content valid) was calculated → items were retained (including their dimensions) at a minimum threshold of 0.8. | $N_1$=6 (No information)<br>$N_2$= $N_1$<br>$N_3$=3 (target population, academics, content domain experts) |
| Yao and Yang (2008)<br><br>(Anderson and Gerbing 1991; Hinkin and Tracey 1999) | (2) Sorting an item to one single corresponding construct definition → As a result: Calculating the proportion of substantive agreement and the substantive validity coefficient with a cut off at a threshold of 0.3 for items;<br>(1) Rating of items whether each captures the definition of different constructs with a seven-point Likert-type evaluation scale → As a result: Calculation of the variance analysis (one-way ANOVA) for all subsets of items in order to decide on item retainment. | $N_1$= 102 (students=target population)<br>$N_2$= 128 (community adults=target population) |

### 9.6.2 Minimum Values of CVR for Statistical Significance

Minimum Values of CVR from Lawshe (1975)

**Table 59.** Minimum Values of CVR, One-Tailed-Test, p=0.05 (Lawshe 1975, p. 568)

| No. of Panelists | Minimum Value for CVR |
|---|---|
| 5 | .99 |
| 6 | .99 |
| 7 | .99 |
| 8 | .75 |
| 9 | .78 |
| 10 | .62 |
| 11 | .59 |
| 12 | .56 |
| 13 | .54 |
| 14 | .51 |
| 15 | .49 |
| 20 | .42 |
| 25 | .37 |
| 30 | .33 |
| 35 | .31 |
| 40 | .29 |

Revisiting Minimum Values of CVR from Lawshe (1975)

Due to some criticism and anomalies detected by scholars concerning the reported minimum values of CVR (also called $CVR_{critical}$) from Lawshe (1975), Wilson et al. (2012) compared the $CVR_{critical}$ with other different distributions, i.e., a binominal distribution with p=1/3 and p=1/2 as well as a normal approximation. The first point of criticism relates to the arbitrary choice of the number of panelists, because after 15 panelists, Table 59 only proceeds in steps of five. Then, an anomaly represents the sudden decrease of a sample size of eight, with a minimum value of 0.75, after the sample size of nine, with a minimum value of 0.78, and an increase for a sample size of seven, with a minimum value of 0.99. It remains unclear if this is due to an erroneous value transfer from data calculation to the paper version or a reversing of the values for the panel sizes of eight and

nine – which may not have been found in the proofreading process. The results of Wilson et al. (2012) are shown in Figure 67, indicating that the values of Lawshe (1975) do not exactly fit the suggested distributions expected from previous studies. The values from Lawshe (1975) rather fit a normal approximation of the binominal for p=0.05 (two-tailed) or for p=0.25 (one-tailed). As a result, Wilson et al. (2012) recalculated minimal values of CVR from Lawshev(1975) and Table 60 shows their results.

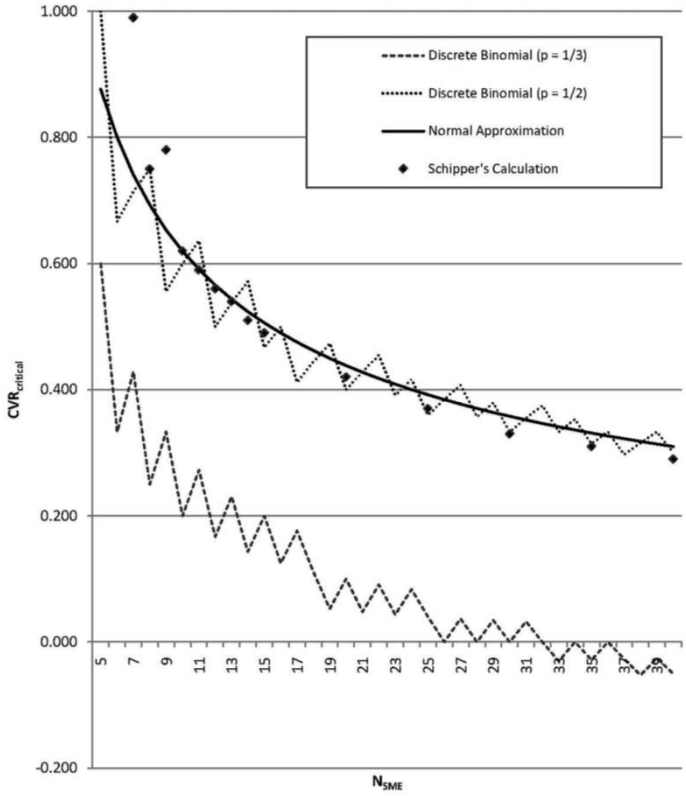



**Figure 67.** Comparison of Schipper's Values of $CVR_{critical}$ with Critical Value Results from Three Recalculations Using Other Distributions (Wilson et al. 2012, p. 205)

**Table 60.** Recalculated Critical Values for $CVR_{critical}$ (Wilson et al. 2012, p. 206)

| | Level of Significance for One-Tailed Test | | | | | |
|---|---|---|---|---|---|---|
| | .1 | .05 | .025 | .01 | .005 | .001 |
| | Level of Significance for Two-Tailed Test | | | | | |
| N | .2 | .1 | .05 | .02 | .01 | .002 |
| 5 | .573 | .736 | .877 | .99 | .99 | .99 |
| 6 | .523 | .672 | .800 | .950 | .99 | .99 |
| 7 | .485 | .622 | .741 | .879 | .974 | .99 |
| 8 | .453 | .582 | .693 | .822 | .911 | .99 |
| 9 | .427 | .548 | .653 | .775 | .859 | .99 |
| 10 | .405 | .520 | .620 | .736 | .815 | .977 |
| 11 | .387 | .496 | .591 | .701 | .777 | .932 |
| 12 | .370 | .475 | .566 | .671 | .744 | .892 |
| 13 | .356 | .456 | .544 | .645 | .714 | .857 |
| 14 | .343 | .440 | .524 | .622 | .688 | .826 |
| 15 | .331 | .425 | .506 | .601 | .665 | .798 |
| 16 | .321 | .411 | .490 | .582 | .644 | .773 |
| 17 | .311 | .399 | .475 | .564 | .625 | .750 |
| 18 | .302 | .388 | .462 | .548 | .607 | .729 |
| 19 | .294 | .377 | .450 | .534 | .591 | .709 |
| 20 | .287 | .368 | .438 | .520 | .576 | .691 |
| 21 | .280 | .359 | .428 | .508 | .562 | .675 |
| 22 | .273 | .351 | .418 | .496 | .549 | .659 |
| 23 | .267 | .343 | .409 | .485 | .537 | .645 |
| 24 | .262 | .336 | .400 | .475 | .526 | .631 |
| 25 | .256 | .329 | .392 | .465 | .515 | .618 |
| 26 | .251 | .323 | .384 | .456 | .505 | .606 |
| 27 | .247 | .317 | .377 | .448 | .496 | .595 |
| 28 | .242 | .311 | .370 | .440 | .487 | .584 |
| 29 | .238 | .305 | .364 | .432 | .478 | .574 |
| 30 | .234 | .300 | .358 | .425 | .470 | .564 |
| 31 | .230 | .295 | .352 | .418 | .463 | .555 |
| 32 | .227 | .291 | .346 | .411 | .455 | .546 |
| 33 | .223 | .286 | .341 | .405 | .448 | .538 |
| 34 | .220 | .282 | .336 | .399 | .442 | .530 |
| 35 | .217 | .278 | .331 | .393 | .435 | .522 |
| 36 | .214 | .274 | .327 | .388 | .429 | .515 |
| 37 | .211 | .270 | .322 | .382 | .423 | .508 |
| 38 | .208 | .267 | .318 | .377 | .418 | .501 |
| 39 | .205 | .263 | .314 | .372 | .412 | .495 |
| 40 | .203 | .260 | .310 | .368 | .407 | .489 |

Note: Values for $CVR_{critical}$ greater than or equal to the limit value of 1.00 were set to .99.

However, two years later, Ayre and Scally (2014) criticize the fact that Wilson et al. (2012) used the normal approximation to the binominal distribution and not the exact binominal probabilities. Furthermore, they query the lack of continuity correction. With a normal approximation from the authors, they completely mapped the values of Lawshe (1975) for panel sizes below ten. Above 10 panelists, the authors completely mapped the original results from Lawshe (1975) with a normal approximation to the binomial, except for one minor discrepancy at n=13. This is depicted in Figure 68. On this account, Ayre and Scally (2014) suggest continuing to use the value of Lawshe (1975) for future research.

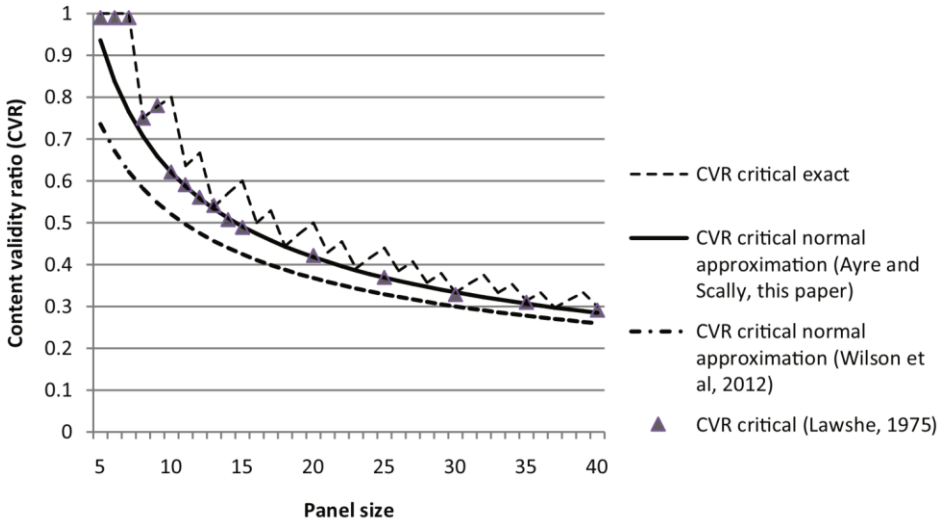



**Figure 68.** Comparison between Critical Values for Content Validity Ratios (Ayre and Scally 2014, p. 83)

### 9.6.3 Exemplary Questionnaires for Content Validity – Round 1

Page 1 – Introduction

# Evaluation of the Construct: Attitudes towards Self-tracking (A1)

## Introdcution

Dear participant,

For my thesis, I develop a construct (abstract concept that helps to measure a latent phenomenon) to measure attitudes towards self-tracking with the help of surveys. To that end, I generated set of items/statements that might be part of the construct and will help researchers to assess attitudes towards self-tracking in the future.

In order to validate the understanding of this set of items and the corresponding question instruction, **I would like to ask you to provide your personal and professional opinion** about the following set of items I will present you on the next pages. Moreover, I will define some terms for a better understanding.

So, the main two goals of this survey is to assess (1) how you perceive the instructions and the items in a first test run and (2) if each item is correctly formulated (understandable and unambiguous).

The evaluation is separated into three sections:

- part 1: **Trial-test** of the Instrument (first version of instructions and items)
- part 2: **Evaluation** of the formulation (clarity, conciseness) & possibility to add/modify
- part 3: Short **background information** about you

Thank you very much for approx. **20-30 minutes** of your time and be a part of a scientific project!

All of the information will be **anonymous** and will be used for nothing other than research purposes.

Thanks for your support!
Anna Kupfer
anna.kupfer@uni-bamberg.de

Page 2 – Presentation of the Construct

## Evaluation of the Construct: Attitudes towards Self-tracking (A1)

### Step 1: Instrument Trial-Test

1. Self-tracking describes one or more of the following components: self-measurement, data collection/storage, analysis, reflection, and behavioral change concerning private activities/facts (e.g. nutrition, weighing, financial issues, energy consumption, activities, sports, menstruation cycle, etc.).

To what extent do you agree to the following statements?

| | Strongly disagree 1 | Disagree 2 | Somewhat disagree 3 | Neither agree or disagree 4 | Somewhat agree 5 | Agree 6 | Strongly agree 7 |
|---|---|---|---|---|---|---|---|
| I like to self-track because it helps me to get in detail information about myself. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I like to see my progress. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is competitive. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is easy. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is annoying. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is time-consuming. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Weighting is frustrating | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is only money making. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is extremely useful for medical problems. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is fun through the scientific appeal. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am afraid of changes, thus I dislike self-tracking. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I dislike self-tracking because others could misuse my data. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is cool because I have a history on things I did in my private life. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I dislike self-tracking because I do not want to be aware of my problems. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is annoying but pushes anyway. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is fun. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking is a reward. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I dislike self-tracking because I dislike goals. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I like self-tracking because it makes my performance more tangible for myself. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I like to measure/note things such that I do not forget anything. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I like to note aspects about my private life. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I do not need self-tracking to know what is good for me. I intuitively know what is good for me. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Page 3: Actual Evaluation of the items

Step 2: Evaluation, Rewording & Suggestions

2. Now, please rate each item. There are **three aspects** where you can **choose between two options**:

1. The first two columns evaluate **clarity** (highlighted in grey): either clarity is low or high.
2. The next columns evaluate **conciseness:** either conciseness is low or high.
3. Finally, you can **adapt the set of statements**: mark if you propose to delete or modify an item (highlighted in black). In case you want to suggest a rewording, please see the text field in the next questions.

**Definitions:**

clarity:

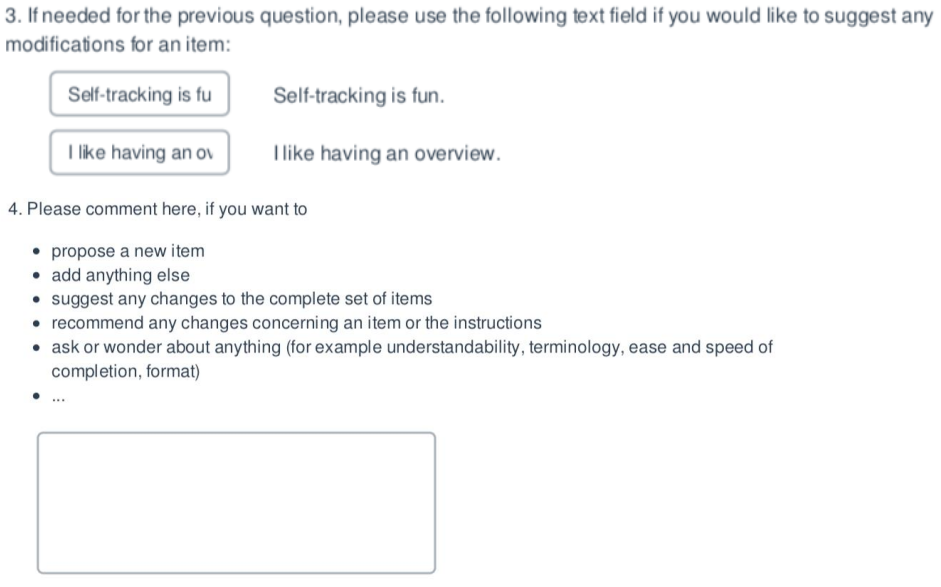
- the state of being clear or easy to see (through) / hear/ or understand (Cambridge Dictionary 2018)
- the quality of being certain and definite / the quality of being coherent and intelligible / sharpness (Oxford Dictionary 2018)
- e.g. no ambiguity of words

concise/conciseness:

- brief but comprehensive (Cambridge Dictionary 2018)
- giving a lot of information clearly and in a few words; brief but comprehensive. (Oxford Dictionary 2018)
- e.g. short but still comprehensive

| | high **clarity** | low **clarity** | high **conciseness** | low **conciseness** | *delete* | *modify* |
|---|---|---|---|---|---|---|
| I dislike the amount of data that is generated through self-tracking. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I like to self-track because it helps me to get in detail information about myself. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Self-tracking is an alternative religion. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| self-tracking is too much structure. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I like to see my progress. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Self-tracking is a routine/ritual. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am interested in collecting data. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Page 4: Room for Suggesting Modifications and Additional Comments



3. If needed for the previous question, please use the following text field if you would like to suggest any modifications for an item:

Self-tracking is fu — Self-tracking is fun.

I like having an ov — I like having an overview.

4. Please comment here, if you want to

- propose a new item
- add anything else
- suggest any changes to the complete set of items
- recommend any changes concerning an item or the instructions
- ask or wonder about anything (for example understandability, terminology, ease and speed of completion, format)
- ...

Page 5: Personal Information for Expert Level Estimation

## Background information

5. Finally, please check one or more statements that fit your background. This information helps me to better understand your ratings.

- ☐ I am currently working in research.
- ☐ I have administered a survey at least once.
- ☐ I have developed a construct/scale (from scratch) at least once.
- ☐ I have been engaged into research in the domain of self-tracking at least once.
- ☐ I have been engaged into research in the domain of attitudes at least once.
- ☐ I have been working in research before.
- ☐ I have already completed an (academic) survey.
- ☐ I have already tracked one aspect about my private life (steps, nutrition, email-behavior, energy consumption, financials, etc.)

### 9.6.4 Exemplary Questionnaires for Content Validity – Round 2 and 3

Page 1 – Introduction

## Evaluation of the Construct: Attitudes towards Self-tracking (A2)

### Introdcution

Dear participant,

For my thesis, I develop a construct (abstract concept that helps to measure a latent phenomenon) to measure attitudes towards self-tracking with the help of surveys. To that end, I generated a set of statements that might be part of the construct and will help researchers to assess attitudes towards self-tracking in the future.

In order to validate the collection of statements and the understanding, **I would like to ask you to provide your personal and professional opinion** about the following set of statements I will present you on the next pages. Moreover, I will define some terms for a better understanding.

So, the main two goals of this survey is to assess (1) how relevant and understandable each statement is (2) if the set of items is well chosen.

The evaluation is separated into three sections:

- step 1: **Overview** on the definitions and terminology
- step 2: **Warm-Up**: Evaluation of the instruction text
- step 3: **Training** example (can be skipped)
- step 4: **Evaluation** of the statements and sorting to dimensions
- step 5: Last comment and short **background information**

Thank you very much for approx. **20-30 minutes** of your time and be a part of a scientific project!

All of the information will be **anonymous** and will be used for nothing other than research purposes.

Thanks for your support!
Anna Kupfer
anna.kupfer@uni-bamberg.de

Page 2: Definitions Overview

## Step 1: Definitions

**In case you are not familiar with any terminology that will be used during the survey, please take some moments to review some of the definitions below.**

**If you are familiar with all the terms, you can skip this part by clicking on the button "next".**

**-How is the attitude towards self-tracking (phenomenon) defined?**
The attitude towards self-tracking is a pre-disposition to respond (affectively, cognitively, or with a certain behavior) in a favorable or unfavorable way to actions or objects implying one or more of the following self-tracking components: self-measurement, data collection/storage, analysis, reflection, and behavioral change concerning private activities/facts. (Kupfer et al. 2018)

**-What are attitudes?**
Attitudes are defined as:

- evaluative/judgmental meaning to an object or person expressed: for example liking or disliking, approving or disapproving, favouring or disfavouring a particular issue, object or person
- on overall evaluation of an object that is based on cognitive (opinions, thoughts), affective (emotional), and behavioral information (Bagozzi 1978, Joyce & Kirakowski 2015)
- Exemplary attitude statements (Thompson et al. 1991, Yang & Yoo 2004):
  - Using a spreadsheet software makes me feel good. (affective evaluation)
  - Working with a PC is fun. (affective evaluation)
  - Using a spreadsheet software is valuable. (cognitive evaluation)
  - Use of a PC will increase the flexibility of changing jobs. (cognitive evaluation)
  - When I need to calculate something I use spreadsheets. (behavioral evaluation)

**-What is self-tracking?**

- measurement efforts of an individual towards collecting, storing, analyzing as well as reflecting and acting upon data on personal (often private) activities (Li et al. 2010)
- activities encompass for example: stepping on a weight scale, checking financial expenditures, noting gas consumption, observing health issues, or fitness tracking

**-What is a construct and an item/statement?**
As explained before, a construct represents a theoretical/abstract concept of a phenomenon. (London et al. 2017) Items/statements represent one major aspect/attribute about the phenomenon. The statements help to measure the construct as whole as they represent the content of the construct. So, the totality of all statements should be fully representative for the phenomenon. (Lewis et la. 2005, MacKenzie et al. 2011)

Example (Richins and Dawson 1992):
In a survey researchers want to assess to what extent an individual sees materialism (phenomenon/concept) as a value. It is much more difficult to measure such values (unobservable construct) than the age or gender of an individual (observable construct). With the help of literature, the construct developers identify three important themes/dimensions that belong to the value of materialism (defining success, acquisition centrality, and pursuit of happiness). In order to measure each aspect, they need statements which help scholars to assess the relevance of materialism for an individual. The construct developers therefore have identified five to six statements for each dimension. The following shows two exemplary statements per dimension (measured in five steps from strongly agree to strongly disagree):

Defining Success:

1. I admire people who own expensive homes, cars, and clothes.
2. I like to own things that impress people.

Acquisition Centrality:

1. I usually buy only the things I need.
2. I like a lot of luxury in my life.

Pursuit of Hapiness:

1. I have all the things I really need to enjoy life.
2. My life would be better if I owned certain things I don't have.

## Page 3: Warm-Up

Step 2: Warm Up: Evaluation of Instruction Text

**Let's start with the easy part:**

**The instruction of the attitude construct is given as follows. Please evaluate, if the instruction text is understandable and if you agree with the selection of the scales.**

1. Please comment on the chosen instruction text and scales:

1. Self-tracking describes one or more of the following components: self-measurement, data collection/storage, analysis, reflection, and behavioral change concerning private activities/facts (e.g. nutrition, weighing, financial issues, energy consumption, activities, sports, menstruation cycle, etc.).

To what extent do you agree to the following statements?

| | Strongly disagree 1 | Disagree 2 | Somewhat disagree 3 | Neither agree or disagree 4 | Somewhat agree 5 | Agree 6 | Strongly agree 7 |
|---|---|---|---|---|---|---|---|
| Self-tracking helps me to track interesting aspects such as expenses or my weight. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking helps for self-observation. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Self-tracking does not help me to solve | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Page 4: Explanation and Training

Step 3: Explanation and Training

**On the next page, we start with the actual main part - the evaluation of the statements. This is an important but also sometimes difficult task.**

**In order to ease the understanding of such an evaluation type, I have prepared an easy training example that might help you to understand the main essence of the evaluation. Please remember that the content of the training has nothing to do with the main evaluation of the attitude scale. Consider the following:**

- **In the case you are familiar with sorting and ranking of items/statements, you can skip this page (by clicking on the button "next").**
- **You can always just have a look at an exemplary solution.**

2. Let's consider the following example of an automobile and its parts as a comparison to a latent construct and its content aspects.

In the following, you should evaluate the necessary and important (but not necessary) aspects about a car. Additionally, you should sort the aspects to the according automobile part category (car body, electrical, interior, power-train, miscellaneous).

| | Car Body and Main Parts | Electrical and Electronics | Interior | Power-train and chassis | Miscellaneo Parts |
|---|---|---|---|---|---|
| A car is assembled with doors and windows. | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if rewo<br>Important<br>Not necessary |
| A car has an engine cooling system. | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if reworded<br>Important<br>Not necessary | Essential<br>Essent. if rewo<br>Important<br>Not necessary |

3. Do you want to see an exemplary solution for the question above?

- Yes
- No

A possible solution follows the rationale that technological and laws aspects are essential (e.g. a person needs to be able to drive the car and the car needs to fulfill safety regulations).

Other aspects are important but not essential make the car function (fuel gauge, power-assisted steering system). Furthermore, additional aspects such as a seat heater and a navigation system are neither essential or important.

Additional essential aspect can be included: lighting and signal system or the steering wheel.

| | Car Body and Main Parts | Electrical and Electronics | Interior | Power-train and chassis | Miscellaneous Parts |
|---|---|---|---|---|---|
| A car is assembled with doors and windows. | Important | -- Please Select -- | -- Please Select -- | -- Please Select -- | -- Please Select -- |
| A car has an engine cooling system. | -- Please Select -- | -- Please Select -- | -- Please Select -- | Essential | -- Please Select -- |
| There are seats for the passengers. | -- Please Select -- | -- Please Select -- | Essential | -- Please Select -- | -- Please Select -- |
| A car has a seat heater. | -- Please Select -- | -- Please Select -- | -- Please Select -- | -- Please Select -- | Not important |

## Page 5: Main Evaluation

### Step 2: Evaluation of Statements

**Let's start with the most important task - Thanks for carefully evaluating each statement given in the table, even if it takes some patience.**

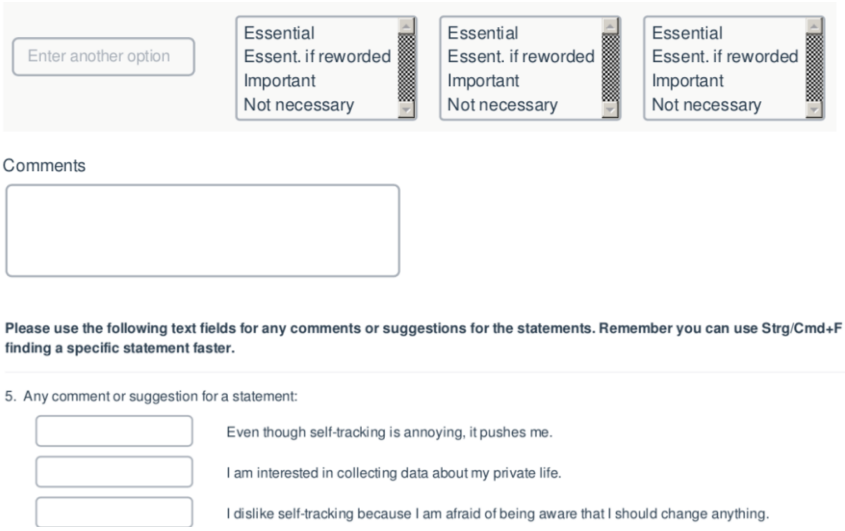
**Please consider that you need to fulfill two simultaneous tasks for this evaluation:**

1. **choose a definition that fits a statement best - according to your opinion. So, whether the statement is more a cognitive (thought, opinion), affective (emotional), and conative (behavioral) attitude.**
2. **then in the chosen column, rate the relevance for the statement in measuring "attitudes towards self-tracking" with the following evaluations:**
   - **essential**
   - **essential but needs rewording (please indicate the rewording suggestion in Question 4)**
   - **important (but not essential)**
   - **not necessary**

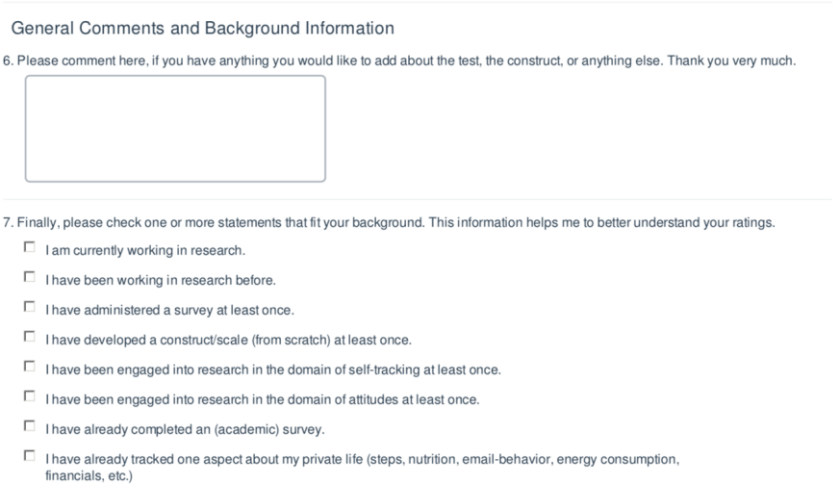
**In the case you think a statement does not fit to one of the categories just use the first column and explain this in Question 4. If you feel a statement is missing to the given set, you can add it at the end of the list and evaluate it, too.**

4. How would you sort and rate each statement?

| | **Cognitive Attitude** - one's thoughts, beliefs, or opinions of statements of facts towards self-tracking. | **Affective Attitude** - one's positive-negative feelings or emotions towards self-tracking. | **Behavioral Attitude** - one's action tendencies towards self-tracking. |
|---|---|---|---|
| I like to write down aspects of my private life. | Essential / Essent. if reworded / Important / Not necessary | Essential / Essent. if reworded / Important / Not necessary | Essential / Essent. if reworded / Important / Not necessary |
| Self-tracking is time-consuming. | Essential / Essent. if reworded / Important / Not necessary | Essential / Essent. if reworded / Important / Not necessary | Essential / Essent. if reworded / Important / Not necessary |




Page 6: Comments and Background information




### 9.6.5 Results of Content Pretest – Round 1

The content validity for two item pools was evaluated in three rounds between May and July 2018. In order to easily distinguish the items from each round and pool of items (A and G), they received an abbreviation that combines the number of the round (1,2,3=round 1–3) and a letter (A=direct, adjective attitude items; G=indirect, general attitude items).

For each item set, three participants evaluated the collection of items. The aim was to evaluate the understandability of the selected items. Overall, four participants received an invitation to the survey with the item set A1 (first round of the direct, adjective statements) and three participants completed it, with a reminder email in between. Three out of five invited participants completed the survey with the item set G1 (first round of the general statements).

For the survey with the item set A1, the participants took an average 27 minutes to complete the survey. All participants had experiences with self-tracking in their private life. Two of them worked in a research environment, probably as student researchers. One participant already had some experience with developing a construct and filling out an academic survey. Another participant had already been engaged in the domain of attitude research. Of course, the extent of those experiences remains unclear.

Each participant evaluated four aspects of an item: clarity, conciseness, deletion, modification. In their comments, the participants mainly listed modification suggestions for the collection of items. The data analysis of the three evaluations per item set was consolidated following a democratic

principle. When the majority evaluated an item as not really understandable, it was considered for deletion or modification according to their suggestions.

For example, in the case of at least two raters agreeing that clarity was low (or high), the merged evaluation resulted in modification (or retention). A pivot-table offers an overview of all summarized decisions for each item. shown in Table 61. For simple cases with high concordance between all raters, the item was retained as it was. For more difficult cases with contradicting evaluations, the modification suggestions were reviewed, and a decision made about the modification. Table 61 shows the decisions for each item and the modifications.

**Table 61.** Results of Round 1 for Direct, Adjective Items (A1)

| Item-ID | Original A-Items | Decision | Items A1 after Round 1 |
|---|---|---|---|
| ArNA1 | I am afraid of changes; thus I dislike self-tracking. | modify | I dislike self-tracking because I am afraid of being aware that I should change anything. |
| ArPA1 | I am curious about things, so I like self-tracking. | modify | I like to self-track because I am curious about aspects of my private life. |
| APA3 | I am interested in collecting data. | modify | I am interested in collecting data about my private life. |
| ArNA4 | I dislike self-tracking because I dislike goals. | retain | I dislike self-tracking because I dislike goals. |
| ArNA6 | I dislike self-tracking because I do not want to be aware of my problems. | retain | I dislike self-tracking because I do not want to be aware of my problems. |
| ArNA5 | I dislike self-tracking because others could misuse my data. | retain | I dislike self-tracking because others could misuse my data. |
| ANA6 | I dislike the amount of data that is generated through self-tracking. | retain | I dislike the amount of data that is generated through self-tracking. |
| ArNCg2 | I do not have problems, so I do not need self-tracking. | modify | I feel no need to self-track because I have no problems that need to be solved with it. |
| ArNA3 | I do not need self-tracking because I am satisfied with my life | modify | I feel no need to self-track because I am satisfied with my life. |
| ArNA2 | I do not need self-tracking to know what is good for me. I intuitively know what is good for me. | modify | I feel no need to self-track because I know what is good for me without any collected data. |
| APA2 | I like having an overview. | modify | I like having a clear overview of my private life |
| ArPA5 | I like self-tracking because it makes my performance more tangible for myself. | retain | I like self-tracking because it makes my performance more tangible for myself. |
| ArPA4 | I like to measure/note things such that I do not forget anything. | modify | I like to note things, so I do not forget anything. |
| APA5 | I like to note aspects about my private life. | modify | I like to write down aspects of my private life. |
| APA6 | I like to see my progress. | retain | I like to see my progress. |
| ArPCg1 | I like to self-track because it helps me to get in detail information about myself. | modify | I like to self-track because it helps me to get in depth information about myself. |
| ANA2 | It is unpleasant to find out things about my private life. | retain | It is unpleasant to find out things about my private life. |
| ANCg4 | Self-tracking is a compulsive need to control. | modify | I feel like I need to self-track for control of my private life. |
| APCg6 | Self-tracking is a reward. | modify | Self-tracking is rewarding |
| APCn1 | Self-tracking is a routine/ritual. | retain | Self-tracking is a routine/ritual. |
| APCg2 | Self-tracking is a verification of my active life. | modify | Self-tracking helps to be aware of my active life. |
| APA4 | Self-tracking is an alternative religion. | modify | Self-tracking is like an alternative religion. |
| AA2 | Self-tracking is annoying but pushes anyway. | modify | Even though self-tracking is annoying, it pushes me. |
| ANA4 | Self-tracking is annoying. | retain | Self-tracking is annoying. |
| APCg4 | Self-tracking is competitive. | retain | Self-tracking is competitive. |
| ArPA6 | Self-tracking is cool because I have a history on things I did in my private life. | retain | Self-tracking is cool because I have a history on things I did in my private life. |
| AP+NA1 | Self-tracking is distraction. | modify | Self-tracking distracts me from the actual experience. |
| APCg5 | Self-tracking is easy. | retain | Self-tracking is easy. |
| ANA5 | Self-tracking is embarrassing. | modify | Self-tracking makes me feel embarrassed. |
| ArPCg2 | Self-tracking is extremely useful for medical problems. | retain | Self-tracking is extremely useful for medical problems. |
| ArPA3 | Self-tracking is fun through the scientific appeal. | modify | Self-tracking is fun because it is similar to science. |
| APA1 | Self-tracking is fun. | retain | Self-tracking is fun. |
| ArNCg1 | Self-tracking is not representative of activities/ experiences. | retain | Self-tracking is not representative of activities/ experiences. |
| ArPA2 | Self-tracking is only interesting at the beginning. | retain | Self-tracking is only interesting at the beginning. |
| ANCg3 | Self-tracking is only money making. | delete | - |
| ANA1 | Self-tracking is painful. | modify | Self-tracking is exhausting. |
| APCg1 | Self-tracking is practical. | retain | Self-tracking is practical. |
| APCg3 | Self-tracking is preventative. | modify | Self-tracking is preventative for my health. |
| ANCg1 | Self-tracking is time-consuming. | retain | Self-tracking is time-consuming. |
| AN5 | Self-tracking is too complex. | modify | Self-tracking is a complex process. |
| ANCg2 | Self-tracking is too much structure. | modify | Self-tracking represents too much structure for my private life. |
| ANA3 | Weighting is frustrating | modify | Self-tracking, e.g., stepping on a scale, is frustrating. |

For the survey with item set G1, the participants took an average 38 minutes to complete the survey. All participants had experiences with self-tracking in their private life. One participant had already worked in a research environment, probably as a student researcher, and another was currently working in research at the time of the evaluation. One participant had already administered an academic survey and two other individuals had already filled out an academic survey. Table 62 shows the decisions for each item and the modifications.

**Table 62.** Results of Round 1 for Indirect, General Items (G1)

| Item-ID | Original G-Items | Decision | Items G1 after Round 1 |
|---|---|---|---|
| GNCg2 | Fun/pleasure is much more rewarding than self-tracking. | modify | Fun is much more rewarding than self-tracking. |
| GNA6 | I am afraid of other using my self-tracked data. | modify | I am afraid of others using my self-tracked data. |
| GPA6 | I am happy to see when I reach my goal and I see that through self-tracking. | modify | I am happy when I see through self-tracking that I reach my goals. |
| GPCg9 | I can act more conscious through self-tracking. | retain | I can act more conscious through self-tracking. |
| GNCg3 | I do not have a goal to reach so I do not need self-tracking. | retain | I do not have a goal to reach so I do not need self-tracking. |
| GNCn1 | I do not have ambitions when playing sports. | modify | I do not have ambitions when I do exercise. |
| GNCg4 | I do not have the expertise to analyze data about my personal behavior. | retain | I do not have the expertise to analyze data about my personal behavior. |
| GNCg1 | I do not have time for tracking. | modify | I do not have time for self-tracking. |
| GNA1 | I do not need self-tracking because I am fit and I feel good. | retain | I do not need self-tracking because I am fit and I feel good. |
| GNCg8 | I do not see any benefits in self-tracking. | retain | I do not see any benefits in self-tracking. |
| GPCn2 | I do self-tracking in other domains of life. | modify | I do self-tracking in various domains of life. |
| GNA10 | I do not like noting things. | modify | I do not like to take notes. |
| GPA3 | I feel guilty/bad when I do not self-track. | modify | I feel bad when I do not self-track. |
| GPCn3 | I get training incentives from self-tracking. | retain | I get training incentives from self-tracking. |
| GPCg10 | I have identified a problem that can be solved by measurements. | modify | There are problems that can be easily solved with self-tracking. |
| GPA8 | I need orientation in order to know when something is good for me. | retain | I need orientation in order to know when something is good for me. |
| GPA10 | I only have good experiences with self-tracking. | retain | I only have good experiences with self-tracking. |
| GNA7 | I prefer individual support of a person when I want to change something in my life. | retain | I prefer individual support of a person when I want to change something in my life. |
| GNA9 | I prefer to listen to by body feeling. | modify | I prefer listening to my body feeling. |
| GNCg5 | I want to spend my time on other things than self-tracking. | retain | I want to spend my time on other things than self-tracking. |
| GPCn6 | In order to investigate how I can be more physical active, I use self-tracking. | retain | In order to investigate how I can be more physical active, I use self-tracking. |
| GPCg5 | It is easier for me to fulfil my goals with facts and numbers on my performance (quantification) | retain | It is easier for me to fulfil my goals with facts and numbers on my performance (quantification) |
| GPA2 | It is interesting to document everything. | retain | It is interesting to document everything. |
| GNA3 | It is strange to collect data about yourself. | retain | It is strange to collect data about yourself. |
| GPA4 | Measuring motivates me. | retain | Measuring motivates me. |
| GNA8 | Self-tracking demotivates/frustrates me. | retain | Self-tracking demotivates/frustrates me. |
| GNA4 | Self-tracking distracts me (from my walking technique). | modify | Self-tracking in sports distracts me (from my walking technique). |
| GNCn2 | Self-tracking does not help me to learn new things. | modify | Self-tracking does not help me to learn something new. |
| GNCg6 | Self-tracking does not help me to solve my problems. | retain | Self-tracking does not help me to solve my problems. |
| GNA2 | Self-tracking does not provide any pleasure. | retain | Self-tracking does not provide any pleasure. |
| GPA5 | Self-tracking feels like an accomplishment. | retain | Self-tracking feels like an accomplishment. |
| GPCn7 | Self-tracking helps for self-observation. | retain | Self-tracking helps for self-observation. |
| GPCg6 | Self-tracking helps me how much money I spend on what. | modify | Self-tracking helps me to monitor how much money I spend on what. |
| GPCg8 | Self-tracking helps me to be disciplined. | retain | Self-tracking helps me to be disciplined. |
| GPCg3 | Self-tracking helps me to control myself | modify | Self-tracking helps me to control important aspects about myself. |
| GPCg4 | Self-tracking helps me to learn things. | retain | Self-tracking helps me to learn things. |
| GPCg7 | Self-tracking helps me to make things visible. | retain | Self-tracking helps me to make things visible. |
| GPCg1 | Self-tracking helps me to reach my goals. | retain | Self-tracking helps me to reach my goals. |
| GPCg2 | Self-tracking helps me to show others how sportive I am /proves how sportive I am. | retain | Self-tracking helps me to show others how sportive I am /proves how sportive I am. |
| GPA7 | Self-tracking helps me to track interesting aspects such as expenses or my weight. | retain | Self-tracking helps me to track interesting aspects such as expenses or my weight. |
| GPCn9 | Self-tracking helps to be aware of things. | modify | Self-tracking helps to be aware of aspects in my life. |
| GPCn10 | Self-tracking helps to be preventive. | retain | Self-tracking helps to be preventive. |
| GPCn4 | Self-tracking helps to get into a success loop because I know that I reached my goals. | retain | Self-tracking helps to get into a success loop because I know that I reached my goals. |
| GPCn5 | Self-tracking helps to remember. | modify | Self-tracking helps me to remember. |
| GPCn1 | Self-tracking helps us to improve room climate. | delete | - |
| GPA1 | Self-tracking is like a religion. | retain | Self-tracking is like a religion. |
| GPCn8 | Self-tracking motivates me to change things (healthier lifestyle, more activities, mindfulness) | modify | Self-tracking motivates me to change aspects of my life (healthier lifestyle, more activities, mindfulness). |
| GNA5 | Self-tracking only produces data in order to patronize me/giving me disadvantages. | modify | Self-tracking data patronizes me in my private life. |
| GPA9 | Self-tracking supports stability. | modify | Self-tracking means stability in my private life. |
| GNCg9 | Some things are not measurable. | retain | Some things are not measurable. |
| GNCg7 | When you self-track you take yourself too serious. | modify | When I self-track I take myself too seriously. |
| GNCg10 | Without numbers and information, I know when something is good for me | retain | Without numbers and information, I know when something is good for me |

### 9.6.6 Results of Content Pilot Test – Round 2

In Round 2, another three participants evaluated each item set of the results of the first round, A1 and A2. The aim was to evaluate the relevancy of each item and categorize each item to one dimension. Additionally, they evaluated the instruction text for the construct.

For the survey with the item set A2, the participants took an average 34 minutes to complete the survey. All participants had experiences with self-tracking in their private life and they had already filled out an academic survey. Two of them worked at that time in a research environment, probably as student researchers. Moreover, two participants had already administered a survey and had been engaged in self-tracking research. They did not mention any further information in their comments.

Concerning the first part of the survey, two participants wrote that the instruction text and the selection of the items is “understandable”, “clear”, and “intuitive”. For the evaluations of the items, the three evaluations were consolidated to find a conforming evaluation for each item and the adequate dimension. So, all decisions about the relevancy of an item (“essential,” “essential if reworded,” “necessary,” and “not necessary”) and the chosen dimension (affective, cognitive, conative) were computed and analyzed with a pivot-table. Table 63 shows the detailed results for the 42 items.

For some items, the categorization between the raters was unanimous. In the case of two raters choosing one dimension (i.e., affective) and the third rater a second dimension (i.e., cognitive), the item was declared affective, but with one behavioral evaluation (i.e.., “rather affective – one behavioral). Additionally, the decision on the final dimension was also weighted with the evaluation of each item. When the relevance of an item was only rated twice as “important” for one dimension, and another participant evaluated the relevance for another dimension differently, the item was not distinctly allocated to one type of dimension; rather, a category for ambiguous items was created (e.g., affective and cognitive). In contrast, when all raters had different opinions about the dimension of an item, no final dimension was chosen (e.g., all three). Overall, of the items categorized as affective in Round 2, 84% had already been categorized as affective in round 1. For the items categorized as cognitive, 71% had already been categorized as cognitive during round 1. Finally, no item categorized as conative in round 1 was confirmed by the categorization of the participants of the second round.

In accordance with the first round, the democratic principle led to the decision about retaining, modifying, or deleting items. Especially when participants thought that an item was essential for different dimensions, a rewording was essential. Moreover, as the survey included the possibility of suggesting modifications of items, such information required consideration as well. In this round, only one participant suggested two small modifications (flagged as “modify”).

As this was only a pilot test, concrete decisions about retaining or deletion were left for the last and main round.

**Table 63.** Summary of the Results of Round 2 for the Items Set A

| Rated Dimension A2 | Items A2 after Round 2 | Decision A2 | Original Dimension A1 | Items A1 after Round 1 | Item ID |
|---|---|---|---|---|---|
| Affective | Self-tracking is annoying. | completely retain | Affective | Self-tracking is annoying. | ANA4 |
| | Self-tracking is cool because I have a history on things I did in my private life. | rather retain | Affective | Self-tracking is cool because I have a history on things I did in my private life. | ArPA6 |
| | Self-tracking is fun. | completely retain | Affective | Self-tracking is fun. | APA1 |
| | Self-tracking is rewarding | completely retain, rather cognitive | Cognitive | Self-tracking is rewarding | APCg6 |
| | Self-tracking makes me feel embarrassed. | consider deletion for A3 | Affective | Self-tracking makes me feel embarrassed. | ANA5 |
| | Self-tracking, e.g., stepping on a scale, is frustrating. | completely retain | Affective | Self-tracking, e.g., stepping on a scale, is frustrating. | ANA3 |
| Rather Affective (one Conative) | Even though self-tracking is annoying, it pushes me. | retain | Affective | Even though self-tracking is annoying, it pushes me. | AA2 |
| | I dislike self-tracking because I am afraid of being aware that I should change anything. | retain, dimension OK | Affective | I dislike self-tracking because I am afraid of being aware that I should change anything. | ArNA1 |
| | I am satisfied with my life, so I feel no need to self-track. | retain, dimension OK, modify | Affective | I feel no need to self-track because I am satisfied with my life. | ArNA3 |
| Rather Affective | I feel no need to self-track because I have no problems that need to be solved with it. | retain, modify | Cognitive | I feel no need to self-track because I have no problems that need to be solved with it. | ArNCg2 |

| Rated Dimension A2 | Items A2 after Round 2 | Decision A2 | Original Dimension A1 | Items A1 after Round 1 | Item ID |
|---|---|---|---|---|---|
| (one Cognitive) | It is unpleasant to find out things about my private life. | rather retain | Affective | It is unpleasant to find out things about my private life. | ANA2 |
| | Self-tracking is exhausting. | retain, dimension OK | Affective | Self-tracking is exhausting. | ANA1 |
| | Self-tracking is only interesting at the beginning. | retain, dimension OK | Affective | Self-tracking is only interesting at the beginning. | ArPA2 |
| Affective or Cognitive | Self-tracking is fun because it is similar to science. | consider deletion for A3, rather affective | Affective | Self-tracking is fun because it is similar to science. | ArPA3 |
| | Self-tracking is like an alternative religion. | retain, dimension OK | Affective | Self-tracking is like an alternative religion. | APA4 |
| Cognitive | I am interested in collecting data about my private life. | rather retain, rather affective | Affective | I am interested in collecting data about my private life. | APA3 |
| | Self-tracking helps to be aware of my active life. | completely retain | Cognitive | Self-tracking helps to be aware of my active life. | APCg2 |
| | Self-tracking is a complex process. | completely retain | Cognitive | Self-tracking is a complex process. | AN5 |
| | Self-tracking is extremely useful for medical problems. | consider deletion for A3 | Cognitive | Self-tracking is extremely useful for medical problems. | ArPCg2 |
| | Self-tracking does not completely represent an experience. | new item | Cognitive | - | ArNCg3 |
| | Self-tracking does not completely represent an activity. | rather retain, modify | Cognitive | Self-tracking is not representative of activities/experiences. | ArNCg1 |
| | Self-tracking is time-consuming. | completely retain | Cognitive | Self-tracking is time-consuming. | ANCg1 |
| Rather Cognitive (one Affective) | Self-tracking entails risks as others could misuse my data. | retain, rather cognitive, modify | Affective | I dislike self-tracking because others could misuse my data. | ArNA5 |
| | I dislike the amount of data that is generated through self-tracking. | retain, rather affective | Affective | I dislike the amount of data that is generated through self-tracking. | ANA6 |
| | I feel no need to self-track because I know what is good for me without any collected data. | consider deletion for A3, rather affective | Affective | I feel no need to self-track because I know what is good for me without any collected data. | ArNA2 |
| | I like having a clear overview of my private life | retain, rather affective | Affective | I like having a clear overview of my private life | APA2 |
| | Self-tracking is practical. | consider deletion for A3 | Cognitive | Self-tracking is practical. | APCg1 |
| Rather Cognitive (one Conative) | I like to self-track because it helps me to get in depth information about myself. | retain, dimension OK | Cognitive | I like to self-track because it helps me to get in depth information about myself. | ArPCg1 |
| | Self-tracking is a routine. | retain, rather conative, modify | Conative | Self-tracking is a routine/ritual. | APCn1 |
| | Self-tracking is easy. | retain, dimension OK | Cognitive | Self-tracking is easy. | APCg5 |
| | Self-tracking is preventative for my health. | retain | Cognitive | Self-tracking is preventative for my health. | APCg3 |
| | Self-tracking represents too much structure for my private life. | retain | Cognitive | Self-tracking represents too much structure for my private life. | ANCg2 |
| Conative | I like to note things, so I do not forget anything. | completely retain | Affective | I like to note things, so I do not forget anything. | ArPA4 |
| | Self-tracking distracts me from the actual experience. | completely retain | Affective | Self-tracking distracts me from the actual experience. | AP+NA1 |
| Rather Conative (one Affective) | I like to write down aspects of my private life. | retain, rather affective | Affective | I like to write down aspects of my private life. | APA5 |
| All three | I dislike goals, so I dislike self-tracking. | retain, dimension OK, modify | Affective | I dislike self-tracking because I dislike goals. | ArNA4 |
| | Self-tracking just makes me aware of my problems which I do not like. | retain, rather cognitive, modify | Affective | I dislike self-tracking because I do not want to be aware of my problems. | ArNA6 |
| | I feel like I need to self-track for control of my private life. | retain, dimension OK | Cognitive | I feel like I need to self-track for control of my private life. | ANCg4 |
| | I like obtaining a more tangible result of my performance through self-tracking. | retain, rather affective, modify | Affective | I like self-tracking because it makes my performance more tangible for myself. | ArPA5 |
| | I like to see my progress. | retain, rather affective | Affective | I like to see my progress. | APA6 |
| | Self-tracking satisfies my curiosity about aspects of my private life. | retain, rather affective, modify | Affective | I like to self-track because I am curious about aspects of my private life. | ArPA1 |
| | Self-tracking is competitive. | retain, rather cognitive | Cognitive | Self-tracking is competitive. | APCg4 |

For the survey with the item set G2, participants took an average 33 minutes to complete the survey. All participants worked at that time in a research environment, probably as student researchers or doctoral students; had already completed a scientific survey; and had tracked one aspect of their life. Two of the participants had administered a survey at least once. One participant had already been engaged in attitude research. Overall, they did not mention any further comments.

Concerning the first part of the survey, two participants wrote that the instruction text and the selection of the items is “understandable,” “reasonable,” “clear,” and “well chosen.”

Concerning the evaluation of the items, one participant misunderstood the ranking instructions and chose an evaluation for each dimension, whereas only one evaluation within one dimension was required. This resulted in three evaluations per ranking and implied a little difficulty for data analysis, as the employed evaluations were not distinct – e.g., each evaluation possibility was not chosen once. In most cases, however, there was only one “essential” ranking for an item, so the other evaluations (“not necessary” or “important”) were disregarded. In the case of multiple “essential” or “important” evaluations (i.e., for 11 out of 42 items), both evaluations were considered for data analysis.

As already described above, data analysis consolidated the three evaluations of the three participants for each item, and a pivot-table summarized the results. Overall, of the items categorized as affective in Round 2, 73% had already been categorized as affective in Round 1. For the items categorized as cognitive, 54% were already categorized as cognitive during Round 1. Finally, eight items categorized as conative included three items that had also been previously categorized as conative. Table 64 shows the detailed results.

**Table 64.** Summary of the Results of Round 2 for the Items Set G

| Rated Dimension G2 | Items G2 after Round 2 | Decision G2 | Original Dimension G1 | Items G1 after Round 1 | Item ID |
|---|---|---|---|---|---|
| Affective | Self-tracking does not provide as much fun as other activities | consider deletion for G3, rather affective, modify | Cognitive | Fun is much more rewarding than self-tracking. | GNCg2 |
| | I do not need self-tracking because I am fit and I feel good. | completely retain | Affective | I do not need self-tracking because I am fit and I feel good. | GNA1 |
| | Self-tracking demotivates/frustrates me. | completely retain | Affective | Self-tracking demotivates/frustrates me. | GNA8 |
| | Self-tracking does not provide any pleasure. | completely retain | Affective | Self-tracking does not provide any pleasure. | GNA2 |
| | Self-tracking feels like an accomplishment. | completely retain | Affective | Self-tracking feels like an accomplishment. | GPA5 |
| Rather Affective (one Conative) | I am happy when I see through self-tracking that I reach my goals. | retain, dimension OK | Affective | I am happy when I see through self-tracking that I reach my goals. | GPA6 |
| | I do not like to take notes. | retain | Affective | I do not like to take notes. | GNA10 |
| | I prefer listening to my body feeling. | retain | Affective | I prefer listening to my body feeling. | GNA9 |
| | I like to spend my time on other things than self-tracking. | retain, rather affective, modify | Cognitive | I want to spend my time on other things than self-tracking. | GNCg5 |
| | I have the feeling to take myself too seriously when tracking aspects about my private life. | consider deletion for G3, rather affective, modify | Cognitive | When I self-track I take myself too seriously. | GNCg7 |
| Rather Affective (one Cognitive) | I am afraid of others using my self-tracked data. | retain, dimension OK | Affective | I am afraid of others using my self-tracked data. | GNA6 |
| | I feel bad when I do not self-track. | retain, dimension OK | Affective | I feel bad when I do not self-track. | GPA3 |
| | I only have good experiences with self-tracking. | consider deletion for G3 | Affective | I only have good experiences with self-tracking. | GPA10 |
| | It is unusual to collect data about yourself. | retain, dimension OK, modify | Affective | It is strange to collect data about yourself. | GNA3 |
| | Without numbers and information, I know when something is good for me | consider deletion for G3 | Cognitive | Without numbers and information, I know when something is good for me | GNCg10 |
| Rather Affective (two Cognitive) | I do not have a goal to reach so I do not need self-tracking. | retain, rather cognitive | Cognitive | I do not have a goal to reach so I do not need self-tracking. | GNCg3 |
| Cognitive or Affective | Self-tracking data patronizes me in my private life. | retain, rather cognitive | Affective | Self-tracking data patronizes me in my private life. | GNA5 |
| | Self-tracking is like a religion. | rather retain, rather affective | Affective | Self-tracking is like a religion. | GPA1 |
| | There are problems that can be easily solved with self-tracking. | retain, rather cognitive | Cognitive | There are problems that can be easily solved with self-tracking. | GPCg10 |
| Cognitive | I do not have the expertise to analyze data about my personal behavior. | consider deletion for G3 | Cognitive | I do not have the expertise to analyze data about my personal behavior. | GNCg4 |
| | In order to realize what is good for me self-tracking provides the necessary orientation. | consider deletion for G3, rather cognitive, modify | Affective | I need orientation in order to know when something is good for me. | GPA8 |

| Rated Dimension G2 | Items G2 after Round 2 | Decision G2 | Original Dimension G1 | Items G1 after Round 1 | Item ID |
|---|---|---|---|---|---|
| | It is easier for me to fulfill my goals with facts and numbers on my performance (quantification) | completely retain | Cognitive | It is easier for me to fulfill my goals with facts and numbers on my performance (quantification) | GPCg5 |
| | It is interesting to document everything. | rather retain, rather affective | Affective | It is interesting to document everything. | GPA2 |
| | Self-tracking does not help me to learn something new. | completely retain, rather cognitive | Conative | Self-tracking does not help me to learn something new. | GNCn2 |
| | Self-tracking does not help me to solve my problems. | completely retain | Cognitive | Self-tracking does not help me to solve my problems. | GNCg6 |
| | Self-tracking helps me to track interesting aspects such as expenses or my weight. | completely retain, rather cognitive | Affective | Self-tracking helps me to track interesting aspects such as expenses or my weight. | GPA7 |
| | Self-tracking helps to be aware of aspects in my life. | completely retain, rather cognitive | Conative | Self-tracking helps to be aware of aspects in my life. | GPCn9 |
| | Self-tracking helps to be preventive. | completely retain, rather cognitive | Conative | Self-tracking helps to be preventive. | GPCn10 |
| | Self-tracking helps to get into a success loop because I know that I reached my goals. | completely retain, rather conative | Conative | Self-tracking helps to get into a success loop because I know that I reached my goals. | GPCn4 |
| | Measurements are useless. | rather retain, modify | Cognitive | Some things are not measurable. | GNCg9 |
| Rather Cognitive (one Affective) | I do not see any benefits in self-tracking. | retain, dimension OK | Cognitive | I do not see any benefits in self-tracking. | GNCg8 |
| | I like individual support of a person when I want to change something in my life. | rather retain, rather affective, modify | Affective | I prefer individual support of a person when I want to change something in my life. | GNA7 |
| | Self-tracking helps me to be disciplined. | retain, dimension OK | Cognitive | Self-tracking helps me to be disciplined. | GPCg8 |
| | Self-tracking helps me to remember. | consider deletion for G3, rather conative | Conative | Self-tracking helps me to remember. | GPCn5 |
| | Self-tracking means stability in my private life. | retain, rather cognitive | Affective | Self-tracking means stability in my private life. | GPA9 |
| Rather Cognitive (one Conative) | I do not have time for self-tracking. | retain | Cognitive | I do not have time for self-tracking. | GNCg1 |
| | Self-tracking helps me to control important aspects about myself. | retain, dimension OK | Cognitive | Self-tracking helps me to control important aspects about myself. | GPCg3 |
| | Self-tracking helps me to learn things. | rather retain | Cognitive | Self-tracking helps me to learn things. | GPCg4 |
| | Self-tracking helps me to make things visible. | rather retain | Cognitive | Self-tracking helps me to make things visible. | GPCg7 |
| | Self-tracking helps me to reach my goals. | retain, dimension OK | Cognitive | Self-tracking helps me to reach my goals. | GPCg1 |
| | Self-tracking helps me to show others how sportive I am /proves how sportive I am. | consider deletion for G3 | Cognitive | Self-tracking helps me to show others how sportive I am /proves how sportive I am. | GPCg2 |
| Conative or Cognitive | Self-tracking helps for self-observation. | rather retain, rather cognitive | Conative | Self-tracking helps for self-observation. | GPCn7 |
| Conative | I do self-tracking in various domains of life. | completely retain | Conative | I do self-tracking in various domains of life. | GPCn2 |
| | I like checking statistics about my private life on mobile phone apps. | new item | | | GPCn11 |
| Rather Conative (one Affective, one Cognitive) | I get training incentives from self-tracking. | retain | Conative | I get training incentives from self-tracking. | GPCn3 |
| Rather Conative (one Affective) | Self-tracking motivates me to change aspects of my life (healthier lifestyle, more activities, mindfulness). | retain | Conative | Some things are not measurable. | GNCg9 |
| Rather Conative (one Cognitive) | I can act more conscious through self-tracking. | consider deletion for G3, rather cognitive | Cognitive | I can act more conscious through self-tracking. | GPCg9 |
| | In order to investigate how I can be more physical active, I use self-tracking. | rather retain | Conative | In order to investigate how I can be more physical active, I use self-tracking. | GPCn6 |
| | Measuring motivates me. | retain, rather cognitive | Affective | Measuring motivates me. | GPA4 |
| | Self-tracking helps me to monitor how much money I spend on what. | retain, rather cognitive | Cognitive | Self-tracking helps me to monitor how much money I spend on what. | GPCg6 |
| | Self-tracking in sports distracts me (from my walking technique). | retain, rather cognitive | Affective | Self-tracking in sports distracts me (from my walking technique). | GNA4 |
| All three | I do not have ambitions when I do exercise. | rather retain, rather conative | Conative | I do not have ambitions when I do exercise. | GNCn1 |

### 9.6.7 Results of Content Validation – Round 3

The third and major round of content validation is similar to the second round. The aim was to evaluate the relevancy of each item and categorize each item to one dimension. Additionally, it evaluates the instruction text for the construct.

First, concerning the instructions of the construct, all participants perfectly understood them but gave some suggestions:

- Clarifying that the construct is about general self-tracking;
- Reconsidering the definition of self-tracking to be more concise (it should all be behavioral and clear about the fact that self-tracking engenders different actions, e.g., self-measurement);
- Considering a five-point Likert-type evaluation scale instead of the seven-point Likert-type evaluation scale (especially if the construct is used in industry).

Second, for the evaluation of each item, the content validity ratio and index were calculated, integrating the evaluations from round 2 and round 3. To that end, for item set A and item set G, the number of experts amounted to 10 and 8 participants, respectively. The following tables show the detailed results for all calculations and evaluations: item ID, the items formulation after the second round (A2 or G2), the variables used for calculating CVI and CVR, and the resulting decisions and significance tests. Additionally, the grey columns indicate the final results concerning the decision about an item (i.e., retainment, modification, deletion), the final formulation of the item, and the final decision for the adequate dimension (mostly in accordance with the majority evaluation of the participants). The last column shows the summary of the major dimension according to the participants. Yet, through modifications and misunderstandings, some final dimensions do not correspond to the proposed ones. For each decision about an item, an extra table was included: green=retainment; blue=retainment and modification; light green=new items suggested by participants; light red=deletion. For the different tables concerning item set A, please refer to Table 65 (p. 226), Table 66 (p.227), and Table 67 (p.228). For item set G, please refer to Table 68 (p. 229), Table 69 (p. 230), Table 70 (p. 231), and Table 71 (p. 232).

The decision for retainment, deletion, or modification depends on the quantitative results from the calculation of CVR and CVI (see Subsection 6.1.3, p. 117). The results were dichotomized into two categories: “Essential/Ess. and Important/Imp.” judgments, and “Not Necessary/NN” judgments. Furthermore, for the decision on the CVI, the threshold of 0.83 (following Lynn (1986)) was selected, which is stricter than the thresholds from Zamanzadeh et al. (2014). For the CVR, the updated results for the thresholds at a significance level of 0.05 were chosen in relation to the exact number of experts who evaluated the item, following Ayre and Scally (2014). For the detailed thresholds depending on the number of experts who evaluated an item, please see Table 59, p. 209. The S-CVIs for the item sets show that for the direct adjective items, a slightly higher rate of items was retained after the third round, probably due to the greater number of experts who evaluated the items (10 experts rather than 8):

- S-CVI direct, adjective items: 69%;
- S-CVI indirect, general items: 67%.

Finally, all participants (12 new individuals in Round 3) worked at that time in research and had already administered a survey before. Over 30% had already developed a construct from scratch and had been engaged in research in the domain of attitudes at least once. Almost 20% had been engaged in pure self-tracking research before. Finally, over 90% of all participants had already tracked one aspect of their private life. The duration of the survey could not be given, as some participants gave the answers in the form of a telephone call.

**Table 65.** Summary of the Results of Round 3 for the Item Set A – Retained Items

| Item ID | Items after A2 | # "Ess. & Imp." Judg-ments = $N_E$ = $N_R$ | # "NN"-Judg-ments | Sum # Judgements ($N_E$) | $N_E/2$ | I-CVI = $N_R/N_E$ | Pc | Kappa | significance of I-CVI Kappa | I-CVI decision (retain for >0.83) | CVR = ($N_E$-($N_E$/2))/($N_E$/2) | CVR decision (retain for >0.62) | Final decision (I-CVI retain + comments and modification suggest-ions) | Final Item (after A3) | Final Dimen-sion | Proposed Dimen-sion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APA3 | I am interested in collecting data about my private life. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 1-retained | I am interested in collecting data about my private life. | Cog | Cog |
| ArNA2 | I feel no need to self-track because I know what is good for me without any collected data. | 10 | 1 | 11 | 5,5 | 0,91 | 0,23 | 0,88 | Excellent | retain | 0,82 | retain | 1-retained | I feel no need to self-track because I know what is good for me without any collected data. | Aff | Aff and Cog |
| ArPA5 | I like obtaining a more tangible result of my performance through self-tracking. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | I like obtaining a more tangible result of my performance through self-tracking. | Aff | Cog |
| ArPA4 | I like to note things so I do not forget anything. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | I like to note things so I do not forget anything. | Beh | Beh |
| ANA2 | It is unpleasant to find out things about my private life. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 1-retained | It is unpleasant to find out things about my private life. | Aff | Aff |
| AP+NA 1 | Self-tracking distracts me from the actual experience. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 1-retained | Self-tracking distracts me from the actual experience. | Aff | Beh and Cog |
| ArNA5 | Self-tracking entails risks as others could misuse my data. | 11 | 0 | 11 | 5,5 | 1,00 | 0,08 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking entails risks as others could misuse my data. | Aff | Cog |
| ANA4 | Self-tracking is annoying. | 10 | 0 | 10 | 5 | 1,00 | 0,04 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking is annoying. | Aff | Aff |
| APCg5 | Self-tracking is easy. | 10 | 0 | 10 | 5 | 1,00 | 0,12 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking is easy. | Cog | Cog |
| APA1 | Self-tracking is fun. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 1-retained | Self-tracking is fun. | Aff | Aff |
| ArPA1 | Self-tracking satisfies my curiosity about aspects of my private life. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking satisfies my curiosity about aspects of my private life. | Aff | Cog |

**Table 66.** Summary of the Results of Round 3 for the Items Set A – Modified Items

| Item ID | Items after A2 | # "Ess. & Imp." Judg-ments = NE = NR | # "NN" - Judg-ments | Sum # Judge ments (NE) | NE/2 | I-CVI = NR/NE | Pc | Kappa | significan-ce of I-CVI Kappa | I-CVI decision (retain for ≥0.83) | CVR = (NE-(NE/2))/(NE/2) | CVR decision (retain for ≥0.62) | Final decision (I-CVI retain + comments and modification suggest-ions) | Final Item (after A3) | Final Dimen-sion | Proposed Dimen-sion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AA2 | Even though self-tracking is annoying, it pushes me. | 10 | 0 | 10 | 5 | 1,00 | 0,12 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking pushes me. | Aff | Aff |
| ArNA3 | I am satisfied with my life so I feel no need to self-track. | 9 | 1 | 10 | 5 | 0,90 | 0,21 | 0,87 | Excellent | retain | 0,80 | retain | 2-modified and retained | I doubt that self-tracking would be beneficial for my already satisfied life. | Aff | Aff |
| ArNA1 | I dislike self-tracking because I am afraid of being aware that I should change anything. | 11 | 0 | 11 | 5,5 | 1,00 | 0,16 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | The awareness provided by self-tracking on what I can improve in my private life makes me feel uncomfortable. | Aff | Aff |
| ANA6 | I dislike the amount of data that is generated through self-tracking. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 2-modified and retained | Self-trackig information is insightful. | Cog | Aff |
| ArNCg 2 | I feel no need to self-track because I have no problems that need to be solved with it. | 10 | 0 | 10 | 5 | 1,00 | 0,25 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking does not solve current problems in my private life. | Cog | Aff and Cog |
| APA6 | I like to see my progress. | 10 | 0 | 10 | 5 | 1,00 | 0,04 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | I like to see my progress in private activities through self-tracking. | Aff | Aff |
| ArPCg 1 | I like to self-track because it helps me to get in depth information about myself. | 10 | 0 | 10 | 5 | 1,00 | 0,04 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | I like to obtain more information about my private activities through self-tracking. | Aff | Cog |
| APA5 | I like to write down aspects of my private life. | 10 | 0 | 10 | 5 | 1,00 | 0,12 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | I like to keep track of my private life with notes. | Aff | Aff and Beh |
| APCg2 | Self-tracking helps to be aware of my active life. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking helps me to be aware aspects about my private life. | Cog | Cog |
| APCg4 | Self-tracking is competitive. | 11 | 0 | 11 | 5,5 | 1,00 | 0,23 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking is too competitive for me. | Cog | Cog |
| ArPA6 | Self-tracking is cool because I have a history on things I did in my private life. | 9 | 1 | 10 | 5 | 0,90 | 0,21 | 0,87 | Excellent | retain | 0,80 | retain | 2-modified and retained | The history on my private life I get with self-tracking is useful. | Cog | Aff |
| ANA1 | Self-tracking is exhausting. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 2-modified and retained | It stresses me when I forget to self-track myself. | Aff | Aff |
| ArPA2 | Self-tracking is only interesting at the beginning. | 9 | 1 | 10 | 5 | 0,90 | 0,12 | 0,89 | Excellent | retain | 0,80 | retain | 2-modified and retained | Self-tracking information is only interesting when I start to self-track an aspect of my private life. | Aff | Cog |
| APCg3 | Self-tracking is preventative for my health. | 11 | 0 | 11 | 5,5 | 1,00 | 0,23 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking helps me to avoid future problems beforehand. | Cog | Cog |
| APCg6 | Self-tracking is rewarding | 11 | 0 | 11 | 5,5 | 1,00 | 0,03 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking feels rewarding. | Aff | Aff |
| ANCg1 | Self-tracking is time-consuming. | 10 | 0 | 10 | 5 | 1,00 | 0,12 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking is too time-consuming for me. | Cog | Cog |
| ArNA6 | Self-tracking just makes me aware of my problems which I do not like. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | I dislike that self-tracking makes me aware of problems. | Aff | Aff |
| ANA3 | Self-tracking, e.g. stepping on a scale, is frustrating. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking is frustrating. | Aff | Aff |

**Table 67.** Summary of the Results of Round 3 for the Item Set A – New and Deleted Items

| Item ID | Items after A2 | # "Ess. & Imp." Judg-ments = $N_e$ = $N_R$ | # "NN" - Judg-ments | Sum # Judgements ($N_E$) | $N_E/2$ | I-CVI = $N_R/N_E$ | Pc | Kappa | Significance of I-CVI Kappa | I-CVI decision (retain for >0.83) | CVR = ($N_e$-($N_E$/2))/($N_E$/2) | CVR decision (retain for >0.62) | Final decision (I-CVI retain + comments and modification suggest-ions) | Final Item (after A3) | Final Dimen-sion | Proposed Dimen-sion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANR31 | | | | | | | | | | | | | 2-new | If I am interested in something, I would self-track every day. | Aff | Beh |
| ANR32 | | | | | | | | | | | | | 2-new | Self-tracking makes me feel proud of my progress. | Aff | Aff |
| ANR33 | | | | | | | | | | | | | 2-new | Self-tracking is cool. | Aff | |
| ANR34 | | | | | | | | | | | | | 2-new | Self-tracking allows me to see personal progress. | Cog | |
| ANR35 | | | | | | | | | | | | | 2-new | Not being able to see a progress frustrates me. | Aff | |
| ANR36 | | | | | | | | | | | | | 2-new | I feel no need to self-track. | Aff | |
| ANR37 | | | | | | | | | | | | | 2-new | Self-tracking information is difficult to process. | Cog | |
| ANR38 | | | | | | | | | | | | | 2-new | I dislike self-tracking. | Aff | |
| ANR39 | | | | | | | | | | | | | 2-new | I write down aspects of my private life. | Beh | |
| APA2 | I like having a clear overview of my private life | 8 | 2 | 10 | 5 | 0,80 | 0,25 | 0,73 | Good | delete | 0,60 | delete | 3-deleted | I like having a clear overview of my private life. | Cog | Aff and Cog |
| ArNCg1 | Self-tracking does not completely represent an activity. | 4 | 5 | 9 | 4,5 | 0,44 | 0,07 | 0,40 | Fair | delete | -0,11 | delete | 3-deleted | Self-tracking does not completely represent an activity. | Cog | Cog |
| APA4 | Self-tracking is like an alternative religion. | 5 | 5 | 10 | 5 | 0,50 | 0,04 | 0,48 | Fair | delete | 0,00 | delete | 3-deleted | Self-tracking is like an alternative religion for me. | Cog | Cog |
| ANA5 | Self-tracking makes me feel embarrassed. | 8 | 2 | 10 | 5 | 0,80 | 0,25 | 0,73 | Good | delete | 0,60 | delete | 3-deleted | Self-tracking makes me feel embarrassed. | Aff | Aff |
| ArNA4 | I dislike goals so I dislike self-tracking. | 7 | 3 | 10 | 5 | 0,70 | 0,21 | 0,62 | Good | delete | 0,40 | delete | 3-modified, but deleted | I dislike goals. | Aff | Aff |
| ANCg4 | I feel like I need to self-track for control of my private life. | 8 | 4 | 12 | 6 | 0,67 | 0,19 | 0,59 | Fair | delete | 0,33 | delete | 3-modified, but deleted | I feel like I need to self-track to gain some control over my private life | Aff | Aff |
| ArNCg3 | Self-tracking does not completely represent an experience. | 4 | 5 | 9 | 4,5 | 0,44 | 0,16 | 0,34 | Bad | delete | -0,11 | delete | 3-modified, but deleted | I do not need self-tracking information to be aware of my activities. | Cog | Cog |
| AN5 | Self-tracking is a complex process. | 6 | 4 | 10 | 5 | 0,60 | 0,25 | 0,47 | Fair | delete | 0,20 | delete | 3-modified, but deleted | Self-tracking overburdens me. | Aff | Cog |
| APCn1 | Self-tracking is a routine. | 8 | 2 | 10 | 5 | 0,80 | 0,21 | 0,75 | Excellent | delete | 0,60 | delete | 3-modified, but deleted | Self-tracking is an easy routine for me. | Cog | Beh |
| ArPCg2 | Self-tracking is extremely useful for medical problems. | 8 | 2 | 10 | 5 | 0,80 | 0,12 | 0,77 | Excellent | delete | 0,60 | delete | 3-modified, but deleted | Self-tracking is useful for solving my private problems. | Cog | Cog |
| ArPA3 | Self-tracking is fun because it is similar to science. | 9 | 2 | 11 | 5,5 | 0,82 | 0,16 | 0,78 | Excellent | delete | 0,64 | retain | 3-modified, but deleted | I like the fact that self-tracking uses scientific approaches. | Aff | Aff |
| APCg1 | Self-tracking is practical. | 7 | 3 | 10 | 5 | 0,70 | 0,21 | 0,62 | Good | delete | 0,40 | delete | 3-modified, but deleted | Self-tracking my private activities is practical. | Cog | Cog |
| ANCg2 | Self-tracking represents too much structure for my private life. | 8 | 2 | 10 | 5 | 0,80 | 0,21 | 0,75 | Excellent | delete | 0,60 | delete | 3-modified, but deleted | Self-tracking imposes too much structure on my private life. | Cog | Cog |

**Table 68.** Summary of the Results of Round 3 for the Item Set G – Retained Items

| Item ID | Items after G2 | # "Ess. & Imp." Judgments = $N_e$ = $N_R$ | # "NN"-Judgment s | Sum # Judgments ($N_E$) | $N_E/2$ | I-CVI = $N_R/N_E$ | $P_C$ | Kappa | significance of I-CVI Kappa | I-CVI decision (retain for >0.83) | CVR = ($N_e$ - ($N_E$/2))/($N_E$/2) | CVR decision | Final decision (I-CVI retain + comments and suggested modifications) | Final Item (after G3) | Final Dimension | Proposed Dimension |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPA6 | I am happy when I see through self-tracking that I reach my goals. | 9 | 0 | 9 | 4,5 | 1,00 | 0,07 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | I am happy when I see through self-tracking that I reach my goals. | Aff | Aff |
| GPCg9 | I can act more conscious through self-tracking. | 8 | 0 | 8 | 4 | 1,00 | 0,22 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | I can act more conscious through self-tracking. | Cog | Cog |
| GNCg8 | I do not see any benefits in self-tracking. | 8 | 0 | 8 | 4 | 1,00 | 0,11 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | I do not see any benefits in self-tracking. | Cog | Cog |
| GPA3 | I feel bad when I do not self-track. | 9 | 0 | 9 | 4,5 | 1,00 | 0,25 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | I feel bad when I do not self-track. | Aff | Aff |
| GNCg5 | I like to spend my time on other things than self-tracking. | 8 | 1 | 9 | 4,5 | 0,89 | 0,16 | 0,87 | Excellent | retain | 0,78 | retain | 1-retained | I like to spend my time on other things than self-tracking. | Aff | Aff |
| GPCg8 | Self-tracking helps me to be disciplined. | 8 | 0 | 8 | 4 | 1,00 | 0,22 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking helps me to be disciplined. | Cog | Cog |
| GPCg3 | Self-tracking helps me to control important aspects about myself. | 10 | 0 | 10 | 5 | 1,00 | 0,21 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking helps me to control important aspects about myself. | Cog | Cog |
| GPCg1 | Self-tracking helps me to reach my goals. | 10 | 0 | 10 | 5 | 1,00 | 0,25 | 1,00 | Excellent | retain | 1,00 | retain | 1-retained | Self-tracking helps me to reach my goals. | Cog | Cog |

**Table 69.** Summary of the Results of Round 3 for the Items Set G – Modified Items

| Item ID | Items after G2 | # "Ess. & Imp." Judgments = $N_e$ = $N_R$ | # "NN" - Judgments | Sum # Judgments ($N_E$) | $N_E/2$ | I-CVI = $N_R/N_E$ | $P_C$ | Kappa | significance of I-CVI Kappa | I-CVI decision (retain for >0.83) | CVR = ($N_e$-($N_E$/2))/($N_E$/2) | CVR decision | Final decision (I-CVI retain + comments and suggested modifications) | Final Item (after G3) | Final Dimension | Proposed Dimension |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNA6 | I am afraid of others using my self-tracked data. | 8 | 1 | 9 | 4,5 | 0,89 | 0,25 | 0,85 | Excellent | retain | 0,78 | retain | 2-modified and retained | I am afraid that others use my self-tracking data. | Aff | Aff |
| GPCn3 | I get training incentives from self-tracking. | 10 | 0 | 10 | 5 | 1,00 | 0,04 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | I think I get inducements for my private life from self-tracking. | Cog | Beh or Cog |
| GPCn6 | In order to investigate how I can be more physical active, I use self-tracking. | 8 | 1 | 9 | 4,5 | 0,89 | 0,25 | 0,85 | Excellent | retain | 0,78 | retain | 2-modified and retained | In order to investigate how I can become better, I can use self-tracking. | Beh | Beh |
| GPCg5 | It is easier for me to fulfill my goals with facts and numbers on my performance (quantification) | 8 | 0 | 8 | 4 | 1,00 | 0,11 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | It is easier for me to reach my goals with facts and numbers. | Cog | Cog |
| GNA3 | It is unusual to collect data about yourself. | 8 | 1 | 9 | 4,5 | 0,89 | 0,25 | 0,85 | Excellent | retain | 0,78 | retain | 2-modified and retained | It feels strange to me to collect data about myself. | Aff | Aff or Cog |
| GPA4 | Measuring motivates me. | 8 | 0 | 8 | 4 | 1,00 | 0,22 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Measuring myself motivates me. | Aff | Aff or Cog |
| GNA8 | Self-tracking demotivates/frustrates me. | 8 | 0 | 8 | 4 | 1,00 | 0,22 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking demotivates me. | Aff | Aff |
| GNA2 | Self-tracking does not provide any pleasure. | 8 | 0 | 8 | 4 | 1,00 | 0,27 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking does not provide me any pleasure. | Cog | Aff |
| GPA5 | Self-tracking feels like an accomplishment. | 8 | 1 | 9 | 4,5 | 0,89 | 0,25 | 0,85 | Excellent | retain | 0,78 | retain | 2-modified and retained | Self-tracking helps to observe myself and my private activities. | Cog | Aff |
| GPCg6 | Self-tracking helps me to monitor how much money I spend on what. | 8 | 1 | 9 | 4,5 | 0,89 | 0,25 | 0,85 | Excellent | retain | 0,78 | retain | 2-modified and retained | Self-tracking helps me to monitor my private activities. | Cog | Beh |
| GPA7 | Self-tracking helps me to track interesting aspects such as expenses or my weight. | 8 | 1 | 9 | 4,5 | 0,89 | 0,16 | 0,87 | Excellent | retain | 0,78 | retain | 2-modified and retained | Self-tracking helps me to track interesting aspects about my private life. | Cog | Cog |
| GPCn9 | Self-tracking helps to be aware of aspects in my life. | 9 | 0 | 9 | 4,5 | 1,00 | 0,25 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking helps me to be aware of aspects in my life. | Cog | Cog |
| GPCn10 | Self-tracking helps to be preventive. | 8 | 1 | 9 | 4,5 | 0,89 | 0,07 | 0,88 | Excellent | retain | 0,78 | retain | 2-modified and retained | Self-tracking helps me to be preventive regarding a specific problem. | Cog | Cog |
| GPCn4 | Self-tracking helps to get into a success loop because I know that I reached my goals. | 8 | 0 | 8 | 4 | 1,00 | 0,11 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | Self-tracking helps me to get into a success loop because I know that I reached my goals. | Cog | Cog |
| GNA4 | Self-tracking in sports distracts me (from my walking technique). | 8 | 1 | 9 | 4,5 | 0,89 | 0,25 | 0,85 | Excellent | retain | 0,78 | retain | 2-modified and retained | Self-tracking distracts me from other aspects. | Aff | Beh |
| GNCg9 | Self-tracking motivates me to change aspects of my life (healthier lifestyle, more activities, mindfulness). | 8 | 0 | 8 | 4 | 1,00 | 0,22 | 1,00 | Excellent | retain | 1,00 | retain | 2-modified and retained | I get inducements for my private life from self-tracking. | Cog | Aff or Cog |
| GNR31 | | | | | | | | | | | | | 2-new | The process of self-tracking feels like an accomplishment. | Aff | |
| GNR32 | | | | | | | | | | | | | 2-new | Self-tracking provides me with expertise to analyze data about my private activities. | Cog | |
| GNR33 | | | | | | | | | | | | | 2-new | Self-tracking frustrates me. | Aff | |

**Table 70.** Summary of the Results of Round 3 for the Item Set G – Deleted Items

| Item ID | Items after G2 | # "Ess. & Imp." Judgments = $N_e$ = $N_R$ | # "NN"-Judgment s | Sum # Judgments ($N_E$) | $N_E/2$ | I-CVI = $N_R/N_E$ | $p_c$ | Kappa | significance of I-CVI Kappa | I-CVI decision (retain for >0.83) | CVR = ($N_e$-($N_E/2$))/($N_E/2$) | CVR decision | Final decision (I-CVI retain + comments and suggested modifications) | Final Item (after G3) | Final Dimension | Proposed Dimension |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNCg4 | I do not have the expertise to analyze data about my personal behavior. | 4 | 4 | 8 | 4 | 0,50 | 0,11 | 0,44 | Fair | delete | 0,00 | delete | 3-deleted | I do not have the expertise to analyze data about my personal behavior. | Cog | Cog |
| GPA10 | I only have good experiences with self-tracking. | 6 | 2 | 8 | 4 | 0,75 | 0,22 | 0,68 | Good | delete | 0,50 | delete | 3-deleted | I only have good experiences with self-tracking. | Aff | Aff |
| GPA2 | It is interesting to document everything. | 6 | 2 | 8 | 4 | 0,75 | 0,27 | 0,66 | Good | delete | 0,50 | delete | 3-deleted | It is interesting to document everything. | Aff | Cog |
| GNA5 | Self-tracking data patronizes me in my private life. | 7 | 2 | 9 | 4,5 | 0,78 | 0,25 | 0,71 | Good | delete | 0,56 | delete | 3-deleted | Self-tracking data patronizes me in my private life. | Aff | Aff |
| GNCg6 | Self-tracking does not help me to solve my problems. | 7 | 1 | 8 | 4 | 0,88 | 0,27 | 0,83 | Excellent | retain | 0,75 | delete | 3-deleted | Self-tracking does not help me to solve my problems. | Cog | Cog |
| GPCg7 | Self-tracking helps me to make things visible. | 6 | 2 | 8 | 4 | 0,75 | 0,27 | 0,66 | Good | delete | 0,50 | delete | 3-deleted | Self-tracking helps me to make things visible. | Cog | Cog |
| GPA9 | Self-tracking means stability in my private life. | 6 | 2 | 8 | 4 | 0,75 | 0,11 | 0,72 | Good | delete | 0,50 | delete | 3-deleted | Self-tracking means stability in my private life. | Cog | Cog |
| GNCg3 | I do not have a goal to reach so I do not need self-tracking. | 6 | 3 | 9 | 4,5 | 0,67 | 0,25 | 0,56 | Fair | delete | 0,33 | delete | 3-modified, but deleted | I do not have goals, so I do not need self-tracking. | Cog | Cog |
| GNCn1 | I do not have ambitions when I do exercise. | 7 | 1 | 8 | 4 | 0,88 | 0,11 | 0,86 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | I do not feel that I need to change anything in my private life. | Aff | Beh or Cog |
| GNCg1 | I do not have time for self-tracking. | 7 | 1 | 8 | 4 | 0,88 | 0,22 | 0,84 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | Self-tracking is very time-consuming. | Cog | Cog |
| GNA1 | I do not need self-tracking because I am fit and I feel good. | 6 | 1 | 7 | 3,5 | 0,86 | 0,16 | 0,83 | Excellent | retain | 0,71 | delete | 3-modified, but deleted | I do not need self-tracking because I feel good. | Cog | Aff |
| GPCn2 | I do self-tracking in various domains of life. | 7 | 1 | 8 | 4 | 0,88 | 0,22 | 0,84 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | I self-track in various domains of my life. | Beh | Beh |
| GNA10 | I don't like to take notes. | 5 | 3 | 8 | 4 | 0,63 | 0,11 | 0,58 | Fair | delete | 0,25 | delete | 3-modified, but deleted | I do not like to record any self-tracking data. | Aff | Aff or Beh |
| GNCg7 | I have the feeling to take myself too serious when tracking aspects about my private life. | 6 | 2 | 8 | 4 | 0,75 | 0,22 | 0,68 | Good | delete | 0,50 | delete | 3-modified, but deleted | I feel like I take myself too serious when tracking aspects about my private life. | Aff | Aff |
| GPCn11 | I like checking statistics about my private life on mobile phone apps. | 5 | 1 | 6 | 3 | 0,83 | 0,23 | 0,78 | Excellent | retain | 0,67 | delete | 3-modified, but deleted | I like checking statistics about my private life. | Aff | All three |
| GNA7 | I like individual support of a person when I want to change something in my life. | 7 | 1 | 8 | 4 | 0,88 | 0,11 | 0,86 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | I prefer personal support instead of self-tracking. | Aff | Aff |

**Table 71.** Summary of the Results of Round 3 for the Item Set G – Deleted Items – Continued

| Item ID | Items after G2 | # "Ess. & Imp." Judgments = $N_e$ = $N_R$ | # "NN"-Judgment s | Sum # Judgments ($N_E$) | $N_E/2$ | I-CVI = $N_R/N_E$ | $P_C$ | Kappa | significance of I-CVI Kappa | I-CVI decision (retain for >0.83) | CVR = ($N_e$-($N_E/2$))/($N_E/2$) | CVR decision | Final decision (I-CVI retain + comments and suggested modifications) | Final Item (after G3) | Final Dimension | Proposed Dimension |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNA9 | I prefer listening to my body feeling. | 7 | 1 | 8 | 4 | 0,88 | 0,22 | 0,84 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | I prefer listening to myself instead of using metrics and numbers. | Aff | Cog |
| GPA8 | In order to realize what is good for me self-tracking provides the necessary orientation. | 5 | 3 | 8 | 4 | 0,63 | 0,22 | 0,52 | Fair | delete | 0,25 | delete | 3-modified, but deleted | Self-tracking provides me with guidance to realize what is good for me. | Cog | Cog |
| GNCg9 | Measurements are useless. | 7 | 1 | 8 | 4 | 0,88 | 0,27 | 0,83 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | Self-measurements are useless. | Cog | Cog |
| GNCn2 | Self-tracking does not help me to learn something new. | 7 | 1 | 8 | 4 | 0,88 | 0,22 | 0,84 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | Self-tracking does not help me to learn new things about myself and my private life. | Cog | Cog |
| GNCg2 | Self-tracking does not provide as much fun as other activities | 5 | 3 | 8 | 4 | 0,63 | 0,22 | 0,52 | Fair | delete | 0,25 | delete | 3-modified, but deleted | Self-tracking does not provide me as much fun as other activities. | Cog | Aff |
| GPCn7 | Self-tracking helps for self-observation. | 7 | 2 | 9 | 4,5 | 0,78 | 0,25 | 0,71 | Good | delete | 0,56 | delete | 3-modified, but deleted | Self-tracking helps to observe myself and my private activities. | Cog | Aff |
| GPCg4 | Self-tracking helps me to learn things. | 7 | 1 | 8 | 4 | 0,88 | 0,22 | 0,84 | Excellent | retain | 0,75 | delete | 3-modified, but deleted | Self-tracking helps me to learn things about myself in my private life. | Cog | Cog |
| GPCn5 | Self-tracking helps me to remember. | 6 | 2 | 8 | 4 | 0,75 | 0,22 | 0,68 | Good | delete | 0,50 | delete | 3-modified, but deleted | Self-tracking helps me to remember aspects about my private activitis | Cog | Cog |
| GPCg2 | Self-tracking helps me to show others how sportive I am /proves how sportive I am. | 6 | 2 | 8 | 4 | 0,75 | 0,22 | 0,68 | Good | delete | 0,50 | delete | 3-modified, but deleted | With self-tracking I can show others my progress. | Cog | Cog |
| GPA1 | Self-tracking is like a religion. | 6 | 3 | 9 | 4,5 | 0,67 | 0,25 | 0,56 | Fair | delete | 0,33 | delete | 3-modified, but deleted | Self-tracking is a very important element in my private life. | Cog | Cog |
| GPCg10 | There are problems that can be easily solved with self-tracking. | 5 | 2 | 7 | 3,5 | 0,71 | 0,16 | 0,66 | Good | delete | 0,43 | delete | 3-modified, but deleted | I think that there problems that can easily be solved with self-tracking. | Cog | Cog |
| GNCg10 | Without numbers and information I know when something is good for me | 7 | 2 | 9 | 4,5 | 0,78 | 0,16 | 0,73 | Good | delete | 0,56 | delete | 3-modified, but deleted | I do not need numbers in my life to know what is good for me. | Cog | Cog |

After having finalized the content validation for each item set, round 3 closes with analyzing all items together, in order to purify the item sets. Through modifications, clarifications, and new items, the other properties (direction, sentiment, and type) and the dimension of the items were mixed up. This is due to the fact that participants were not aware that they had different item sets and that only attitudes toward behavior are of interest. For that reason, all retained items were recategorized according to the major properties of items (see Subsection 6.1.2, p. 115). Table 72 shows the results before and after the content validation.

**Table 72.** Recategorization of the Finally Selected Items – Categorization before and after the Content Validation

| Item ID | Final Item (after Round 3) | Final Dimension | Old Type | Old Sentiment | Old Dimension | New Sentiment | New Direct-ion | New Type | Other Possible Constructs |
|---|---|---|---|---|---|---|---|---|---|
| APA3 | I am interested in collecting data about my private life. | Cog | Adj | Pos | Aff | Pos | ATO | Gen | - |
| ArNA2 | I feel no need to self-track because I know what is good for me without any collected data. | Aff | Adj + reasoning | Neg | Aff | Neg | ATB | Gen | - |
| ArPA5 | I like obtaining a more tangible result of my performance through self-tracking. | Aff | Adj + reasoning | Pos | Aff | Pos | ATB | Gen | - |
| ArPA4 | I like to note things, so I do not forget anything. | Beh | Adj + reasoning | Pos | Aff | Pos | ATB | Gen | - |
| ANA2 | It is unpleasant to find out things about my private life. | Aff | Adj | Neg | Aff | Neg | ATB | Gen | - |
| AP+NA1 | Self-tracking distracts me from the actual experience. | Aff | Adj | Pos + Neg | Aff | Neg | ATB | Adj | - |
| ArNA5 | Self-tracking entails risks as others could misuse my data. | Aff | Adj + reasoning | Neg | Aff | Neg | ATB | Adj | - |
| ANA4 | Self-tracking is annoying. | Aff | Adj | Neg | Aff | Neg | ATB | Adj | - |
| APCg5 | Self-tracking is easy. | Cog | Adj | Pos | Cog | Pos | ATB | Adj | - |
| APA1 | Self-tracking is fun. | Aff | Adj | Pos | Aff | Pos | ATB | Adj | - |
| ArPA1 | Self-tracking satisfies my curiosity about aspects of my private life. | Aff | Adj + reasoning | Pos | Aff | Pos | ATB | Adj | - |
| AA2 | Self-tracking pushes me. | Aff | Adj | | | Pos | ATB | Adj | - |
| ArNA3 | I doubt that self-tracking would be beneficial for my already satisfied life. | Aff | Adj + reasoning | Neg | Aff | Neg | ATB | Gen | - |
| ArNA1 | The awareness provided by self-tracking on what I can improve in my private life makes me feel uncomfortable. | Aff | Adj + reasoning | Neg | Aff | Neg | ATO | Gen | - |
| ANA6 | Self-tracking information is insightful. | Cog | Adj | Neg | Aff | Pos | ATO | Adj | - |
| ArNCg2 | Self-tracking does not solve current problems in my private life. | Cog | Adj + reasoning | Neg | Cog | Neg | ATB | Adj | - |
| APA6 | I like to see my progress in private activities through self-tracking. | Aff | Adj | Pos | Aff | Pos | ATB | Gen | - |
| ArPCg1 | I like to obtain more information about my private activities through self-tracking. | Aff | Adj + reasoning | | Cog | Pos | ATB | Gen | - |
| APA5 | I like to keep track of my private life with notes. | Aff | Adj | Pos | Aff | Pos | ATB | Gen | - |
| APCg2 | Self-tracking helps me to be aware aspects about my private life. | Cog | Adj | Pos | Cog | Pos | ATB | Adj | - |
| APCg4 | Self-tracking is too competitive for me. | Cog | Adj | Pos | Cog | Neg | ATB | Adj | - |
| ArPA6 | The history on my private life I get with self-tracking is useful. | Cog | Adj + reasoning | | Aff | Pos | ATO | Gen | - |
| ANA1 | It stresses me when I forget to self-track myself. | Aff | Adj | Neg | Aff | Neg | ATB | Gen | - |
| ArPA2 | Self-tracking information is only interesting when I start to self-track an aspect of my private life. | Aff | Adj + reasoning | | Aff | Neg | ATO | Adj | - |
| APCg3 | Self-tracking helps me to avoid future problems beforehand. | Cog | Adj | Pos | Cog | Pos | ATB | Adj | - |
| APCg6 | Self-tracking feels rewarding. | Aff | Adj | Pos | Cog | Pos | ATB | Adj | - |
| ANCg1 | Self-tracking is too time-consuming for me. | Cog | Adj | Neg | Cog | Neg | ATB | Adj | - |
| ArNA6 | I dislike that self-tracking makes me aware of problems. | Aff | Adj + reasoning | Neg | Aff | Neg | ATB | Gen | - |
| ANA3 | Self-tracking is frustrating. | Aff | Adj | Neg | Aff | Neg | ATB | Adj | - |
| ANR31 | If I am interested in something, I would self-track every day. | Aff | Adj | | | Pos | ATB | Gen | - |
| ANR32 | Self-tracking makes me feel proud of my progress. | Aff | Adj | 1 | 1 | Pos | ATB | Adj | goal setting |
| ANR33 | Self-tracking is cool. | Aff | Adj | 1 | 1 | Pos | ATB | Adj | - |
| ANR34 | Self-tracking allows me to see personal progress. | Cog | Adj | 1 | 1 | Pos | ATB | Adj | goal setting |
| ANR35 | Not being able to see a progress frustrates me. | Aff | Adj | 1 | 1 | Neg | ATB | Gen | self-efficacy |
| ANR36 | I feel no need to self-track. | Aff | Adj | 1 | 1 | Neg | ATB | Gen | - |
| ANR37 | Self-tracking information is difficult to process. | Cog | Adj | 1 | 1 | Neg | ATO | Adj | - |
| ANR38 | I dislike self-tracking. | Aff | Adj | 1 | 1 | Neg | ATB | Gen | - |
| ANR39 | I write down aspects of my private life. | Beh | Adj | 1 | 1 | Pos | ATB | Gen | - |

| Item ID | Final Item (after Round 3) | Final Dimension | Old Type | Old Sentiment | Old Dimension | New Sentiment | New Direct-ion | New Type | Other Possible Constructs |
|---|---|---|---|---|---|---|---|---|---|
| GPA6 | I am happy when I see through self-tracking that I reach my goals. | Aff | Gen | Pos | Aff | Pos | ATB | Gen | goal setting |
| GPCg9 | I can act more consciously through self-tracking. | Cog | Gen | Pos | Cog | Pos | ATB | Gen | - |
| GNCg8 | I do not see any benefits in self-tracking. | Cog | Gen | Neg | Cog | Neg | ATB | Gen | - |
| GPA3 | I feel bad when I do not self-track. | Aff | Gen | Pos | Aff | Pos | ATB | Gen | - |
| GNCg5 | I like to spend my time on other things than self-tracking. | Aff | Gen | Neg | Cog | Neg | ATB | Gen | - |
| GPCg8 | Self-tracking helps me to be disciplined. | Cog | Gen | Pos | Cog | Pos | ATB | Adj | - |
| GPCg3 | Self-tracking helps me to control important aspects about myself. | Cog | Gen | Pos | Cog | Pos | ATB | Adj | - |
| GPCg1 | Self-tracking helps me to reach my goals. | Cog | Gen | Pos | Cog | Pos | ATB | Adj | goal setting |
| GNA6 | I am afraid that others use my self-tracking data. | Aff | Gen | Neg | Aff | Neg | ATB | Gen | - |
| GPCn3 | I think I get inducements for my private life from self-tracking. | Cog | Gen | Pos | Con | Pos | ATB | Gen | - |
| GPCn6 | In order to investigate how I can become better, I can use self-tracking. | Beh | Gen | Pos | Con | Pos | ATB | Gen | - |
| GPCg5 | It is easier for me to reach my goals with facts and numbers. | Cog | Gen | Pos | Cog | Pos | ATB | Gen | goal setting |
| GNA3 | It feels strange to me to collect data about myself. | Aff | Gen | Neg | Aff | Neg | ATB | Gen | - |
| GPA4 | Measuring myself motivates me. | Aff | Gen | Pos | Aff | Pos | ATB | Gen | - |
| GNA8 | Self-tracking demotivates me. | Aff | Gen | Neg | Aff | Neg | ATB | Adj | - |
| GNA2 | Self-tracking does not provide me any pleasure. | Cog | Gen | Neg | Aff | Neg | ATB | Adj | - |
| GPA5 | Self-tracking helps to observe myself and my private activities. | Cog | Gen | Pos | Aff | Pos | ATB | Adj | - |
| GPCg6 | Self-tracking helps me to monitor my private activities. | Cog | Gen | Pos | Cog | Pos | ATB | Adj | - |
| GPA7 | Self-tracking helps me to track interesting aspects about my private life. | Cog | Gen | Pos | Aff | Pos | ATB | Adj | - |
| GPCn9 | Self-tracking helps me to be aware of aspects in my life. | Cog | Gen | Pos | Con | Pos | ATB | Adj | - |
| GPCn10 | Self-tracking helps me to be preventive regarding a specific problem. | Cog | Gen | Pos | Con | Pos | ATB | Adj | - |
| GPCn4 | Self-tracking helps me to get into a success loop because I know that I reached my goals. | Cog | Gen | Pos | Con | Pos | ATB | Adj | goal setting |
| GNA4 | Self-tracking distracts me from other aspects. | Cog | Gen | Neg | Aff | Neg | ATB | Adj | - |
| GNCg9 | I get inducements for my private life from self-tracking. | Cog | Gen | Neg | Cog | Pos | ATB | Gen | - |
| GNR31 | The process of self-tracking feels like an accomplishment. | Aff | Gen | 1 | 1 | Pos | ATB | Gen | - |
| GNR31 | Self-tracking provides me with expertise to analyze data about my private activities. | Cog | Gen | 1 | 1 | Pos | ATO | Adj | self-efficacy |
| GNR31 | Self-tracking frustrates me. | Aff | Gen | 1 | 1 | Neg | ATB | Adj | - |

"1"=new item, therefore, no sentiment and dimension was defined before the content validation
"-"=no other possible construct
ATO: attitude towards objects
ATB: attitudes toward behavior
Aff: affective
Cog: cognitive
Con: cognitive
Adj: adjective
Gen: general
Pos: positive
Neg: negative

As seven items focus on attitudes toward an object (data/information), they were deleted from the final data set. Additionally, three items were deleted as they were quite similar to each other.

### 9.6.8 Formative and Relative Item Determination

This part of the appendix presents two guidelines that help to decide on the underlying measurement model of a construct. On this account, the guidelines help to establish a measurement model for the items of each item set.

Guidelines for Measurement Model Specification

First of all, Hair et al. (2017) provide a guideline[49] with five criteria relevant to the relationship between construct and item, the nature of the construct, and interchangeability of the items. Table 73 shows all criteria and the satisfying decisions.

**Table 73.** Guidelines for Choosing the Measurement Model Mode (Hair et al. 2017)

| Criterion | Decision |
|---|---|
| Causal priority between the item and the construct | • From the construct to the item: reflective<br>• From the items to the construct: formative |
| The construct is a trait explaining the items or rather a combination of the items | • If trait: reflective<br>• If combination: formative |
| The items represent consequences or causes of the construct | • If consequences: reflective<br>• If causes: formative |
| All items change in a similar manner, when the trait changes | • If yes: reflective<br>• If no: formative |
| Items are mutually interchangeable | • If yes: reflective<br>• If no: formative |

However, Hair et al. (2017) do not differentiate between the construct development and statistical as well as empirical validation. In contrast, Coltmann et al. (2008) differentiate between theoretical and empirical considerations, which also covers the aspects from Hair et al. (2017). For that reason, the framework[50] from Coltmann et al. (2008) is chosen and applied to the item set A and G. Table 74 shows the considerations and the satisfying occurrences, depending on the model.

**Table 74.** A Framework for Assessing Reflective and Formative Models – Theoretical Considerations from Coltmann et al. (2008)

| Considerations | Reflective Model | Formative Model |
|---|---|---|
| Nature of construct | Latent construct is existing<br>→ Latent construct exists independent of the measures used | Latent construct is formed<br>→ Latent construct is determined as a combination of its items |
| Direction of causality between items and latent construct | Causality from construct to items<br>→ Variation in the construct causes variation in the item measures<br>→ Variation in an item measure does not cause variation in the construct | Causality from items construct<br>→ Variation in the construct does not causes variation in the item measures<br>→ Variation in an item measure cause variation in the construct |
| Characteristics of items used to measure the construct | Items are manifested by the construct<br>→ Items share a common theme<br>→ Items are interchangeable<br>→ Adding or dropping an item does not change the conceptual domain of the construct | Items define the construct<br>→ Items need not to share a common theme<br>→ Items are not interchangeable<br>→ Adding or dropping an item may change the conceptual domain of the construct |

In order to determine the **nature of the construct,** a decision must be made regarding whether the latent construct is existing or formed. Coltmann et al. (2008) differentiate the following examples. Attitudes or personality constructs are represented prevailingly as reflective models, which refers to the criteria of trait from Hair et al. (2017). In contrast, the human-development index represents a formative model. This depends upon the "constructivist, operationalist or instrumentalist interpretation by the scholar" (Coltman et al. 2008, p. 6) as the change in the items – such as education or health – impacts the human-development index.

The **direction of causality refers** to the relationship between the construct and the items. Due to the causality, a change in construct causes a change in the items, or vice versa. Edwards and Bagozzi (2000, p. 157) specify that causality "requires temporal precedence, such that the cause occurs before the effect." Four conditions are enumerated for causality. First, the construct and the item should be distinct. As Edwards and Bagozzi (2000) say that this distinction is evident for attitudes, this condition is not considered any further. The second condition refers to association. Besides empirical testing for covariances, the mental experiment from Bollen (2001) should be employed to try to figure out if a change in the construct causes a change in the items or vice versa. This mental experiment was already undertaken in the first consideration, the nature of the construct. For that reason, it is not considered for the categorization of the items of item set A and G. The third condition refers to temporal precedence of the change in construct or items. As the temporal precedence was also considered within the mental experiments, it will not be considered. Finally, the fourth condition describes the "elimination of rival explanations for the presumed relationship between the cause and effect" (2000, p. 157). Mostly experimental settings and statistical validation with related constructs (e.g., self-efficacy, goal-setting) will help to discern such rival explanations in the future work of the empirical validation.

[49] The guideline originates from different scientific articles. For more details about the sources, please see Hair et al. (2017).
[50] The guideline originates from different scientific articles. For more details about the sources, please see Coltmann et al. (2008).

The final consideration refers to the **characteristics of items**. For example, in formative models, the items may not share a common theme – i.e., high correlation, according to MacKenzie et al. (2005) – and the construct is sensitive toward the item's amount and type. Adding or removing an item may change the complete construct. For example, the human-development index cannot be estimated without all relevant items, e.g., health or education. In contrast, for reflective models, all items share a common theme and are interchangeable. MacKenzie et al. (2005) adds another characteristic: the question of whether an item is rather a manifestation or a "defining characteristic that collectively explain[s] the meaning of the construct" (MacKenzie et al. 2005, p. 713). In the latter case, the relationship is formative.

The criteria described above will be applied and considered in the following.

Application of the Guidelines to the Present Items

In order to categorize the relationship between each item with the construct, the differentiation of first- and second-order construct should be considered. Attitudes represent a second-order construct. The direct, adjective item set is generally seen as cognitive, affective, or conative responses to the stimulus object. For that reason, each dimension (affective, cognitive, conative) represents a first-order construct that is defined by the created direct, adjective items – at least for more items, this relationship was confirmed after applying the framework from Coltmann et al. (2008). In contrast, the general attitude item set is interpreted as a second-order construct. Table 75 and Table 76 show the evaluation of the relationships for each item to the dimension of the attitude construct.

As Coltmann et al. (2008) suggest, the theoretical considerations must be examined with empirical methods to accept or reject the measurement models. This will be included in future work. Bollen and Bauldry (2011) offer an overview of empirical tests.

**Table 75.** Final Assessment of the Items in Regard to the Measurement Model

| Type | Sentiment | Dimension | Final Item | Abbreviation | reflective/ formative | Nature of construct | direction of causality | characteristics of items |
|---|---|---|---|---|---|---|---|---|
| adv | Neg | Aff | Self-tracking demotivates me. | Aff_Res_1 | reflective | Negative affective attitude towards self-tracking exists and drives demotivati | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking distracts me from the actual experience. | Aff_Res_2 | reflective | Negative affective attitude towards self-tracking exists and drives distraction | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking entails risks as others could misuse my data. | Aff_Res_3 | formative | Fear forms affective negative self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, may share a common theme, and might be interchangeable |
| | | | Self-tracking is annoying. | Aff_Res_5 | reflective | Negative affective attitude towards self-tracking exists and drives boredom | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking is frustrating. | Aff_Res_6 | reflective | Negative affective attitude towards self-tracking exists and drives frustration | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | Cog | Self-tracking distracts me from other aspects. | Cog_Res_1 | reflective | Negative cognitive attitude towards self-tracking exists and drives distraction | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking does not provide me any pleasure. | Cog_Res_2 | reflective | Negative cognitive attitude towards self-tracking exists and drives lack of plea | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking does not solve current problems in my private life | Cog_Res_3 | reflective | Negative cognitive attitude towards self-tracking exists and drives feeling that self-tracking won't help to solve current problems | Causality from construct to items | may collectivley explain the meaning of the construct, may share a common theme, and might be interchangeable |
| | | | Self-tracking is too competitive for me. | Cog_Res_4 | reflective | Negative cognitive attitude towards self-tracking exists and drives feeling about too much competitive | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking is too time-consuming for me. | Cog_Res_5 | reflective | Negative cognitive attitude towards self-tracking exists and drives feeling about time consumption | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | Pos | Aff | Self-tracking feels rewarding. | Aff_Res_7 | reflective | Positive affective attitude towards self-tracking exists and drives the feeling o | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking is cool. | Aff_Res_8 | reflective | Positive affective attitude towards self-tracking exists and drives coolness fee | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking is fun. | Aff_Res_9 | reflective | Positive affective attitude towards self-tracking exists and drives fun | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking makes me feel proud of my progress. | Aff_Res_10 | formative | Positive affective attitude towards self-tracking exists and drives pride | Causality from items to construct | may collectivley explain the meaning of the construct, may share a common theme, and might be interchangeable |
| | | | Self-tracking pushes me. | Aff_Res_11 | reflective | Positive affective attitude towards self-tracking exists and drives feeling abou | Causality from construct to items | may collectivley explain the meaning of the construct, may share a common theme, and might be interchangeable |
| | | | Self-tracking satisfies my curiosity about aspects of my private | Aff_Res_12 | reflective or formative | Positive affective attitude towards self-tracking exists and drives satisfaction / Curiosity and satisfaction drive self-tracking | Causality from construct to items /Causality from items to construct | a manifestation, share a common theme and may be interchangeable |
| | | Cog | Self-tracking allows me to see personal progress. | Cog_Res_6 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, do not share a common theme and might not be interchangeable |
| | | | Self-tracking helps me to avoid future problems beforehand. | Cog_Res_7 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, do not share a common theme and might not be interchangeable |
| | | | Self-tracking helps me to be aware aspects about my private life. | Cog_Res_8 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking helps me to be disciplined. | Cog_Res_10 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, do not share a common theme and might not be |
| | | | Self-tracking helps me to be preventive regarding a specific | Cog_Res_11 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, do not share a common theme and might not be |
| | | | Self-tracking helps me to control important aspects about myself. | Cog_Res_12 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking helps me to get into a success loop because I know that I reached my goals. | Cog_Res_13 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, do not share a common theme and might not be interchangeable |
| | | | Self-tracking helps me to monitor my private activities. | Cog_Res_14 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking helps me to reach my goals. | Cog_Res_15 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, do not share a common theme and might not be interchangeable |
| | | | Self-tracking helps me to track interesting aspects about my private life. | Cog_Res_16 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking helps to observe myself and my private activities | Cog_Res_17 | reflective | Positive cognitive attitude towards self-tracking exists and drives support fee | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |
| | | | Self-tracking is easy. | Cog_Res_18 | reflective | Positive cognitive attitude towards self-tracking exists and drives easiness | Causality from construct to items | a manifestation, share a common theme and may be interchangeable |

**Table 76.** Final Assessment of the Items in Regard to the Measurement Model – Continued

| Type | Sentiment | Dimension | Final Item | Abbreviation | reflective/ formative | Nature of construct | direction of causality | characteristics of items |
|---|---|---|---|---|---|---|---|---|
| gen | Neg | Aff | I am afraid that others use my self-tracking data. | Aff_Form_1 | formative | Fear of missuse forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I dislikte that self-tracking makes me aware of problems. | Aff_Form_2 | formative | Disliking the awareness of problems forms negative affective self-tracking at | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I dislike self-tracking. | Aff_Form_3 | reflective | Negative attitude towards self-tracking exists and drives disliking | Causality from construct to items | Items are manifested by the construct / Items define the construct |
| | | | I doubt that self-tracking would be beneficial for my already satisfied life. | Aff_Form_4 | formative | Already satisfied life forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I feel no need to self-track because I know what is good for me without any collected data. | Aff_Form_5 | formative | No need for data forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I feel no need to self-track. | Aff_Form_6 | reflective or formative | Needs form negative affective attitude towards self-tracking / Negative attitude towards self-tracking exists and drives needs | Causality from construct to items /Causality from items to construct | a manifestation, do not share a common theme and might not be interchangeable |
| | | | I like to spend my time on other things than self-tracking. | Aff_Form_7 | formative | Time spending preference forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | It feels strange to me to collect data about myself. | Aff_Form_8 | formative | Oddity forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | It is unpleasant to find out things about my private life. | Aff_Form_9 | formative | Unpleasantry forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | It stresses me when I forget to self-track myself. | Aff_Form_10 | formative | Stress forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | Not being able to see a progress frustrates me. | Aff_Form_11 | formative | Frustration forms negative affective self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | Cog | I do not see any benefits in self-tracking. | Cog_Form_1 | formative | Lack of benefits forms negative cognitive self-tracking attitude | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | Pos | Aff | I am happy when I see through self-tracking that I reach my goals. | Aff_Form_13 | formative | Happiness forms the positive affective self-tracking attitude. | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I feel bad when I do not self-track. | Aff_Form_14 | reflective or formative | Feeling bad forms positive affective attitude towards self-tracking / Positive affective attitude towards self-tracking exists and drives bad feeling | Causality from construct to items /Causality from items to construct | a manifestation, do not share a common theme and might not be interchangeable |
| | | | I like obtaining a more tangible result of my performance through self-tracking. | Aff_Form_15 | formative | Interest forms positive affective attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I like to keep track of my private life with notes. | Aff_Form_16 | formative | Note taking forms positive affective attitudes towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I like to obtain more information about my private activities through self-tracking. | Aff_Form_17 | formative | Interest forms positive affective attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I like to see my progress in private activities through self-tracking. | Aff_Form_18 | formative | Interest forms positive affective attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | If I am interested in something, I would self-track every day. | Aff_Form_19 | reflective or formative | Interest forms positive affective attitude towards self-tracking / Positive affective attitude towards self-tracking exists and drives interest | Causality from construct to items /Causality from items to construct | Items are manifested by the construct / Items define the construct |
| | | | Measuring myself motivates me. | Aff_Form_20 | formative | Measuring preference forms positive affective attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | The process of self-tracking feels like an accomplishment. | Aff_Form_21 | reflective or formative | Accomplishment forms positive affective attitude towards self-tracking / Positive affective attitude towards self-tracking exists and drives the | Causality from construct to items /Causality from items to construct | a manifestation, do not share a common theme and might not be interchangeable |
| | | | I like to note things so I do not forget anything. | Beh_Form_1 | formative | Noting preference forms positive affective attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | Beh | I write down aspects of my private life. | Beh_Form_2 | formative | Writing down aspects forms positive behavioral attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | In order to investigate how I can become better, I can use self-tracking. | Beh_Form_3 | formative | Optimization urge forms positive behavioral attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | I can act more consciously through self-tracking. | Cog_Form_2 | formative | Urge for consciousness forms positive behavioral attitude towards self-trackir | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | Cog | I think I get inducements for my private life from self-tracking. | Cog_Form_4 | reflective | Interest for inducements forms positive cognitive attitude towards self-trackir | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |
| | | | It is easier for me to reach my goals with facts and numbers. | Cog_Form_5 | formative | Simplificaiton forms positive cognitive attitude towards self-tracking | Causality from items to construct | may collectivley explain the meaning of the construct, do not share a common theme and might not be interchangeable |