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Proceedings of KogWis 2012

11th Biannual Conference of the German Cognitive Science Society

Ute Schmid, Michael Siebers, Claus-Christian Carbon, Marius Raab, Jascha Rüsseler, Tom Gross, Christoph Schlieder, Dietrich Dörner (Eds.)

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Angela Schwering, Westfälische Wilhelms-Universität Münster
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Preface

The bi-annual conference of the German Cognitive Science Society took place the 11^{th} time since the founding of the society in 1994. The number of society members as well as the number of participants at the conference series grew steadily over the years. We were pleased to welcome more than 120 guests at KogWis 2012 in Bamberg.

For the statistics: KogWis 2012 had 46 accepted talks and 23 accepted poster contributions. Furthermore, 40 researchers presented their work in 9 symposia. The majority of participants came from German universities and research institutions. However, there were also participants from The Netherlands, Denmark, Turkey, Switzerland and the United Kingdom. Disciplines covered (by keyword classification of submissions) are Anthropology (2), Artificial Intelligence (19), Cognitive Psychology (53), Language (24), Neuroscience (16), Philosophy of Mind (18) and applications in eduction (5), human-computer-interaction (11), and clinical work (6).

Over the last years the German Cognitive Science Society formed KogWis to be a conference which focusses on providing a forum for junior scientists and at highlighting current research topics in the German cognitive science community. Therefore, the reviewing process is not very competitive and only abstracts and not long papers are submitted and published in the proceedings. The mixture of sessions with short presentations and symposia with focus topic provides a good balance between presentations of young researchers and established ones. On the one hand, many German students give their first conference presentation at KogWis. On the other hand, many senior researchers appreciate the opportunity to discuss specific research topics with colleagues. Of course, being a cognitive science conference, the presenters and their audience have an interdisciplinary background and participants value the possibility to learn from presentations and discussions from disciplines different from their own.

We were proud that we could win four very renowned researches as plenary speakers: Elsbeth Stern (ETH Zürich) highlighted the relation between cognitive science and education, Mike Oaksford (Birkbeck College, University of London) presented current research in the domain of probabilistic reasoning, Rainer Goebel (Universiteit Maastricht) showed how experimental psychology, neuroimaging and computational neuroscience can play together to gain a better understanding of how the mind emerges from the brain, and Dietrich Dörner (University of Bamberg) challenged the audience with his proposition that artificial intelligence does not exists.

The following areas of cognitive science research were covered in the invited symposia: Cognitive Aspects of Human-Technology Interaction (Manfred Thüring, TU Berlin), Cognitive Models of Error Processing (Marco Steinhauser, KU Eichstätt-Ingolstadt), Modeling Cognition in Communcation (Stefan Kopp & Kirsten Bergmann, Universität Bielefeld), Linguistic versus Non-Linguistic Knowledge (Barbara Kaup & Claudia Maienborn, Universität Tübingen), Multimodal Interaction (Christopher Habel, Universität Hamburg), Social Cognition and Culture (Albert Newen, Universität Bochum & Kai Vogeley, University of Cologne), and Spatial Cogniton – Foundations and Applications (Christoph Hölscher, Universität Freiburg). Two further symposia were dedicated to the topics of Cultural Consitution of Causal Cognition (Sieghard Beller & Andrea Bender, ZiF Research Group, Bielefeld University and University Freiburg) and Clinical Applications of Cognitive Science (Wolfgang Trapp, SozialStiftung Bamberg).

The conference program furthermore included a doctoral symposium (organized by Stefan Kopp), a satellite workshop of the German National Educational Panel Study (NEPS) and – the first time at a KogWis conference – tutorials covering cognitive modeling approaches and human-computer interaction.

By the selection of plenary speakers and symposia organizers, we hope to highlight the motto of the Bamberg conference "From Cognitive Models to Cognitive Assistance" by bringing together basic cognitive science research with applications in education and HCI.

The Editors

Acknowledgements

The organization of an academic conference depends on the support of a lot of people and institutions who invest time, ideas and also money.

I want to thank my colleagues from the board of the German Cognitive Science Society Michael Pauen, Stefan Kopp, Marco Ragni, and Angela Schwering as well as Gerhard Strube as speaker of the advisory board for the support they gave me over the last two years.

I am very grateful to the members of the programm committee for giving their time to review about eight abstract submissions each: Thomas Barkowski, Leandra Bucher, Claus-Christian Carbon, Dietrich Dörner, Peter Gerjets, Tom Gross, Johannes Haack, Barbara Kaup, Martin Christof Kindsmüller, Markus Knauff, Stefan Kopp, Kai-Uwe Kühnberger, Hanspeter Mallot, Michael Pauen, Marco Ragni, Jascha Rüsseler, Tobias Schlicht, Christoph Schlieder, Angela Schwering, Frieder Stolzenburg, Thora Tenbrink, Manfred Thüring.

Furthermore, I want to thank my colleagues and conference co-chairs Claus-Christian Carbon, Dietrich Dörner, Tom Gross, Jascha Rüsseler and Christoph Schlieder for their support and helpful discussions which gave valuable input for many decisions concerning the conference program and schedule.

The German National Educational Panel Study (NEPS) at University of Bamberg supported the conference by sponsoring an invited speaker and by organzing an satellite event focussing on education as an important application area of cognitive science research. Special thanks to Cordula Artelt, Jutta von Maurice and Sabine Weinert.

Several local software companies supported KogWis 2012 with donations. I am very grateful for the support from DOCUFY, Mediatixx, upjers. Cordial thanks to Brain Products as a longtime sponsor of the KogWis Best Poster Award and to the Cognitive Science Society for their sponsoring of a Best Student Paper Award. Thanks also to the Research Committee (FNK) of the University of Bamberg for monetary support.

Several people in the administration of the University of Bamberg gave support in smaller and larger degrees.

A bulge of work in preparing and conducting the conference was handled by my secretary Gaby Bauer, my assistants Mark Wernsdorfer and Michael Munz and by several assistants of my co-chairs, namely Marius Raab, Klaus Stein, Dominik Kremer, and Sascha Herr. Furthermore,

I say many thanks to the highly dedicated student assistants Bettina Finzel, Michael Kleber, Sandra Mai, Klaus Schneider, Dominik Seuß, and Robert Terbach.

The biggest thanks of all goes to my assistant Michael Siebers who put lots of hours in setting up the submission and registration system, the web pages and the proceedings.

Ute Schmid

Invited Talks

Does Artificial Intelligence Exist? No, it doesn't!

Dietrich Dörner

Theoretische Psychologie, Otto-Friedrich-Universität Bamberg

Does artificial intelligence exist? In my eyes there exists not one example for artificial intelligence. What is intelligence? Unfortunately Psychology does not provide us with a sound definition of this term, although since more than a hundred years psychologists try to develop systems to measure intelligence and the story of intelligence testing is considered as a story of success. Normally in intelligence testing subjects get a number of tiny tasks which they have to solve and intelligence is considered hence accordingly as a collection of abilities to solve such tasks.

Systems of artificial intelligence can solve such tiny tasks too, but they can solve "big" tasks additionally. They can play chess on grandmaster level, solve algorithmitically not solvable problems as the 'travelling salesman'-problem, etc. But unfortunately the systems of artificial intelligence have no insight, why they solve such problems in the form they do. And therefore they cannot understand why it is better to solve one problem in this way, another one in a different way. To understand why I use a certain strategy opens the possibility to elaborate strategies or to change them or to abandon them. Without this insight a system could change strategies only by the criterion of success or failure. Certainly this criterion works, but in no ways it is the best one. I shall discuss, what insight means in this context and why insightful thinking is only possible by using natural language with its polysemie and metaphors and unlimited levels of reasoning about the characteristics of a lower order language.

Cracking the Columnar-Level Code in the Visual Hierarchy with Sub-Millimeter fMRI and Neural Network Modeling

Rainer Goebel

Universiteit Maastricht, Faculty of Psychology, Department of Neurocognition

The brain is the most complex organ we know but we still do not understand how cognitive phenomena such as object recognition, speaking and consciousness are created by billions of interacting neurons. With standard functional brain imaging (i.e. fMRI at 3 Tesla), we can routinely see specialized areas in the human brain, including "experts" for colour, visual motion, faces, words, language, planning, memory and emotions. This level of resolution reveals an amazing organisation of the brain that is similar, but not identical, across individuals. We still, however, know little about the representations coded inside specialised brain areas and how complex features emerge from combinations of simpler features when we move from one area to the next. With high-field MRI scanners (7 Tesla and beyond), the achievable functional resolution reaches to the sub-millimetre level (500–1000 microns). This is important since neurons with similar response properties spatially cluster into functional units or cortical columns with a lateral extent of hundreds of microns. Studying the brain at the cortical columnar level seems to be the right level to reveal the principles that the brain uses to code information. I propose that this columnar-level code can be "cracked" by adequately combining clever experimental designs (psychology), sub-millimetre fMRI (neuroimaging), sophisticated data analysis tools (signal analysis) and large-scale neuronal network modelling (computational neuroscience). It is my belief that, with a massive attempt to crack the columnar-level code in as many areas as possible, we will ultimately reach a deeper understanding how mind emerges from simpler units in the brain. I will present first empirical evidence that cracking the columnar-level code is indeed possible. I will also show exciting applications of real-time brain scanning at the columnar-level that will allow to create sophisticated brain computer interfaces (BCIs).

A Probabilistic Approach to the Psychology of Conditional Inference

Mike Oaksford

Birkbeck College, University of London

A new paradigm in the psychology of reasoning has recently emerged (Over, 2009) that proposes a probabilistic approach to reasoning where previously logical approaches had prevailed, e.g., mental logic and mental models. In this talk, I discuss one particular probabilistic approach to conditional reasoning-involving if...then statements-developed by Nick Chater and I over the last couple of decades (Oaksford & Chater, 2009). At the computational level, this theory views conditional inference as dynamic belief update by Bayesian conditionalization (Oaksford et al, 2000; Oaksford & Chater, 2007). I review the theory and some of the data it can explain before addressing recent critiques (Oberauer et al, 2006). I show that a more recent model incorporating rigidity violations better explains the data (Oaksford & Chater, 2008) and that experiments on enthymematic and explicit conditional inference reveal results only consistent with the probabilistic approach. I then discuss possible algorithmic level implementations of the probabilistic approach in a constraint satisfaction neural network (Oaksford & Chater, 2010) and using Causal Bayesian Networks (Ali, Chater, & Oaksford, 2011). I conclude with a proposal for the cognitive architecture of reasoning based on these empirical and theoretical results and compare it to recent proposals in dual and tri process theory (Evans, 2010; Stanovich, 2011).

Presidential Lecture
Kognitionswissenschaft als interdisziplinäres Projekt. Grenzen und Perspektiven.

Michael Pauen

Institut für Philosophie, Berlin School of Mind and Brain,
Humbold-Universität zu Berlin

Kognitionswissenschaft ist von ihrer Anlage her interdisziplinär. Will man sie ernsthaft betreiben, dann ist man auf die Zusammenarbeit einer ganzen Reihe von Disziplinen angewiesen: Dazu gehören Psychologie und Neurowissenschaften, Informatik, Linguistik und Philosophie. Diese Zusammenarbeit, ursprünglich ein Experiment mit ungewissem Ausgang, klappt mittlerweile erstaunlich gut – und sie wird vielfach gefördert. Meine These ist, dass die Zukunftsperspektiven interdisziplinärer Forschung umso besser sind, je genauer man sich deren Grenzen vor Augen hält. Das Wissen um solche Grenzen dient nicht nur dem Schutz vor Dilettantismus, sondern auch der Konzentration auf die wirklich erfolgversprechenden Projekte – eben die mit den besten Perspektiven.

Understanding what students know: How Cognitive Science can inform Educational Decisions

Elsbeth Stern
ETH Zurich

It has been repeatedly shown that teachers' pedagogical content knowledge (PCK) has noticeable influence on students' learning gains. PCK is understood as the integration of content knowledge and knowledge about human learning and cognition, and it provides the basis for understanding learners' difficulties with particular content areas and reacting properly to them. PCK can be characterized as seeing the content through the eyes of the learners. Therefore, teachers need knowledge about human learning and cognition, such as it has been developed in Cognitive Science. Concepts like working-memory, reasoning, procedural and declarative knowledge or problem solving have to be made usable for teachers, whose university training predominantly focused on subject knowledge. At present, however, there is still a wide gap between what Cognitive Science and Psychology have ascertained about powerful learning environments, and how these findings do inform daily classroom practice. On the one hand, schools are still governed by traditions that are in conflict with well accepted principles of human learning and cognitive functioning. On the other hand, findings from research on learning and cognition hardly ever go along with clear practical implications, and therefore may be more confusing than helpful for teachers. An approach in teacher education that has as yet not met with much success has been to teach the concepts developed in Cognitive Science in isolation. Instead of being applied to school subjects, these concepts often have been trivialized by deriving oversimplified recipes. In more promising attempts of teacher education, the concepts developed in Cognitive Science are translated from the very beginning into a language of didactics and merged into Pedagogical Content Knowledge. In my talk I will evaluate these attempts.

Invited Symposia and Symposia

Social Cognition and Culture

Organisers: Albert Newen[1] and Kai Vogeley[2]

[1] Institut für Philosophie II, Ruhr-Universität Bochum
[2] Zentrum für Neurologie und Psychiatrie, Uniklinik Köln

Contributors: Shaun Gallagher, Shinobu Kitayama, Albert Newen, Kai Vogeley

The leading questions of the symposium are: How do we understand other human beings, what are the best theoretical perspectives, what can we learn from cognitive neuroscience and what is the role of culture in the process of understanding others? In the recent development of social cognition it has become clear that we not only have to account for the observational stance towards other people but that we also have to systematically consider situations of online interaction with other human beings (2nd person perspective). Furthermore, it will be reflected in which way self-understanding and understanding others interact. Finally, a strong focus of the symposium will be the discussion of the role of a cultural dimension for representations of oneself and of the other. The main aim of the symposium is to present the state of the art of some key topics of social and cultural cognition and to outline some paradigmatic lines for future research.

Introduction and Statement "Theories of social and cultural understanding"
Albert Newen

Diversity and Narrative in Social Cognition
Shaun Gallagher

Culture, Mind, and the Brain: Implications for Social Cognition
Shinobu Kitayama

A Statement: "The neuroscience of social and cultural cognition."
Kai Vogeley

Spatial Cognition – Foundations and Applications

Organiser: Christoph Hölscher
University of Freiburg
hoelsch@cognition.uni-freiburg.de

Contributors: Sven Eberhardt[1], Tobias Kluth[1], Thomas Reineking[2], Christoph Zetzsche[2], Kerstin Schill[2], Florian Röser[3], Antje Krumnack[3], Kai Hamburger[3], Markus Knauff[3], Thomas Wolbers[4], Christoph Schlieder[5]

[1]Universität Bremen
[2]SFB/TR8, Universität Bremen
[3]Justus Liebig University Gießen
[4]DZNE Magdeburg
[5]University of Bamberg

sven2@cognium.de
tkluth@math.uni-bremen.de
trking@tzi.de
{zetzsche, kschill}@informatik.uni-bremen.de
{Florian.Roeser, Antje.Krumnack, Kai.Hamburger, Markus.Knauff}@psychol.uni-giessen.de
thomas.wolbers@dzne.de
christoph.schlieder@uni-bamberg.de

This symposium brings together neuroscientific, psychological and computer science researchers whose common theme is the investigation of human spatial cognition. This session serves as a showcase of current trends in spatial cognition research in four German research groups. The talks illustrate the broad range of topics of basic and applied research, including the neural basis of place perception, empirical investigation of landmarks as well as age-related changes in wayfinding performance and representing place information in a digital recommender system.

Models for invariant place recognition

Sven Eberhardt, Tobias Kluth, Thomas Reineking, Christoph Zetzsche, and Kerstin Schill

The representation and interaction of humans with the spatial environment is essentially linked to the concept of place. The discovery of place cells (O'Keefe und Dostrovsky 1971) has connected the concept of 'being at a place' to a neural level, motivating the use of bio-inspired models for place detection. Though this task is related to the problem of object recognition, it differs in the specific invariance properties being required.

We used a setup for systematically investigating the rotational invariance and place selectivity of different place recognition methods. First, the method is applied to three different holistic representations: raw pixel values , wavelet-like histograms, texture descriptors, where a strong generalization performance is achieved. We also found some fundamental differences that limit the suitability of different image processing techniques for place recognition. Second, we show the applicability of hierarchical multi-layer systems for place detection.

Wayfinding: the influence of structural salience and visibility

Florian Röser, Antje Krumnack, Kai Hamburger, and Markus Knauff

Landmarks are essential for wayfinding and human orientation. But how can landmarks be defined? And what does the term "landmark salience" exactly mean? There exist three accepted aspects of landmark salience: visual, semantic, and structural. "Visibility" is another important aspect. Klippel and Winter (2005) used these saliences and defined a mathematical model for the connection and relation between them. We will present empirical evidence for the connection between visibility and structural salience.

Spatial navigation – a unique window into mechanisms of cognitive ageing

Thomas Wolbers

While research into cognitive ageing is a very active field, one key cognitive ability that is particularly relevant to everyday functioning has received very little attention: Surveys have shown that elderly people often report substantial declines in navigational abilities, for example problems with finding one's way in complex environments, planning

routes to distant locations and returning to the car after a trip to the supermarket. Such deficits severely restrict the mobility of elderly people and affect levels of (physical) activity and social participation, but the underlying behavioural and neuronal mechanisms are poorly understood.

In this talk, I will outline recent studies that have begun to elucidate age-related changes in navigational processing, using novel paradigms that target specific spatial computations. These studies not only demonstrate that key regions of the brain's spatial navigation network are particularly sensitive to the deleterious consequences of ageing, but they also offer novel insights into general mechanisms of brain ageing that also affect processes beyond the spatial domain.

Image-based Place Models for Geographic Recommendations

Christoph Schlieder

Classical recommender systems solve an information filtering task by suggesting data objects that are likely to be relevant to the user based upon her or his previous choices. A geographic recommender system recommends items from a library of geo-referenced objects. In multi-object recommendation, collections of items are suggested which should consist of somehow similar exemplars but, at the same time, must show variability. A geographic multi-object recommender suggests, for instance, a list of cities to visit or a slide show of images illustrating a certain place.

The talk presents the approach taken by our Tripost multi-object recommender for selecting a small set of geo-referenced images of a touristic location. Motivated by this research, we ask how different conceptualizations of a city can be identified in web-based image collections. In addition, the talk presents a recently collected data set of GPS tracks and geo-referenced photographs taken from visitors of the Old Town of Bamberg. Our data suggests that differences in the frequency of spatial choices need to be taken into account when building place models for recommender systems.

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Linguistic vs. Non-Linguistic Knowledge

Organisers: Barbara Kaup[1] and Claudia Maienborn[2]

[1] Psychologisches Institut, Universität Tübingen
barbara.kaup@uni-tuebingen.de
[2] Deutsches Seminar, Universität Tübingen
claudia.maienborn@uni-tuebingen.de

Contributors: Nicholas Asher[1], Christian Dobel[2], Holden Härtl[3], Maj-Britt Isberner[3], Barbara Kaup[4], Claudia Maienborn[4], Tobias Richter[3]

[1]CNRS Toulouse
[2]Universität Münster
[3]Universität Kassel
[4]Universität Tübingen
Nicholas.Asher@irit.fr,
cdobel@uni-muenster.de,
{holden.haertl, maj-britt.isberner,
tobias.richter}@uni-kassel.de,
{barbara.kaup, claudia.maienborn}@uni-tuebingen.de

For understanding language we may exploit a huge variety of rich knowledge resources: linguistic structure, contextual information, sensory-motor input, world knowledge, pragmatic strategies, etc. The question of whether there is a need for systematically distinguishing between linguistic and non-linguistic knowledge is of interest for both linguistics and cognitive psychology. Yet, until recently both sides tended to ignore this issue more or less. Theoretical linguists usually suppose tacitly that there is such a difference but then only take care of (what they assume to be) the linguistic meaning part. (A prominent exception is Asher's (2011) theory of lexical meaning in context.) In cognitive psychology the standard assumption is that word forms gain meaning by being connected to nodes in the conceptual system. However, the exact nature of this relationship is rarely discussed. With a few exceptions (e.g., Vigliocco & Vinson, 2007), most authors seem to assume that word meanings and concepts are identical.

This issue is particularly relevant because it points to the status of compositionality as a guiding principle for the formation of complex meanings. In a frequently cited study by Hagoort et al. (2004) the distinction between linguistic and non-linguistic knowledge has been challenged by experimental results. Hagoort et al. concluded that semantic and conceptual information is processed in one step, making obsolete the distinction, and challenging, furthermore, the idea of compositionality which proclaims the primacy of syntax as a combinatorial guideline. This controversial issue has been taken up more recently in several experimental studies (e.g., Pylkkänen et al. 2009). What can be learnt from these studies is above all, that we are strikingly missing a good understanding of what could count as methodically and empirically solid criteria to distinguish linguistic and non-linguistic knowledge. The symposium will provide an interdisciplinary platform for linguists and cognitive psychologists to discuss questions pertaining to the distinction of linguistic vs. non-linguistic knowledge.

Linguistic Structure Meets Natural Language Metaphysics

Nicholas Asher

In this talk I want to address the themes of the workshop from the perspective of someone who works in lexical semantics. I will argue that phenomena that are ubiquitous in the understanding of language pose problems for a strict Fodor-like separation between conceptual structure related to the non linguistic world and the sort of type system and composition logic needed to handle complex predications that involve coercion or the selection of an aspect of some type of object for predication.

On the Time Course of Semantic/Conceptual Processing – Insights from Neutral and Emotional Words

Christian Dobel

We found in a series of studies (e.g. Dobel et al., 2010) that the N400 can be taken as a general index for the difficulty of retrieving conceptual knowledge. In contrast, if the sentential context facilitates a visual representation, we also found earlier activity in regions of visual processing arguing for "embodied" semantic representation (Hirschfeld et al., 2010). Similarly, the processing of emotional words is characterized by enhanced activity already around 100 ms (Keuper et al., subm.) which

has been often interpreted as attentional effects. It seems, thus, that "meaningful" representations can be achieved by several means with different time course and neural correlates.

Pitfalls in the Language-Thought Distinction: a View on Studies of Linguistic Relativity

Holden Härtl

The distinction between linguistic and non-linguistic cognition is a logical prerequisite for the old Whorfian hypothesis that "thought", i.e. our perception of the world, is structured relative to "language". In my paper I will critically discuss a selection of current linguistic relativity studies and in how far they indeed access non-linguistic cognition and, in particular, if accusations of a circular reasoning in the interpretation of the observed effects may be justified. Here, the characteristics of the causal relations involved in cognitive differences between linguistic systems need to be carefully considered as well as the philosophically rooted notion of the unavoidability of language.

Is Comprehension Feasible Without Validation? Evidence from a Stroop-like Paradigm

Maj-Britt Isberner and Tobias Richter

Based on the distinction between semantic and world knowledge, comprehension and validation of linguistic information have often been conceptualized as separate stages in a two-step process, with validation being subsequent, optional and strategic. In contrast with this idea, we present evidence from a Stroop-like paradigm suggesting that validation is nonstrategic and fast by showing that readers cannot ignore violations of (easily accessible) world knowledge even if this is in conflict with their processing goal. These results indicate that both access to and evaluation based on world knowledge are obligatory components of language comprehension.

"Accumulating a coin" or "accumulating nuns": Processing Semantic vs. Conceptual Violations

Barbara Kaup and Claudia Maienborn

The talk is concerned with the distinction between semantic and conceptual knowledge. In a first experiment the final word of a sentence (e.g., sour) was processed more slowly when it brought about a semantic compared to a conceptual violation (These clocks were sour vs. These

bananas were sour.). However, similar differences were observed when the respective word pairs (e.g., clocks— sour vs. bananas – sour) were presented in a word priming experiment, suggesting that the results may reflect differences in lexical associations instead of differences in the type of knowledge that is being violated. In our talk we will discuss several alternative ways to empirically investigate the distinction between semantic and conceptual knowledge.

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Kognitive Modelle der Fehlerverarbeitung

Organisator: Marco Steinhauser
Katholische Universität Eichstätt-Ingolstadt

Contributors: Claudia Danielmeier[1], Nicola K. Ferdinand[2], Hans-Jochen Heinze[3], Marcus Heldmann[3,4], Thomas Münte[4], Marco Steinhauser[5], Markus Ullsperger[1], Nick Yeung[6]

[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University
[2]FR Psychologie, Universität des Saarlandes
[3]Campus Lübeck, Klinik für Neurologie, Universitätsklinikum Schleswig-Holstein
[4]Universitätsklinik für Neurologie, Magdeburg
[5]Katholische Universität Eichstätt-Ingolstadt
[6]University of Oxford

Optimales Verhalten erfordert, dass Fehler im eigenen Verhalten erkannt und aus diesen gelernt wird. In den letzten Jahren sind hierzu eine Reihe theoretischer Vorstellungen entwickelt worden, die mit unterschiedlichen neuro- und kognitionswissenschaftlichen Methoden getestet wurden. Das Symposium stellt verschiedene theoretische und methodische Ansätze aus diesem Forschungsbereich vor.

Lernen aus positivem und negativem Feedback: Die Rolle von Erwartungsverletzungen

Nicola K. Ferdinand

Wir scheinen vor allem aus solchen Ereignissen zu lernen, die unsere Erwartungen verletzen. Die Verarbeitung solcher Erwartungsverletzungen lässt sich besonders gut mit Hilfe ereigniskorrelierter Potentiale, beispielsweise anhand der sog. „feedback-related negativity“ (FRN), untersuchen. In den meisten Paradigmen liegt dabei der Fokus auf der Untersuchung von negativem Feedback und es wird allgemein angenommen, dass die FRN auftritt, wenn ein Ereignis „schlechter als erwartet“ ist. Das Ziel unserer Studie war es, ein Paradigma zu entwickeln mit dem auch positive Erwartungsverletzungen untersuchbar sind. Zu diesem Zweck haben wir eine Zeitschätzaufgabe entwickelt, in der das

Feedback in Abhängigkeit der Performanz der Probanden unerwartet positiv, unerwartet negativ oder erwartet (neutral) sein konnte. Um die Auftretenswahrscheinlichkeit von positivem und negativem Feedback gering und somit unerwartet zu halten, wurde ein adaptiver Mechanismus verwendet, der das Feedback an die Leistung der Probanden anpasste. Die Ergebnisse zeigen, dass eine FRN nicht nur im Falle von unerwartetem negativen Feedback auftritt, sondern auch bei unerwartetem positiven Feedback. Dieser Befund spricht dafür, dass die Erwartungsverletzung, nicht aber die negative Valenz des Feedbacks, kritisch für die Generierung der FRN und somit für Verhaltensanpassung und Lernen ist.

Ereigniskorrelierte lokale Feldpotentiale des Nucleus Accumbens bei Handlungskontrolle

Marcus Heldmann, Hans-Jochen Heinze und Thomas Münte

Die erfolgreiche Anpassung eigenen Verhaltens an sich ständig ändernde Umweltbedingungen wird als Ausdruck erfolgreicher Handlungskontrolle erachtet. Holroyd & Coles (2002) postulieren in ihrem reinforcement learning Modell eine zentrale Bedeutung des mesolimbische dopaminerge Belohnungssystem für diesen Teilbereich der exekutiven Funktion. Bei psychiatrischen Störungsbildern, insbesondere Zwangsstörungen oder Substanzabhängigkeiten, die u.a. durch eine gestörte Handlungskontrolle charakterisiert sind, nimmt man entsprechend eine veränderte Funktionalität des mesolimbischen dopaminergen Belohnungssystems an. Eine Möglichkeit bei der Behandlung schwerer therapierefraktärer Zwangsstörungen und Substanzabhängigkeiten stellt die Tiefe Hirnstimulation dar. Dabei ist der Nucleus accumbens als Teil des mesolimbischen dopaminergen Belohnungssystems Zielstruktur der Tiefen Hirnstimulation, wodurch man nicht nur die Möglichkeit erhält, durch Stimulation auf diese für die Handlungskontrolle wichtige anatomische Struktur unmittelbar Einfluss zu nehmen, sondern ebenso ereigniskorrelierte lokale Feldpotentiale abzuleiten und die elektrophysiologischen Korrelate der Handlungskontrolle mit einer ausgezeichneten räumlichen und zeitlichen Auflösung darzustellen. In einer Serie von Einzelfalluntersuchungen haben wir uns dabei an zwei ereigniskorrelierten Komponenten von Oberflächenpotentialen orientiert, der error related negativity (ERN) und der feedback related negativity (FRN). Mit der Untersuchung dieser beiden Komponenten können wir einen Bei-

trag zur Bedeutung des Nucleus accumbens bzw. des ventrale Striatum für die Handlungskontrolle liefern.

Die Rolle des posterioren frontomedianen Cortex bei adaptiven Prozessen in visuellen und motorischen Arealen

Claudia Danielmeier und Markus Ullsperger

Wenn wir einen Fehler machen, ist es wichtig, dass unser Verhalten und relevante Prozesse im Gehirn möglichst schnell angepasst werden, um weitere Fehler zu vermeiden und unser Handlungsziel zu erreichen. Der posteriore frontomediane Cortex (pMFC) spielt eine wesentliche Rolle bei Prozessen der Handlungsüberwachung. Es wurde spekuliert, dass die Aufgabe des pMFC darin besteht, notwendige neuronale Anpassungen zu signalisieren. Ich werde Daten vorstellen, die zeigen, dass aus der Aktivität des pMFC die Anpassungen nach Fehlern in visuellen und motorischen Hirnarealen vorhergesagt werden können. Nach Fehlern werden üblicherweise verlängerte Reaktionszeiten beobachtet (post-error slowing, PES), die möglicherweise hilfreich sind, um Anpassungsprozesse zu implementieren. Mit Hilfe der funktionellen MRT und diffusions-gewichteter Bildgebung konnten wir zeigen, dass a) fehlerbezogene pMFC-Aktivität Aktivitätsänderungen im motorischen Cortex vorhersagt, die mit PES in Zusammenhang steht, und b) PES strukturell mit Verbindungen in der weißen Substanz assoziiert ist, die ein Netzwerk bilden, dass funktionell der motorischen Inhibition dient. Darüber hinaus gibt es attentionale Anpassungen nach Fehlern, die sich in aufgaben-relevanten und aufgaben-irrelevanten visuellen Arealen unterschiedlich auswirken, und die ebenfalls mit der vorangehenden pMFC-Aktivität in Verbindung stehen. In einer Folgestudie wurde die Rolle von Acetylcholin bei diesen attentionalen Anpassungen untersucht.

Mechanismen der bewussten Fehlerdetektion

Marco Steinhauser und Nick Yeung

Eigene Fehler in einfachen Klassifikationsaufgaben können meist zuverlässig detektiert und angezeigt werden. Während Prozesse der Fehlerverarbeitung bereits unmittelbar nach Auftreten eines Fehlers nachweisbar sind, scheint die bewusste Fehlerverarbeitung erst deutlich später einzutreten. So konnte durch eine Reihe von Studien gezeigt werden, dass vor allem die Amplitude der späten Fehlerpositivierung (Pe) in er-

eigniskorrelierten Potenzialen zwischen detektierten und nicht-detektierten Fehlern differenziert. In diesem Vortrag soll die Frage diskutiert werden, wie bewusste Fehlerdetektion zustande kommt und was bewusste Fehlerverarbeitung von unbewusster Fehlerverarbeitung unterscheidet. Hierzu werden zum einen experimentelle Studien dargestellt, in denen der Zusammenhang bestimmter ereigniskorrelierter Potenziale mit der bewussten Fehlerdetektion untersucht wurde. Zum anderen wird ein konnektionistisches Modell der bewussten Fehlerdetektion diskutiert, welches bewusste Fehlerdetektion als Konsequenz selbstkorrigierenden Verhaltens postuliert. Die Ergebnisse dieser Studien deuten darauf hin, dass der bewussten Fehlerdetektion Entscheidungsprozesse zugrunde liegen, die eine große Ähnlichkeit mit primären Aufgabenprozessen aufweisen.

Modeling Cognition in Communication

Organisers: Stefan Kopp and Kirsten Bergmann

Center of Excellence "Cognitive Interaction Technology" (CITEC), SFB 673
Alignment in Communication, Bielefeld University
{skopp, kbergman}@techfak.uni-bielefeld.de

Contributors: Jan de Ruiter[1], Vera Demberg[2], Kirsten Bergmann[3], Hendrik Buschmeier[4]

[1]Dept. of Linguistics, Bielefeld University
[2]Center of Excellence on "Multimodal Computing and Interaction", University Saarbrücken
[3]SFB 673, Bielefeld University
[4]CITEC, Bielefeld University

jan.deruiter@uni-bielefeld.de,
vera@coli.uni-saarland.de,
kirsten.bergmann@uni-bielefeld.de,
hbuschme@techfak.uni-bielefeld.de

Modeling cognitive processing has become a vital branch of Cognitive Science. General purpose architectures, like SOAR, ACT/R, CLARION, etc., provide us with means of simulating cognitive tasks based

on principles of human-like memory, activation, control, or distributed processing. Bayesian models allow for modeling cognitive phenomena while considering incompleteness and uncertainty of data as a ubiquitous constraint. Such methods have been successfully employed to model and understand tasks like categorization, language processing, arithmetics or car-driving. Modeling the complex cognitive processes underlying communication and social interaction, however, still poses open challenges and has been investigated only rudimentarily. At the same time, there is a growing awareness that cognitively plausible (or at least inspired) models and algorithms can help to build better autonomous technical systems. Yet, they are relatively underrated in the design of interactive systems that model human-like communication with natural language, nonverbal behavior, or dialogue. This symposium aims to further the development and the convergence of these two branches of Cognitive Science: (1) the use of techniques from cognitive modeling to study what the human mind is doing in interactive settings; (2) the use of cognitively oriented approaches to model communicative abilities for technical systems. Four presentations by researchers in different fields will emphasize the role of cognitive models in modeling communication from different perspectives:

Modelling Prediction in Language Processing
Vera Demberg

Recent psycholinguistic evidence indicates that humans do not only process language incrementally but also anticipate upcoming input. Anticipation of input or events is not only restricted to language processing but evident from other aspects of cognition as well, and can be thought of as a process that helps humans deal with partial or noisy information. A cognitively plausible model of language processing should therefore also have an explicit prediction mechanism. I will briefly present PLTAG, a grammar formalism which allows us to model incremental predictive processing as well as a linking theory which links the parsing process to processing difficulty.

The Production of Co-speech Iconic Gestures
Kirsten Bergmann

In this talk a comprehensive computational simulation model for the production of co-speech iconic gestures in virtual agents will be pre-

sented. Based on empirical insights from a corpus analysis, we employ Bayesian decision networks which combine data-driven machine learning techniques with rule-based decision making. This enables us to account for both commonalities as well as inter-individual differences in how meaning is mapped onto gesture form. Evaluation studies have shown that this approach allows to successfully approximate human use of iconic gestures, and moreover, when brought to application in a virtual agent, the generated gestural behavior was found to be positively rated by human recipients.

Adapting to Addressee Feedback on the Basis of Attributed Mental States

Hendrik Buschmeier

Speakers design their utterances with their addressees' general needs in mind and respond to communicative listener feedback by adapting their language to more specific aspects. In this talk I will (1) present a speaker-centric, cognitive model that enables probabilistic reasoning about an addressee's mental state of listening on the basis of her feedback signals and (2) discuss how this 'attributed listener state' can inform a speaker's decisions of whether and how to adapt his subsequent communicative actions to accommodate the addressee.

The AIRBUS Model: A Bayesian Model for Intention Recognition in Communication

Jan de Ruiter

The rapid and fluent nature of human communicative interactions strongly suggests the existence of an online mechanism for intention recognition. In this talk, I propose a new mathematical model that addresses these requirements. Our model provides a way of integrating knowledge about both directions of the relationship between linguistic expressions and communicative intentions, through a rapid process of Bayesian update. It enables us to generate new predictions about the process of intention recognition during (explicit) communication. Moreover, by equipping this model with entropy related distance measures, we can also predict under which circumstances utterance planning can start before the preceding utterance is completed, and when repair must be initiated to resolve "misalignment". I will sketch an example of this

model in operation in an existing robot platform, and discuss its implications for a broader theory of communication.

The Cultural Constitution of Causal Cognition:
Cross-disciplinary perspectives from the ZiF Research Group

Organisers: Andrea Bender and Sieghard Beller
Center for Interdisciplinary Research ZiF, Bielefeld University

Contributors: Sieghard Beller[1,2], Andrea Bender[1,2], Sibylle Duda[1,3], York Hagmayer[1,4], Anita Schroven[1,2], Keith Stenning[1,5,6], Heike Wiese[1,3]
[1]Center for Interdisciplinary Research ZiF, Bielefeld University
[2]University of Freiburg
[3]University of Potsdam
[4]King's College London
[5]University of Edinburgh
[6]University of Gieen

Causality is one of the core concepts in our attempts to make sense of the world, and this renders causal cognition a core topic for the social as well as the cognitive sciences. In the past, however, respective research has been split into diverging paradigms, each pertaining to a distinct (sub)discipline and focusing on specific domains, thus creating a rather fragmented picture of causal cognition. Furthermore, most of this previous research paid only incidental attention to culture as a constitutive factor. Yet, cultural variation can be expected with respect to the delineation of domains, the concepts referred to, the mechanisms of processing, and even the willingness to search for causal explanations in the first place (e.g., Bang et al., 2007; Bender & Beller, 2011; Legare & Gelman, 2008). A systematic and thorough investigation into the cultural constitution of causal cognition is thus overdue.

The current ZiF Research Group on "The cultural constitution of causal cognition: Re-integrating anthropology into the cognitive sciences" (funded by the Center for Interdisciplinary Research at Bielefeld University)

intends to take on the challenge. In this symposium, fellows of the research group with backgrounds in anthropology, linguistics, psychology and philosophy present their perspective on causal cognition and its cultural constitution, and try to establish connections across disciplines and paradigms.

How Universal is Causal Cognition? And How Can we Know?

Andrea Bender, Sieghard Beller, and Anita Schroven

This talk briefly introduces the ZiF Research Group and its agenda. It provides an overview on cultural variability in causal cognition, on conceptual and methodological aspects in approaching respective questions, and on the strategies developed by the Research Group to tackle them. In doing so, it will also elaborate on what can be learned from anthropological contributions.

Weighing up Physical Causes in Germany and Tonga: Effects of Presentation and Answer Mode

Sieghard Beller and Andrea Bender

When people determine which of the entities involved in a physical interaction is responsible for its outcome, they weigh the entities differently even if the interaction is symmetric. This effect depends on various factors and also varies cross-culturally (Beller et al., 2009; Bender & Beller, 2011). However, our results differ from previous research. In a replication study with participants from Germany and Tonga we investigate whether this is due to differences in the presentation of stimuli (visual vs. verbal) or to differences in answer mode (explanations vs. ratings of responsibility), and we test hypotheses on which cultural and/or linguistic factors may account for the cultural differences.

Complex Causal Relations Without Overt Linguistic Expression: the Case of Sonst ('else/otherwise')

Heike Wiese and Sibylle Duda

In naturally occurring discourse, causal relations are often not expressed explicitly but have to be retrieved from asyndectic clausal chains, such as "I like him. He is such a friendly person." An interesting case in point are instances like "Don't open. Alarm will ring.", where a complex causal connection for an 'otherwise' condition, usually epistemically mediated, is left unexpressed – even though it is crucial for the preferred interpretation – thus making the literal interpretation infelici-

tous. Such patterns pose an interesting challenge for models of semantic composition and the interface between grammar and causal cognition. We discuss a German construction from this domain that involves a clause-initial particle sonst ('else/otherwise'), using data from a corpus of spontaneous speech in adolescent peer-groups (Wiese et al., 2012).

How Causal Models of Mind and Behavior Shape Causal Models of Mental Illnesses

York Hagmayer

The literature is full of causal models of mental illnesses, some of which describe folk-theories of lay-people. These models are seemingly constrained by general framework models of mental illness, which in turn are based on how people assume causal relations connecting mind and behavior. Developmental studies indicate that some of these assumptions may be universal, whereas cross-cultural studies report substantial differences. This talk explicates how causal models of mind and behavior constrain framework theories of mental illness by specifying normal and abnormal mental states and behaviors. Such fundamental differences in causal models about mind and behavior are one reason for why cross-cultural differences in mental illnesses are difficult to capture by standard diagnostic manuals.

Causality and Discourse: How do we Talk Ourselves into the Causal Models that we Use?

Keith Stenning

Halpern and Pearl (2005) propose the "structural model" approach to causality which makes a distinction between the causal systems in the "real world" and the highly abstracted structured models which we employ in assigning causes in context. On this view, it is possible to arrive at two quite different causal attributions about the same event by reasoning from two perfectly reasonable different structured models of the context. This talk will explore implications for causal cognition of the separation of "actual causation" from structural models. It will argue that this separation makes the interpretative component of establishing structural models an essential part of causal cognition, and that this makes defeasible logical models preferable to probability based ones.

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Clinical Applications of Cognitive Science

Organiser: Wolfgang Trapp

SozialStiftung Bamberg

Contributors: Michael Landgrebe, Robert Meyrer, Matthias Weinberger, Christoph Ziegelmayer

SozialStiftung Bamberg

Mental Relief by Electromagnetic Stimulation – can rTMS Cure Depression?

Michael Landgrebe

Repetitive transcranial magnetic stimulation (rTMS) is a modern, non-invasive neurostimulation and neuromodulation technique, based on the principle of electromagnetic induction of an electric field in the brain. Originally, rTMS has been developed as a diagnostic tool in neurological disorders. After the discovery, that depending on the stimulus frequency, long-lasting modulation of neuronal activity can be induced, the therapeutic potential of rTMS has been investigated in various neuropsychiatric conditions (e.g. depression, schizophrenia, hallucinations, chronic tinnitus). Low-frequency rTMS (i.e. 1 Hz or below) leads to a

reduction while high-frequency stimulation (i.e. 1 Hz or more, usually 10–20 Hz) increases neuronal activity in the directly stimulated cortical areas as well as in transneuronally connected regions. First clinical studies of rTMS in the treatment of depression have been performed more than 15 years ago. Since that, numerous studies point to a therapeutic potential of rTMS in depression.

A Creeping Mental Breakdown – Why Dementia is Still a Big Therapeutic Challenge

Robert Meyrer

Due to demographic developments in Germany the number of patients suffering from Alzheimer's disease is expected to double by 2050. Alzheimer's disease and other dementias represent an increasing clinical challenge. They are associated with substantial economic costs and burden to health services. Therefore, early detection of possible precursors of dementia, early diagnosis and management of dementia and its prodromal stages become increasingly important.

The effectiveness of presently approved specific antidementive drugs for symptomatic treatment of Alzheimer's disease is still not satisfactory. Existing medical treatments slow the progression of symptoms of the disease, but their efficacy does not extend to all patients and is not sustained beyond an average of 6 months. Despite a number of promising rationales for therapeutic treatments in Alzheimer's disease, very few of these have been developed beyond preclinical studies. Still there is a distinct lack of novel approaches or new disease modifying therapies for Alzheimer's disease.

The question arises whether the treatment of modifiable risk factors, comorbid somatic diseases or cognition-based nonpharmacologic training may constitute an effective intervention in Alzheimer's disease and its prodromal stages.

Molding the Virtual Body – How Induced Illusions can Help Patients Suffering from Chronic Pain

Matthias Weinberger

In the last few decades we have learned that pain is more than just a result of tissue damage: Exiting insights have emerged leading to theories that integrate pain perception and behavior into more complex frameworks. Imaging studies have found multiple brain regions that

are activated during subjective experience of pain and thus matching its complex sensory, emotional and cognitive aspects.

Mirror therapy is a very recent therapeutic strategy that creates the illusion of intact and pain-free movement of either amputated or painful body parts mainly by mirrored visual feedback. This approach leads to a dramatic reduction of pain in many cases where conventional treatment has proven either ineffective or only slightly effective. An underlying assumption is that the patients' mental model of their own body (their so called virtual body) is distorted and because of this, creating the illusion of an intact virtual body acts on brain areas responsible for their experience of pain.

After a short historical outline covering "milestones" of mirror therapy treatment, results of an own study applying mirror therapy to 30 patients suffering from chronic low back pain are presented.

Cognitive Remediation is Fun! Effects of Game-like Cognitive Training Interventions for Psychiatric Patients

Wolfgang Trapp

Dysfunction of attention, memory and problem solving is considered as a key symptom in many mental diseases. These deficits tend to persist even after conventional treatment and limit social and vocational functioning. Hence it makes sense to administer cognitive training to positively influence patients' further course of illness. However, controlled efficacy studies of cognitive training in patients (mainly suffering from schizophrenia) have remained inconclusive hitherto: While some report significant effects mainly on working memory and executive function, minor or no effects could be found in other studies. Results of several controlled studies using training software that was designed very "game-like" and motivating are presented. Positive effects - mainly on executive function and working as well as episodic memory - could be found throughout for several patient groups und training settings. Even effects on the long term course of illness could be demonstrated. Finally an outlook is given, how future approaches in cognitive remediation could utilize mobile device's "multi-player features" and thus bring cognitive training from psychiatric wards into patients' everyday life.

Pressing the Brain's Reset Button – is Electroconvulsive Therapy Still an Option?

Christoph Ziegelmayer

Die Methode, über durch elektrische Stimulation ausgelöste Krampfanfälle eine Linderung bei psychischen Störungen zu erreichen (Elektrokonvulsionstherapie, EKT) ist bereits relativ alt. Im Zuge der Einführung der Psychopharmaka in den 50er Jahren und aufgrund negativer Darstellung in den Medien ist ihre Anwendung zwischenzeitlich deutlich zurückgegangen. Seit intensiven wissenschaftlichen Untersuchungen in den 80er Jahren und der Anerkennung des wissenschaftlichen Beirates der Bundesärztekammer 2003 hat die EKT bei der Therapie affektiver und schizophrener Erkrankungen an Bedeutung deutlich gewonnen. Ihre Wirksamkeit ist inzwischen eindrucksvoll empirisch belegt. Der Beitrag enthält Informationen über Indikationen und Kontraindikationen der EKT sowie Risiken und Nebenwirkungen dieser Behandlungsform. Ergebnisse zu kurz und langfristigen Effekten auf die kognitive Leistungsfähigkeit und zur therapeutischen Wirksamkeit anhand einschlägiger Metaanalysen sowie anhand von Daten aus der Behandlung von Patienten in der Klinik für Psychiatrie, Psychotherapie und Psychosomatik der Sozialstiftung Bamberg werden dargestellt.

Cognitive Aspects of Human-Technology Interaction

Organiser: Manfred Thüring

Technische Universität Berlin

Contributors: Martin Baumann[1], Stefan Brandenburg[2], Uwe Drewitz[1], Thomas Franke[3], Maik Friedrich[1], Astrid Kassner[1], Josef Krems[3], Michael Minge[2], Nele Rußwinkel[2], Marlene Vogel[2], Dieter Wallach[4]

[1]Deutsches Zentrum für Luft- und Raumfahrt
[2]Technische Universität Berlin
[3]Technische Universität Chemnitz
[4]FH Kaiserslautern

Technology has become an integral part of everyday life. It is present in our homes, it is part of our working places, we use it to travel, and when we are on the move we are equipped with mobile devices that support us in many ways. Cognition plays a major role when we learn how to operate a technical system, when we try to understand its functionality and when we finally employ it. Obviously, human-technology interaction (HTI) offers a wide range of fascinating research opportunities for cognitive science. At the same time, it poses a number of serious challenges.

To begin with, most technical systems are complex by nature and so are the cognitive processes that are involved when we try to master such a system. This constellation is highly demanding for theories that intend to capture the cognitive aspects of human-technology interaction. Due to the large variety of cognitive aspects involved, HTI may prove as an ideal test bed for theories that reach beyond the explanation of isolated phenomena. In the future, research in this field may therefore contribute to fulfill the requirements of a "unified theory of cognition" as called for by Alan Newell in 1990.

Introduction
Manfred Thüring

Investigating the Emergence of User Experience
Stefan Brandenburg and Uwe Drewitz

Zeitabhängige Entscheidungsfindung im Fluglotsenkontext
Nele Rußwinkel and Maik Friedrich

Temporal Aspects of User Experience
Manfred Thüring, Marlene Vogel, and Michael Minge

Driving and Situation Awareness: a Cognitive Model of Memory-Update Processes
Josef Krems, Thomas Franke, and Martin Baumann

Der Einfluss des Automationsgrads auf die Situationsrepräsentation des Fahrers: Ein Experiment zur Reaktionszeit des Fahrers in Übernahmesituationen
Martin Baumann and Astrid Kassner

Human-Computer Interaction: Lessons in Applied Cognitive Science
Dieter Wallach

Multimodal Interaction

Organiser: Christopher Habel

International Research Training Group ("Graduiertenkolleg", IRTG) 1247
"Cross-modal Interaction in Natural and Artificial Cognitive Systems"
(CINACS), Department of Informatics, Universität Hamburg
habel@informatik.uni-hamburg.de

Contributors: Christopher Habel[1], Kai Hamburger[2], Barbara Kaup[3], Stefan Kopp[4], Florian Röser[2], Junlei Yu[1]

Phenomena of multimodal interaction can be investigated and discussed on a variety of layers, namely, (1) the representational layer, e.g. language – graphics, taking into consideration sub-layers, e.g. "speech" – "language in written form", and (2) the perceptual layer, in particular, the layers concerning the sensor channels of vision, audition, and haptics.

Multimodality in the Wild – Speech and Gesture in Human Communication

Stefan Kopp

Multimodal behavior is ubiquitous in human communication. One striking example is speech and co-verbal gesture which are produced spontaneously, especially when communicating spatial information. Both modalities are known to be coordinated in a number of ways, e.g., with respect to temporal, semantic or pragmatic aspects (McNeill 2005), but the underlying coordination principles and cognitive processes are still largely unknown. I will present findings from ongoing empirical as well as computational work on how humans coordinate concomitant speech and gesture with each other in spatial direction-giving dialogues. Results suggest that the multimodal coordination does not follow universal principles but underlies both communicative and cognitive constraints that arise dynamically in an interactive context.

The Role of Sensorimotor Representations for Language Comprehension

Barbara Kaup

In language comprehension research many authors nowadays assume that sensori-motor representations play an important role for language comprehension: Comprehenders are assumed to mentally simulate the experience of the referent situation during text processing (e.g., Zwaan, 2004). Research has until now focused mainly on providing evidence that linguistic and non-linguistic cognition interact. Relatively little attention has been devoted to the exact processes by which meaning is being composed at the sentence level. In my talk I will report about an ongoing research project devoted to investigating this issue. I will discuss several different possibilities with respect to the role that sensory-motor processes and representations play during language comprehension.

Modality Switching Costs – Evidence from Human Wayfinding

Kai Hamburger and Florian Röser

How much does it cost to switch between modalities when processing landmark information for wayfinding? Recognition and wayfinding tasks in our virtual environment SQUARELAND (Hamburger & Knauff, 2011) revealed no evidence for modality switching costs (lower performance, increased decision times). For example, learning visual landmarks and retrieving them visually was as effective as learning visual landmarks but retrieving them in the acoustic domain. This was tested for visual, verbal, and acoustic material. Results challenge the assumption of switching costs in wayfinding. The human brain seems to integrate relevant information in different modalities at the time of exposure (learning) so that no additional costs occur at information retrieval.

Verbally Assisted Exploration of Virtual-tactile Graphical Representations

Christopher Habel and Junlei Yu

External representations that are based on graphical elements constituting meaning by use of their spatial properties and spatial relations among them are effective means in communication and collaboration (cf. Kosslyn 1989, Habel & Acartürk 2007). For visually impaired people appropriate substitutions of such graphical representations are re-

quired. Haptic interfaces for human-computer interaction offer a large variety of prospects for training and assisting blind people. To overcome deficits in haptic exploration, providing additional information, such as auditory assistance through the auditory channel, has been proved to be helpful. The tasks of providing conceptual information to the user can be distributed between different modalities based on principles of "division of labor" (DoL) (Habel & Acartürk, 2007). We exemplify this in a floor-plan exploration-task: the provided content is distributed between the haptic and the auditory modality, and additionally, in the auditory layer between speech and non-speech audio, based on systematic DoL-principles.

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Satellite Symposium

Das Nationale Bildungspanel (NEPS): Anlage, Funktion und Messung von Kompetenzen

Organisatoren: Jutta von Maurice, Cordula Artelt und Sabine Weinert

Universität Bamberg

{jutta.von-maurice, cordula.artelt, sabine.weinert}@uni-bamberg.de

Teilnehmer: Jutta von Maurice[1], Sabine Weinert[1], Claus H. Carstensen[1], Cordula Artelt[1], Marion Händel[2], Stefan Zimmermann[1], Karin Gehrer[1], Anna Südkamp[1], Kathrin Lockl[1], Annika Langmann[1], Kristin Hecker[1], Hans-Peter Blossfeld[1], Elsbeth Stern[3]

Ziel des Nationalen Bildungspanels (NEPS) ist es, qualitativ hochwertige und nutzerfreundlich aufbereitete Daten zu den relevanten Bildungsprozessen und zur Kompetenzentwicklung von früher Kindheit bis ins hohe Erwachsenenalter zur Verfügung zu stellen. Im Rahmen eines Multi-Kohorten-Sequenz-Designs wurden in den Jahren 2009 bis 2012 sechs repräsentative Startstichproben mit insgesamt etwa 60.000 Personen gezogen; alle Teilnehmerinnen und Teilnehmer werden auf ihren individuellen Lebenswegen begleitet und regelmäßig werden Daten zu Kompetenzen, zu jeweils relevanten Lernumwelten, Bildungsentscheidungen und Bildungsrenditen erhoben. Die Entfaltung sozialer Ungleichheit und die besondere Situation von Personen mit Migrationshintergrund werden dabei beleuchtet.

Das Symposium gibt zunächst einen Überblick über die thematischen Schwerpunkte, die methodische Anlage und das Datenangebot des NEPS (von Maurice/Blossfeld). Der weitere Fokus des Symposiums liegt auf der Darstellung und Begründung der Auswahl und Konzeption der im Rahmen des NEPS erfassten Kompetenzen. Im Beitrag von Artelt u.a. wird ein Überblick über die gemessenen Kompetenzen gegeben. Diese reichen von domänenspezifischen kognitiven Kompetenzen (z.B.

Sprachkompetenzen, Mathematik) über allgemeine kognitive Grundfähigkeiten bis hin zu Metakompetenzen (z.B. ICT Literacy, Metakognition) und sozialer Kompetenz. Drei der erfassten Fähigkeiten – Hörverstehen, Lesekompetenz und Metakognition – werden in einzelnen Beiträgen genauer dargestellt.

Im Beitrag von Südkamp u.a. wird das Konstrukt des Hörverstehens auf Diskursebene (in der Mehrheitssprache Deutsch), so wie es im NEPS operationalisiert wird, dargestellt und begründet. Hörverstehen auf der Diskursebene wird definiert als die Fähigkeit, längere und kürzere Abschnitte realistischer, gesprochener Sprache automatisiert und in Echtzeit zu verarbeiten und die hierin enthaltenen Informationen bei der Beantwortung von Fragen zu nutzen.

Der Beitrag von Händel u.a. beschäftigt sich mit den Herausforderungen der Messung metakognitiven Wissens in verschiedenen Altersstufen und verdeutlicht, wie das Ziel der validen Erfassung des deklarativen Aspekts von Metakognition im NEPS über verschiedene Altersgruppen (Grundschulalter bis Erwachsenenalter) und damit einhergehend variierenden Fertigkeiten und Fähigkeiten als lebensweltlich relevantes Konstrukt umgesetzt wird. Dargestellt wird u.a., wie sich die gewählte Operationalisierung im Rahmen von Pilotstudien (hier speziell bei Grundschülerinnen und -schülern) bewährt hat.

Schließlich wird im Beitrag von Zimmermann u.a. eine Gegenüberstellung der kognitiven Anforderungen von Leseverstehensaufgaben aus Kompetenzstufenmodellen verschiedener Studien vorgenommen, und mit den Verstehensanforderungen aus den NEPS Tests zur Messung von Lesekompetenz verglichen und die Implikationen bzgl. der Vergleichbarkeit bewertet. Abschließend diskutiert Elsbeth Stern die vorgestellten Beiträge.

Beiträge

1. Das Nationale Bildungspanel (NEPS): Thematische Schwerpunkte, methodische Anlage und Datenangebot
   Jutta von Maurice und Hans-Peter Blossfeld

2. Die Messung von Kompetenzen im Rahmen des NEPS
   Cordula Artelt, Sabine Weinert und Claus H. Carstensen

3. Entwicklung von Aufgaben zur Erfassung von Hörverstehen auf Diskursebene
   Anna Südkamp, Anika Langmann und Kristin Hecker

4. Herausforderungen bei der Erfassung metakognitiven Wissens in verschiedenen Altersstufen
   Marion Händel, Kathrin Lockl, Sabine Weinert und Cordula Artelt

5. Kognitive Anforderungen von Leseverstehensaufgaben auf den unteren Kompetenzstufen in IALS und PISA: Implikationen für die Messung von Lesekompetenz im NEPS
   Stefan Zimmermann, Karin Gehrer und Cordula Artelt

6. Diskussion
   Elsbeth Stern

Doctoral Symposium

organised by Stefan Kopp

Technical Agency – A Minimal Theory of Mind

Holger Lyre and Gerhard Chr. Bukow
Department of Philosophy, University of Magdeburg

Our DFG-funded project (and my PhD-project) deals with the foundations of realistic non-ideal agents and the minimal components such agents must have to have a capacity for Theory of Mind. First, it works on the interface of philosophy and cognitive psychology and links Theory of Mind to the human capacity to "thought-follow" the structural change of belief systems. Second, it bases on the cooperation with the Leibniz Institute for Neurobiology and develops Theory of Mind-concepts in the realm of man-machine-interface. The project's aim is to give a theory about the connections between agents, rationality and Theory of Mind and to give advice for its practical usage.

Our main motivation is that in the philosophical theory of agency, agents are mostly thought to have an idealized form of rationality – and this background constrains models of agents handled in Theory of Mind-research. But, it is dubious how such models should be able to capture the essentials of realistic agents – not just in case of limits of computational power, but with respect to properties of the cognitive machinery, change of belief system, inconsistency, or different levels of rationality. In the first part of the project, we investigated in the hypothesis that the capacity to follow the change (e.g. revision) of belief systems is strongly connected to Theory of Mind – not just the attribution of just singular beliefs. We used experiments in spatial cognition and mental model theory as a case study to ground what it does mean for a realistic agent to be able to follow another agent's variation of mental models and how to think of minimality in cognitively informed way.

In the second part of the project, now, we are concerned with the handling of inconsistency by a Theory of Mind-agent, e.g. the capacity to understand inconsistent belief systems and to be able to follow their changes. We argue that inconsistency is an essential part of every realistically based Theory of Mind-agent. But what does it mean to follow rationally inconsistent belief systems? In the next two years, we investigate in 1) how different levels of rationality influence Theory of Mind-capacities, 2) the entanglement of psychology and ontology of agents

(e.g. in consistency), and 3) how to transfer insights about Theory of Mind, change and inconsistency to man-machine-interaction.

Reading Comprehension and Mental Models

Regina E. Fabry
Johannes Gutenberg University of Mainz

The purpose of my PhD project is to develop an interdisciplinary framework in order to specify the necessary and sufficient conditions for reading comprehension. The target phenomenon has been investigated by various researchers in cognitive science. However, a unifying account of the various results and implications is still lacking. Furthermore, a satisfying description of reading comprehension has to be accompanied by a thorough metatheorical discussion. This philosophically motivated approach aims at evaluating the plausibility, significance and conceptual coherence of empirically developed insights and theories.

Refering to Philip N. Johnson-Laird's (1983) claim, that the result of comprehensive language and text processing consists in the construction of a mental model that represents the state of affairs described in a discourse, the following core questions have to be resolved: 1. How can mental discourse models be linked to the external world? 2. To what extent do mental models and perceptual representations converge? 3. How are mental models and their construction mechanisms implemented in the human brain? 4. What are the differences between reading and listening comprehension with regard to linguistic processing? The general background assumption of my PhD project amounts to the insight that the development and application of reading comprehension ideally leads to the distribution of knowledge structures. Since this phenomenon is crucial for cultural and scientific communication, I argue that an interdisciplinary and integrative framework is urgently needed in order to describe and explain the underlying neural, functional, computational and representational mechanisms.

As I have been working on my PhD project since April 1 2012, my progress consists primarily in the ongoing evaluation of the relevant literature. After having finished this important stage, I plan to contribute to the conduction of further experiments that could resolve existing in-

consistencies and desiderata. To date, one crucial question that seems to be negleted consists in the influence of specific text genres and their properties on particular reading comprehension processes.

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Enabling Semantic Context in the Agent Simulation ARS (Artificial Recognition System)

Isabella Hinterleitner

Vienna University of Technology

The work solves the problem of establishing semantic context in project ARS [1]. Semantic context is needed in the artificial life simulation ARS, if two agents have to solve a question in a certain problem domain. It is defined through a domain specific ontology and a general upper ontology.

Relevant work in the field has been discussed in the following works [2, 3, 4, 5, 6].

Talking about a specific problem requires agents to know the exact problem domain and domain-specific knowledge. Solving a more general problem requires a less domain-specific ontology, such as an upper level ontology and semantic knowledge. For that reason, two different ways of knowledge bases and ontologies exist. Up to now different ontologies haven been realized including a function for the context. Based on defined use cases it will be demonstrated at the end of the work how semantic context can be established in specific situations.

In building automation usage of domain-specific ontologies and semantic situational context solves the question of a user-centered control. For example, a building automation system is usually controlled by one control unit. The idea of a user-centered control is that a domain-specific ontology gathers data on routines of a person in a room. If a certain context is established frequently by one user the control unit stores a situational semantic context. Thus, the system can adapt to the individual based on past experiences that have been stored as semantic situational context. According to the semantic context established by

the individual in one room, the building automation systems' control takes into account the needs of the individual that is represented in a domain-specific ontology.

Further work includes usage of semantic situational context in the field of cognitive vision systems and autonomous robots for navigating in novel situation. The research investigates how a robot can adapt to a new situation when entering a room and successfully fulfill a task there. The challenge is that general models of a room cannot be used to adapt to a new situation. The problem is tackled by defining an ontology hierarchy, ranging from process and object to abstract knowledge [7]. Another way of addressing the problem is, using upper and lower level ontologies for establishing context and enabling the robot to adapt to a novel room based on contextual knowledge.

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Relational Message Communication Through Touch by Humanoid Robots

Laura Hoffmann
Social Psychology: Media and Communication, University Duisburg-Essen
laura.hoffmann@uni-due.de

Motivation

In the near future robots can be applied in a wide range of fields, where they possibly get into physical contact with humans. From a social psychological point of view, interactions that take place in social domains where robots act as pets, companions, or health advisors are of special interest. Studies that compared physically embodied robots with virtual characters resulted in inconsistent findings with regard to the question which entity is more persuasive, present and better evaluated (Hoffmann & Krämer, 2001 for an overview). For instance Jung and Lee (2004) reported differences in the evaluation and the perceived sense of social presence between the robotic dog Aibo and a computer simulation, however, they could not replicate these findings in a second study. A closer look at the studies revealed that the interaction between the subject and the robot included touch in the first study, but not in the second one. Based on this the authors concluded that touch seems to be a crucial factor in the interaction with robots which is necessary for them to unfold their full potential. Because of that it seems reasonable to deepen the focus on touch within human-robot interaction (HRI).

Research Objective

This PhD work is generally concerned with the evaluation of human-robot interactions that include touching. In order to get first insights on how touch is perceived within HRI an interview study is conducted in which participants were confronted with photographs that depict situations in which touch happens between a humanoid robot and a human. The design of the study is based on the work of Burgoon (1991), who researched relational messages conveyed via touching. Therefore he compared photographs that showed different kinds of touches that occurred between two persons (e.g. handshake, touch to the face) and asked for

an evaluation of these pictures. The results unveiled that highly intimate touches like handholding or touch to the face express more affection, immediacy, trust, composure, similarity and informality than the other forms of touch. The interview study should reveal whether these results can be replicated within HRI and if touch with robots is perceived as desirable. Since it can be suspected that the size of the robot may influence whether touch by a robot is desirable or not, robots of different sizes are chosen as stimulus material (e.g. Robosapien, Nao and iCub).

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An Analytical Framework for Place Research

Dominik Kremer

Research Group on Computing in the Cultural Sciences, Laboratory for Semantic Information Technology University of Bamberg

dominik.kremer@uni-bamberg.de

Spatial cognition research has recently become interested in the notion of place (Winter et al. 2009). Beside cognitive aspects place as a "meaning soaked entity" (Lynch 1960) also covers social processes. This interplay has been studied – with an emphasis on the social aspects – by place research, a field within human geography (Cresswell 2004) that methodologically complements spatial cognition. While the cognitive processes involved in the constitution and the use of places are best studied using spatial behavior data, social negotiation processes are examined best by qualitative content analysis. I argue that for a detailed analysis of place, both approaches should be combined. My talk presents two data sets, (1) movement tracks of tourists, and (2) narratives of a place tradition from which I derive requirements for an analytical framework for studying social and cognitive processes in the context of

place research. Prototypical software implementations for parts of the framework are discussed.

Due to a pervasive use of GPS-sensors there is now a rich basis of empirical data reflecting locomotion behavior. The data from Schlieder/ Kremer 2011 covers motion patterns and images taken of day-trip first time visitors in the Old Town of Bamberg. Laube et al. (2007) provide a framework for a criteria-based extraction of features. Turning from behavior to action, geo-tagged image data indicate decisions taken and attention paid (Schlieder/Matyas 2008, Schlieder/Kremer 2011). Qualitative content analysis of places can be derived from image tags, diaries or interviews. The second data set covers narratives on the place tradition of Bamberg collected by guided interviews of people living for longer than 10 years in Bamberg. Common text mining approaches can reveal basic symbolic understanding. Social sciences have developed techniques to extract place based argumentation patterns (Christmann/Mahnken 2011).

Based on a first analysis of the two data sets, I propose a set of requirements that an analytical framework for place research has to meet. The most important are: (1) beside behavioral locomotion data, the framework hast to support action sequences (e.g. image data) and text as input data. (2) The framework should allow place to be identified as locomotion pattern, action pattern and as argumentation pattern. (3) The association of all types of patterns should be supported. (4) Temporal analyses regarding change and connectivity of places have to be possible.

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From Discrete Systems to Evolving Representations: An Integrative Model of Visual Working Memory

Johannes Lohmann

Department of Cognitive Modeling, University of Tübungen

Working memory is a crucial part of the human cognitive system. It provides an interface between perception, memory and action. One of the most influential models of working memory is the one proposed by Baddeley and Hitch [1], which distinguishes between visual and phonological working memory, which are both controlled by a central executive.

Early research on visual working memory (VWM) indicated that VWM consists of a volatile but very detailed sensory memory and a longer lasting, more abstract short-term memory. The content of VWM depends on selective attention. Usually sensory memory, short-term memory, and attention are investigated separately. But there is evidence that these mechanisms are based on the same neural processes [2]. Therefore we propose a computational model based on TVA [3] that integrates selective attention, sensory memory, and short-term memory. The key assumptions are that:

1. encoding of information can be modeled in terms of a race model as proposed by TVA;
2. the amount of information stored in VWM changes over time;
3. these changes are due to probabilisitc processes of active maintenance and passive decay;
4. the same processes that guide top-down biases on attention are involved in the maintenance of information.

We use change detection tasks as benchmark tests for our model, as change detection allows the study of the interactions between memory and attention. We implemented our model to predict mean detection rates as well as distributions of responses. We also track the eye movements of the participants as it should be possible to model performance based on scan paths.

Our final goal is to provide a computational model that can account for visual attention and visual working memory in a single framework with a sparse parameter set. Such a model combines results from cognitive psychology and neuroscience and could provide another bridge between both fields of research.

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Perspective and Perspectivation in Language and Cognition: A Cognitive-Linguistic and Cognitive-Developmental Approach

Michael Pleyer

Ruprecht-Karls-Universität Heidelberg

The notion of 'perspective' captures an important dimension of how knowledge and meaning are communicated, transmitted and shared (Graumann & Kallmeyer 2002). It thus also presents an important concept in cognitive science.

In particular, the phenomenon of perspective-taking and -setting in language, interaction and cognition has come to be one of the central topics in a number of fields in cognitive science, including Cognitive Linguistics (Verhagen 2007), developmental psychology (Moll & Tomasello 2007), language acquisition (Tomasello 2003) and psycholinguistics (Barr & Keysar 2006).

In my dissertation project I argue that the concept of perspective can be used as an integrative, interdisciplinary concept at the interface of these disciplines. Specifically, I hold that the analytical apparatus of Cognitive Linguistics developed to capture the complex phenomena of perspectivationin language and cognition can be applied fruitfully to the analysis of young children's cognitive and linguistic development. In Cognitive Linguistics, the concept of perspectival construal describes

the fact that when conceptualizing a scene for purposes of expression, speakers structure scenes in a specific manner and from a certain perspective. They employ the perspectival nature of linguistic utterances to assign salience to specific aspects of a conceptualisation and to organize conceptual content with respect to a particular vantage point (Verhagen 2007).

In my dissertation, I am looking at how young children learn to take and set perspectives in discourse and how they learn the inventory of perspectival constructions used to conceptualise states of affairs in specific ways. I am currently preparing a Cognitive-Linguistic corpus study of the acquisition of construal operations, whose results will then be integrated with theories and data from developmental psychology and psycholinguistics. Overall, my PhD project will yield a more complete cognitive-scientific explication of the concept, structure and development of perspective-taking and -setting. It will also enable a fruitful synergetic dialogue between Cognitive Linguistics, developmental psychology, language acquisition research and psycholinguistics and highlight points of convergence and common foci of interest.

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Facial Expressions of Pain
Automated Analyses

Michael Siebers

Cognitive Systems Group, Faculty Information Systems and Applied Computer Science, University of Bamberg

Facial expressions convey a lot about the mental state of a person. Thus, the analysis of facial expressions is a promising research area [1]. My thesis is attended to facial expressions of persons in pain, especially the individually of those expressions. I'm surveying this topic from two perspectives: One aim is to determine whether subject-specific image classifiers are neccessary for a good accuracy. On the other hand I'm interested in the temporal patterns of facial pain expressions.

To answer the first question a study comparing subject-specific and general classifiers were compared. A broad repertoire of learning algorithms was used. The study was conducted with images of subjects in pain (no acting involved). Though first results indicated that subject-specific classifiers were not needed, it could be shown that the study suffered a lot of overfitting. The experiences of the first study will be used to redesign the experiment.

Nevertheless, at first we are collecting a baseline for the classifiers. We are running a study with human observers which are to rate images according to the shown facial expression. Shown are neutral expressions, expressions of pain, and – as distraction – expressions of disgust. The study is designed as a learning experiment that allows us to attribute accuracy to general knowledge about pain expressions, familarity with the shown person, and knowledge about the individual pain expression of the person shown.

For the second aim the facial expressions are encoded as Action Units (AU). The temporal patterns of AU beginning and endings are analysed. In general this kind of learning is challenging as only positive examples (in a narrow meaning) are available. In a first study we tried to form a context-free grammar from the beginnings using the ABL framework of van Zaanen [2]. The results are promissing yet disappointing. Jusing clustering methods we could identify related patterns. However, the grammars contain too many rules to be comprehensible. In further

studies I will try different approaches to the grammar induction (evolutionary algorithms) and also adhere to the endings of the AUs. Also context-sensitive grammars might pose a more natural representation of expression generation rules.

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Building a Hierarchy of Functional Representations for Domain-Independent Reinforcement Learning in Non-Markovian Environments

Mark Wernsdorfer

Cognitive Systems Group, Faculty Information Systems and Applied Computer Science, University of Bamberg

This project explores dependencies between specific ways of representing sensomotoric data, identifying its functional role and in how far it enables inferring appropriate conclusions about different rewarding environments. Following the initial proposal of Harnad (1990), a hybrid architecture has been designed that consists of a sub-symbolic and a symbolic layer. The project is motivated by the assumption that symbols need not be grounded in communication, but can also be exclusively mental in nature. Therefore it differs from other research in Symbol Grounding like Steels (1999) where a community of artificial speakers tries to agree upon a common dictionary for designating objects. Furthermore, the motivation for grounding is not consensus but reward in a continuous environment. Successful interaction with different rewarding environments can be approached by Temporal Difference Learning (Sutton & Barto, 1998). But optimality of this method is limited to environments where the agent's sensorimotor states are dependent only on the frequency of previously experienced states (Markov assumption).

This does not hold for interaction with natural environments. Therefore different inductive biases besides probability have been examined (sequentiality, hierarchical structure and functional role of input data).

Inductive transfer is the problem of how obtained knowledge from one domain may be reused in a significantly different domain (e.g. Pan and Yang (2010)). By subsuming representations according to function rather than structural features, knowledge from structurally different domains can be interchanged. In future research, inductive transfer promises to be a fertile field for determining whether symbols have been grounded "the right way." Function centered representations also connect to research in modeling affordances and designing according algorithms (Rome, Hertzberg, & Dorffner, 2008).

The system's modules have been identified. Algorithms for initial partitioning of sensorimotor space have been determined. Also several different Markov predictors have been modified to produce hierarchical representations on different levels of generalization. Hierarchisation of representations, however, has not yet overcome the probabilistic limitation of Markov predictors. Alternatives like L* (Angluin, 1980) and Stochastic Context Free Grammars are being investigated for applicability.

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Computational Exploration of the Structure of Spatial Representations in Humans

Rasmus Wienemann

SFB/TR 8 Cognitive Systems, Universität Bremen

What is the inherent structure of mental spatial representations? Are they pseudo-pictoral, inspected before the mind's eye (e.g. Kosslyn et al., 2006)? But spatial need not be visual (Johnson-Laird, 1989) and vice versa: Most visual information is not spatial at all nor need spatial information be visual. Schultheis et al. (2007) have argued against a dichotomous distinction between spatial and visual, though, and proposed a continuous scale between the two extremes. Within the framework of Casimir, a cognitive architecture for spatial knowledge processing (Schultheis & Barkowsky, 2011), my doctoral research will explore which differences in information content constitute changes on this continuum and what information humans represent.

Spatial cognition is a necessity for an intelligent, moving organism, so pervasive that spatial metaphors and analogies are used in human reasoning. Understanding the structure of the formed representations will advance the understanding of spatial cognition.

After extensive study of the literature I have designed the first experiment and will start collecting data within the next month. With the experiment I will investigate which knowledge types (e.g. dis- tance, orientation) are (implicitly) included in mental representations of spatial configurations of abstract entities. This is the first experiment investigating wether a positive correlation between the number of represented knowledge types and the visuality of the representation exists.

To study these elusive processes a novel methodology will be used utilizing analogies. Analogies can be formalized using the Structure Mapping Engine (e.g. Falkenhainer et al., 1989). This allows for objective mapping from mental representations of an abstract domain to a non-spatial domain sensitive to the structure of the spatial representation. Thus providing means to study the mental representation without implying a visual or non-visual interpretation of it. I intend to present the results of the first experiment at the doctoral consortium.

The approach with an established formalization enables us to analyze the requirements of spatial representations as well as make predictions

of what effect the presence or absence of knowledge types has. This will help advance Casimir and also provide a first step towards automated assistive technology (e.g. in architecture, CAD, wayfinding).

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A Mereotopological Theory for the Unity of Consciousness

Wanja Wiese

Johannes Guttenberg-Universität Mainz

Problem description and motivation

Mereotopologies are formal theories that define mereological and topological notions and relations between them in an axiomatic way (see Casati and Varzi 1999). Although it is common in philosophical accounts of the unity of consciousness to use mereological and topological notions like parthood, overlap, continuity or connectedness, it is uncommon to apply mereotopological theories explicitly and in a rigorous way. With my dissertation, I seek to occupy this niche and show that a mereotopological treatment of the unity of consciousness can promote the discussion in at least two ways:

1. Mereotopology can help formulate philosophical accounts in a clearer and more systematic manner, as well as open paths to new, conceptually coherent accounts;

2. Mereotopology can be used to formulate bridging principles between different levels of description. My goal is to show how mereotopological axioms can be applied to the phenomenological, representational, functional, informational-computational, and neurobiological level of description. A mereotopological theory that can meaningfully be applied to all these levels can thus be used as a tool to integrate research programs operating on different levels of description. This will hopefully also promote interdisciplinary research on consciousness in general.

Progress made to date

So far, I have started analyzing phenomenological descriptions of the unity of consciousness in terms of mereological and topological notions and have begun to provide a representationalist reading of those notions. This work has partly been conducted in cooperation with my supervisor Thomas Metzinger (see Wiese and Metzinger (forthcoming)). Two main conclusions drawn by us are that

1. the talk of "temporal parts" that is ubiquitous in discussions of the continuity of consciousness is questionable;

2. some aspects of the unity of consciousness can be captured by the notion of a self- embedding, which can be analyzed on the representational level by alluding to meta- representational processes and what we call the "Principle of Globalization by Representational Fusion" (PGRF).

Proposed plan of further research

The next steps in my dissertation project will include:

- a comprehensive formulation of a mereotoplogical theory that can be applied to the domain of conscious experience;

- a more detailed analysis of mereological and topological notions on the representational level of description, including an account of (subpersonal) meta-representation;

- a formulation of desiderata for research on the informational-computational and neurobiological level to enable the application of mereotopology to these domains.

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Tutorials

Human-Computer Interaction: Concepts, Methods, Tools

Tom Gross and Christoph Beckmann
Human-Computer Interaction Group, University of Bamberg

Aim

The aim of this tutorial is to present basic concepts and paradigms of Human-Computer Intearction (HCI) as well as its design principles and prototypes. The primary focus is on concepts, methods, and tools for the design, the implementation, and the evaluation of interactive systems.

Contents

In particular the following areas are covered: introduction and basic concepts; human factors and technological factors; interaction, design, and prototyping; as well as evaluation and usabililty. In evaluation and usability participants will get hands-on experience to empirical methods and eyetracking.

Instructors

Dr. Tom Gross is full professor and chair of Human-Computer Interaction at the Faculty of Information Systems and Applied Computer Science of the University of Bamberg, Germany. He also heads the Cooperative Media Lab. Christoph Beckmann is a senior researcher in the group. Further information on the research and teaching of the instructors can be found at: http://cmlab.de/.

Die Kognitive Architektur ACT-R

Marco Ragni
Universität Freiburg

Kognitive Modellierung ist die Algorithmisierung psychologischer Theorien. Das Ziel ist es, neben der Identifikation von Widersprüchen in psychologischen Theorien, ein algorithmisches und zugleich psychologisch fundiertes Erklärungsmodell zu entwickeln, welches die präzise Reproduktion empirischer Ergebnisse (Reaktionszeiten und Fehlerraten) und auch die Vorhersage aufgabenspezifischer Gehirnaktivationen (aus fMRT-Untersuchungen) gestattet. In diesem Tutorial wird dabei die kognitive Architektur ACT-R (Anderson et al., 2004; Anderson, 2007) vorgestellt. ACT-R ist ein Produktionsregelsystem und zugleich eine hybride Theorie (mit symbolischen und subsymbolischen Elementen) menschlicher Kognition. Die Architektur umfasst eine Reihe von Grundannahmen, die es erlauben kognitive Phänomene verschiedener Bereiche zu modellieren. Die einzelnen Elemente (sogenannte Module) sind dabei psychologisch fundiert und schränken zugleich mögliche kognitive Modelle sinnvoll ein. Anwendungen reichen dabei von kognitionspsychologischen Modellen des Lernens und Gedächtnisses, des Problemlösens, der Wahrnehmung, der Aufmerksamkeitssteuerung, bis hin zur Mensch-Computer-Interaktion (HCI).

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Modeling Motivational Dynamics with Psi/MicroPsi

Joscha Bach[1] and Dietrich Dörner[2]
[1] HU Berlin
[2] Otto-Friedrich-Universität Bamberg

The Psi theory (Dörner 1999, Dörner et al. 2002) contributes to a general understanding of the principles of cognition. Specifically, it explains how a finite set of physiological, social and cognitive demands can be functionally specified and lead to the observable heterogeneity and dynamism that characterizes human intentions, goals and decision making. It details the emergence of affective states and emotion, and their integration into perceptual, anticipatory, reflective, deliberative processes and so on. Thereby, the Psi theory defines constraints and principles for a cognitive architecture with respect to motivational control, affective modulation, perception, mental representation and general organizational principles. MicroPsi (Bach 2009) is an implementation of the Psi theory as an AI architecture. It offers of a simulator for spreading activation networks that represent semantic content and are grounded in sensory input and actuator output. MicroPsi agents are situated in dynamic simulation environments and implement a motivational system with a set of physiological, social and cognitive drives, and have been applied for experiments in affective computing, categorization and multi-agent interaction.

The tutorial will give an overview over the general principles and core assumptions of the Psi theory, and introduce our implementation approaches, which can either be directly used, or adapted for other computational models of autonomous behavior, affective modulation and grounded representation.

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Talks

Towards a Computational Cognitive Model of Concept Blending

Ahmed Abdel-Fattah, K.-U. Kühnberger, H. Gust, U. Krumnack, T. R. Besold, and M. Schmidt

Institute of Cognitive Science, University of Osnabrück

Concept blending (CB) has been proposed as a powerful mechanism that facilitates the creation of new concepts by a constrained integration of available knowledge. As a framework, CB proved its importance in expressing and explaining cognitive phenomena, such as counterfactual reasoning, metaphor-making, as well as creating new theories. However, there is no general computational account of blending, as of yet, that has proven powerful enough to cover all the examples from the literature. The well-known optimality principles of CB raise another sort of challenge: these principles are the guideline pressures that are assumed to derive the generation of a feasible blend and distinguish good blends from bad ones. Only very few accounts have been given to formalize such principles, though they are not broad enough to suit generic computational accounts of CB (Fauconnier and Turner, 2002).

We present a logic-based framework for CB. The framework is based on HDTP, which is a powerful analogy making system for computing analogical relations between two domains axiomatized in first-order logic (Schwering et al., 2009). The motivation and background needed for our approach are provided, along with an overview of CB and an exploration of its applicability in settings as diverse as mathematical domain formation, classical rationality puzzles, and noun-noun compounds. We also explain how CB is an essential cognitive mechanism for productivity and is related to creativity abilities of natural cognitive agents (Martinez et al., 2011).

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The Contextual Planning Effect: Memory Processing in Visuospatial Problem Solving

Rebecca Albrecht and Marco Ragni
Center for Cognitive Science, University of Freiburg

The Tower of London (ToL) task is a powerful tool to assess human planning abilities (Shallice, 1982). ToL is a disk manipulation task, where a given goal state has to be reached by applying operations sequentially on an initial state. A state consists of three pegs and three disks; the allowed operation is to move an unblocked disk from one peg to another. Typically, it is not allowed to move disks during the planning process, i.e. changes to the initial state have to be performed mentally. The number of moves necessary to reach a goal state correlates with planning time and error rates. This effect has been explained by limited working memory capacity (Phillips et al., 2001). We extend this theory to explain human planning performance on fine-grained task differences. We show that not only the total number of moves but also the visually observable context of a disk has an impact on internal memory processing. Context describes the position of a disk relative to the positions of the other disks in one state. The similarity between the configuration of the initial state and the goal state influences the ability to recall the target location and the intermediate location of a disk during the planning process. We present an ACT-R (Anderson et al, 2004) model, which explains effects on planning time and eye-movement patterns for eight different problems within the category of three-move problems (Kaller et al., 2010). Context is realized by using spreading activation. Based on relations between disks recognized during the planning process, disks occurring in similar configurations are recalled more easily. This explanation yields a deeper understanding on internal memory processing of visually presented tasks and their properties.

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Linearization Processes during Language Production: A Case Study of Object Pronouns in German

Markus Bader, Sascha Dümig, and Friederike Kops
Department of Linguistics, Goethe-University Frankfurt

We present a corpus study and three experiments that have jointly examined the linearization of arguments during natural language production. Our major question is how non-grammatical factors like weight interact with grammatical factors like animacy and definiteness.

The particular phenomenon under investigation is the placement of object pronouns in German embedded clauses. Like other objects, object pronouns can precede or follow the subject ("...dass der Opa ihn besucht" – lit. 'that the grandpa him visits' vs. "...dass ihn der Opa besucht" - lit. 'that him the grandpa visits'). Prior corpus studies reveal that the placement of definite objects is almost exclusively determined by animacy ('animate before inanimate') (Bader & Häussler, 2009). For pronouns, more factors seem to be involved (Heylen, 2006). However, Heylen's study analyzed only 179 personal pronouns and did not include definiteness as a factor.

To overcome these shortcomings, we analyzed about 3000 embedded clauses with object pronoun from the deWac corpus (Baroni et al., 2009). Overall, the object occurred in front of the subject in ca. 63% of all cases, which is about ten times higher than for definite objects. A logistic regression analysis shows that the order of object pronoun and non-pronominal subject is mainly a function of the subject's animacy, modulated by the subject's weight and definiteness.

In three production experiments, participants first read a sentence (e.g., "Der Opa besucht den Lehrer" – 'Grandpa will visit the teacher'). After a visual prompt with a main clause ("Der Lehrer sagt" – 'The teacher says'), the initial main clause had to be orally repeated from

memory in form of an embedded clause ('dass ihn der Opa besucht'). The first factor in all experiments was the order of subject and object within the sentence to be transformed. In two experiments with animate agents as subject, subject-object order was strongly preferred. In a third experiment with inanimate theme subject, object-subject order was strongly preferred. Additional factors (weight and definiteness of the subject) had only small effects.

Corpus and experimental results converge on the conclusion that word order is mainly determined by the animacy constraint, with weight and definiteness also having important effects. We use our results for evaluating current two-stage accounts of syntactic production, asking whether the strict separation of syntactic-function assignment and linearization can be upheld.

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The Missing-VP Effect in German: Evidence for Shared Production and Comprehension Mechanisms

Markus Bader[1] and Jana Häussler[2]

[1] Department of Linguistics, Goethe-University Frankfurt
[2] Department of Linguistics, University of Potsdam

Ever since Chomsky & Miller (1963), multiple center-embedding ("The rat the cat the dog chased killed ate the malt.") has played a pivotal role for theories of sentence complexity. A special phenomenon in this regard is the so-called missing-VP effect: sentences in which the VP of the higher relative clause is missing ("The patient the nurse the clinic had hired met Jack."; Frazier, 1985) are often perceived as grammatical.

While the missing-VP effect is well-established for VO-languages, Vasishth et al. (2010) presented evidence indicating that it does not occur in the OV language German.

In our presentation, we review data from comprehension experiments and a corpus study that have investigated German sentences with multiple center-embedded relative clauses, focusing in particular on the missing-VP effect. A corpus analysis of the deWac corpus (Baroni et al., 2009) revealed 352 instances of embedded clauses containing a doubly center-embedded relative clause. In ca. 16% of these sentences, the VP of the higher relative clause was missing, as in Frazier's original example. This shows that, as far as the OV language German is concerned, the missing-VP effect occurs in language production.

Several reading experiments lead to the same conclusion for language comprehension. In experiments using speeded-grammaticality judgments, sentences with doubly center-embedded relative clauses in which the VP of the higher relative clause was missing were judged as grammatical at a rate of 40–60%. When the relative clauses were extraposed into a sentence-final position, in contrast, sentences with a missing VP were rejected as ungrammatical with high reliability. In a self-paced reading experiment, the final VP of missing VP sentences was read somewhat faster than the final VP of complete sentences, indicating that readers did not notice the ungrammaticality caused by the missing VP.

In sum, our data show that the missing-VP effect occurs in German, an OV-language, too. Since this is true for both language production and comprehension, it points to shared resources underlying language production and comprehension. We will discuss our findings with regard to current theories of working memory constraints on language processing. With regard to Vasith et al's finding of no missing-VP effect in German, we will present evidence showing that this is due to stimulus differences concerning the position of the doubly center-embedded relative clause within its superordinate clause.

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Moral Aspects in Mental Models of Risk Perception

Claudia Bassarak[1], Hans-Rüdiger Pfister[1], and Gisela Böhm[2]

[1] Leuphana University Lueneburg
[2] University Bergen

Our research is concerned with mental models of risk perception. We draw on the psychometric paradigm for studying risk perception (cf. Slovic, 1987). The traditional approach of the psychometric paradigm presents a multitude of potentially hazardous technologies, substances or activities to study participants. Then, participants evaluate each of these risks with respect to several risk characteristics such as voluntariness, controllability or knowledge of possible consequences, resulting in a questionnaire of risks being fully crossed with evaluations. Subsequent principal component analysis of aggregated data usually yields two underlying factors of people's risk perception that relate to the dreadfulness and the novelty of a risk. We expand the psychometric paradigm regarding two aspects. First, we consider moral aspects of people's risk perception. Second, we explore the sample of presented risks and subcategorize it. In sum, we add morality-related risk characteristics plus moral judgment items and we subcategorize the sample of presented risks according to their perceived fragility of scientific evidence.

We assume that morality-related risk characteristics and moral judgment relate to each other. Furthermore, we hypothesize that risk-related moral emotions, moral judgments and epistemic judgments of presented risks are interrelated. We expect moral judgment to predict epistemic judgment, particularly regarding risks with high perceived fragility of scientific evidence.

Principal component analyses show that morality-related risk characteristics and moral judgment contribute to the explanation of the same

principal component, albeit not composing a separate dimension within the mental model of risk perception, when all risk items are considered. However, regarding risks with low perceived fragility of evidence (i.e. unambiguous risk items) a separate morality dimension can be found.

Multilevel regression analyses treating risks and individuals as random effects indicate that in general moral emotions significantly predict moral judgment. Furthermore, moral judgment significantly predicts epistemic judgment, with fragility serving as a binary moderator variable. If risks are perceived as reprehensible, they are judged more risky. This effect attenuates when perceived fragility of evidence is low.

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Gestural Alignment in Human-Human and Human-Machine Dialogue

Kirsten Bergmann and Stefan Kopp

AG "Sociable Agents", SFB 673, CITEC, Technische Fakultät, Universität Bielefeld

A well-known phenomenon in natural interaction is that speakers adapt their linguistic and nonverbal behaviors. Research on gestural alignment is, however, still in its early stages based on evidence from experimental settings in human-human communication (e.g. Holler & Wilkin 2011, Mol et al. 2012). We report complementary evidence from two different studies of gestural alignment in dialogues with humans and virtual agents.

First, we present a systematic analysis of gesture form convergence in natural human-human dialogues based on a large sample of data (4449 iconic/deictic co-speech gestures; Bergmann & Kopp 2012). Here, we found evidence for gestural alignment, but not all gesture features are subject to the alignment effect. While some form features like wrist movement and "finger orientation seem resistant to these contingencies, we found that the use of particular gestural representation techniques as well as the gesture form features handshape, handedness and palm orientation are significantly subject to inter-speaker convergence effects. In

a detailed analysis of those sensitive features we further address questions of how gestural alignment depends on the temporal distance between gestures, and whether intra-speaker or inter-speaker influences on gesture form are stronger.

Second, we are currently concerned with a study to test whether gestural alignment also takes place in interaction between humans and virtual agents: Participants are engaged in a communication game with a virtual agent in which tangram figures have to be explained to one another. In a between-subject design the virtual agent uses different variations of gesturing behavior whereby particular gesture features are systematically manipulated (e.g. two-handed vs. one-handed gestures). We present and discuss our results regarding the question to which degree humans adopt their own gestural behavior to the gestures used by virtual agents.

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Cognitivizing Turing's Test

T. R. Besold

Institute of Cognitive Science, University of Osnabrück
tbesold@uni-osnabrueck.de

Initially, I discuss and compare the two main interpretations of the Turing Test (Turing, 1950), namely the "Standard Turing Test" and the "Original Imitation Game Test" (Sterret, 2003), also outlining why the latter is a by far more meaningful and suitable test for machine intelligence.

Against this background, a proposal for the cognitively-inspired Sub-Turing decomposition (Besold, 2012) of the Turing Test into smaller subtasks is reproduced. This decomposition, in a form of division of labor between different AI subfields and research programs, formulates four intermediate subtasks solutions of which can be considered condiciones

sine quibus non on the way to successfully passing the overall Turing Test: human language understanding, human language production, human rationality and human creativity.

This decomposition follows the idea that human intelligence is closely connected to actual cognition, rendering human-style intelligent behavior an emergent phenomenon on the basis of a set of cognitive capacities.

Subsequently, in accordance with this paradigm, initial ideas and suggestions for how to address two of the subtasks (namely the rationality and the creativity task) on system level are sketched: Proposed methods for solving these tasks include models for computational analogy-making and conceptual blending.

Finally, on a more meta-theoretical level, two important conceptual questions concerning the status and implications of the SubTuring tasks are addressed. Firstly, in order to clarify the status of the SubTuring decomposition itself, the difference between the original Turing Test and the decomposition is considered. Secondly, reflections on what the consequences a failure in any of the SubTuring tasks would have for the overall endeavor of general artificial intelligence are given.

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An Ecological Rationality Multiverse

T. R. Besold, K.-U. Kühnberger, U. Krumnack, H. Gust, M. Schmidt, and A. Abdel-Fattah

Institute of Cognitive Science, University of Osnabrück
tbesold@uni-osnabrueck.de

We argue for a new view on and an approach to rationality as a concept of study and modeling paradigm of human behavior.

Traditional (normative) approaches to rationality, decision-making, and rational behavior, namely logic-based, probability-based, game theory-

based, and heuristics-based theories and frameworks, all by themselves exhibit shortcomings and disadvantages: Classical logic-based and probability-based models of rationality struggle with findings from experiments such as the Wason selection task (Wason, 1966) or the Linda problem (Tversky & Kahnemann, 1983), game theory offers a plethora of distinct equilibrium and solution concepts, possibly defining very different notions of rationality, and the "heuristics toolbox" as a theory suffers from severe meta-methodological drawbacks (e.g. a tendency towards apodicticity due to its open nature).

Therefore, continuing work started in (Besold & Kühnberger, 2012), we present cornerstones of a positive, integrative, and holistic conception of frameworks for rationality and related cognitive capacities: Subject-centricity (i.e. integration of subject-related properties and constraints), a positive predictive nature of theories, realized in holistic and integrative models (i.e. without a priori commitment to one single formalism).

Finally, we show close connections of our approach to many of the ideas and insights underlying the notion of "ecological rationality" (Rieskamp & Reimer, 2007), proposing analogy as one possible mechanism of linking cognition and environment, i.e. as one of the driving forces underlying the alleged adaption of the reasoning process to the reasoner's context and surroundings.

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Dative Alternation in English as a Second Language

Katja Böer
Universität Kassel

Dative alternation as displayed in (1) has been widely researched in the language of native speakers of English (cf. among others Collins, 1995; Bresnan et al., 2007; Bresnan & Ford, 2010).

(1)a. The young man gives the white flowersNP to his girlfriendPP. [PP-Dative]

(1)b. The young man gives his girlfriendNP the white flowersNP. [NP-Dative]

Factors like length, animacy, pronominality of theme and recipient, respectively and the type of dative verbs govern the speaker's choice (cf. among many others Bresnan & Ford, 2010). Dative verbs are known to bias the probability for a certain structure to occur in the one or other direction, cf. Wasow (1997, 2002).

As of now, there are only few studies available which systematically investigate the factors that govern dative alternation, i.e., the influence of lexical and processing factors, for second language learners. Among them is Mazukrevich (1984), whose results indicate that learners have a general tendency to choose the PP-Dative over the NP-Dative, probably since the former is easier to process. Further studies have shown that French (Hawkins, 1987) and German (Führer, 2009) learners of English are influenced by the same lexical bias as native speakers of English. These studies imply that the acquisition of the dative alternation is govern by factors which are independent of the L1. However, up to now no study has investigated the acquisition of the lexical bias for learners whose native languages differ typologically and the processing factors involved in the alternation.

This paper investigates the interplay of processing and lexical information and the role of this interplay in the choice of particular syntactic constructions. I hypothesize that verb bias is acquired by all learners, irrespective of their L1, and, that this bias can easily be overridden by

processing factors, which indicates that processing factors are more relevant in the interlanguage than lexical ones.

To test this three studies are conducted, the first of which is based on the ICLE corpus, a collection of English essays written by English learners speaking 16 different L1s. Here, sentences containing dative verbs of both biases, produced by speakers of different L1s, are investigated.

The objective of the second study is to test Bresnan & Ford's (2010) stimuli on L2 speakers of English. Participants are asked to read a short text passage followed by two dative structures and decide which structure seemed more natural to them. A first analysis of exploratory data indicates that learners prefer structures which are easier to process to those which are in line with lexical constraints, i.e. a verb biasing the NP-Dative will nonetheless be preferred in the PP-structure if this ensures a long constituent occurring after a short one. This effect seems to be much stronger than it is the case for L1 speakers.

A third experiment, a continuous lexical decision task is employed in which the prepositional dative structures of the items above are read word by word. The results are collected to validate the results of the questionnaire study and give evidence that the observed effects are indeed a reflection of online mechanisms.

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Two Processes in Action Prediction as Dissociated using (Non-)Human Movement Kinematics

Simone Brandstädter[1], Anne Springer[2], and Waltraud Stadler[3]

[1] Department of Work and Organizational Psychology, University of Heidelberg

[2] Department of Sport and Exercise Psychology, University of Potsdam

[3] Department of Sports and Health Science, Technische Universität München

Previous research suggests that predicting another individuals action during occlusion may involve two processes, real-time simulation (i.e., dynamic updating) and matching recently perceived action images (i.e., static matching) (Springer & Prinz, 2010). Here, we tested the impact of movement kinematics on action prediction accuracy.

Our participants watched every-day actions performed by a point-light actor animated with human movements (natural condition) or artificial movements that were more uniform regarding velocity profiles and trajectories (artificial condition). The actions were briefly occluded and then followed by a static test pose. Participants judged whether or not this test pose depicted a coherent continuation of the previously seen action. We independently manipulated the duration of the occlusion and the temporal advance of the test pose relative to occlusion onset. This paradigm allows the assessment of real-time simulation and static matching by comparing the prediction performances of different combinations of occluder duration and test pose advance.

Consistent with our expectations, in the natural condition, performance decreased with increasing temporal incoherence among occluder duration and test pose advance, indicating evidence of real-time simulation. In contrast, in the artificial condition, performance decreased with increasing test pose advances (i.e. decreasing postural similarity), revealing evidence of static matching. These results support the notion that internal action prediction involves two processes, dynamic simulation and static matching. Their relative contribution seems to depend on stimulus-inherent factors like the velocity profile in the observed movement. Results will be discussed with respect to recent research on the neural correlates of action simulation, indicating that action prediction involves sensorimotor representations of action (Stadler et al., 2011).

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Minimal Changes in Spatial Belief Revision

Leandra Bucher, Jelica Nejasmic, and Markus Knauff

Justus Liebig University Giessen

{leandra.bucher, jelica.nejasmic, markus.knauff}@psychol.uni-giessen.de

Humans frequently need to change their minds in the light of information that contradicts an existing set of beliefs. This process includes decisions about which belief to retract and which one to retain. In the spatial domain, this process is accomplished by the variation of spatial mental models. Usually there are several alternatives for model variation to re-establish consistency and these alternatives are often logically equivalent. Nevertheless, human reasoners show clear preferences for certain alternatives. We report a series of response-time and drawing experiments, in which the participants had to sketch models and then to revise these sketches in order to consider a contradicting fact. With these experiments, we tested whether these preferences result from the principle of "minimal change", which implies that as much as possible of the initially existing model is maintained in the revised model. We also tested whether the number of objects that must be changed affects the revision process. Our results suggest that spatial belief revision follows the minimal change principle, whereas we did not find evidence for the influence of the number of objects. We discuss these results in the context of model-based theories of belief revision.

A Model for Context-sensitive Interpretation of Communicative Feedback

Hendrik Buschmeier and Stefan Kopp
Sociable Agents Group, CITEC and Faculty of Technology, Bielefeld University
hbuschme@uni-bielefeld.de

A prevalent and important coordination mechanism in dialogue is communicative 'listener feedback' in form of short verbal-vocal signals (e.g., 'uh-huh', 'yeah', 'huh'), head gestures (e.g., nodding, wiggling) or facial expressions. Listeners' feedback signals are indications of their cognitive state and communicate whether listeners and speakers are in contact, whether listeners perceive, understand and accept the speakers' utterance as well as whether they agree to or which attitude they have towards the speakers' utterance (Allwood et al., 1992).

Feedback signals are rich in their form – enabling a fine-grained expression of subtle differences in meaning –, multi-functional, and interact heavily with their dialogue context. Consequentially, feedback is only conventionalised to a certain degree. Speakers are nevertheless able to interpret communicative feedback, use it to reason about the listener's cognitive state as well as their common ground, and adapt their language accordingly (Clark, 1996).

Our objective is to model this ability of human speakers for artificial conversational agents (e.g., dialogue systems, embodied conversational agents), making them attentive to their users' needs as expressed in their feedback behaviour (Buschmeier & Kopp, 2011).

Here we present an agent-centric cognitive model for the interpretation of feedback signals in their dialogue context. It uses features of the feedback behaviour observed by the agent as well as the agent's utterance, expectations and knowledge about the task to reason about an 'attributed listener state' (ALS; the agent's reconstruction of the user's cognitive state) and the grounding status of information. Using the framework of Bayesian networks, the model represents ALS and common ground probabilistically in terms of degrees of belief. Because of this, it is straightforward to deal with the uncertainties inherent in the observations, the form-meaning relation of a feedback signal and the user's behaviour.

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The Revision of Spatial Mental Models – Does Distance Matter?

Stefan Czoschke, Leandra Bucher, Jelica Nejasmic, and Markus Knauff

Justus-Liebig Universität Gießen

The revision of mental representations is necessary whenever reasoners encounter conflicting, yet trustworthy information. The aim of such a revision process is to regain consistency of the mental representation with the new information about the state of affairs. In the spatial domain it is assumed that resolving such a conflict of information by reestablishing consistency is achieved by modification of the initially held spatial representation. Little is known about the nature of this modification process. Even though a great deal of research has been concerned with the construction and inspection of mental representations in the spatial domain, there is basically no research investigating the processes underlying the revision of such representations. The aim of our research is to present a first insight into these processes. In our experiments we operationalize "revision" as the relocation of an object in a given spatial layout. After learning a visually presented linear spatial layout of different objects (e.g. peach – pear – kiwi – apple) participants get a verbal piece of information about the spatial relation of two of the layout's objects (e.g., the kiwi is to the left of the peach) that is inconsistent with the arrangement of the objects in the initial layout. The participants' task is to integrate the new information by modifying the initial layout so that a revised layout, consistent with the verbal information, results (e.g., kiwi – peach – pear – apple). This paradigm allows us to systematically vary certain aspects of the task, such as the distance the to-be-relocated object has to be "moved" within the layout as well

as its initial and final position. In line with the spatial mental models theory and the embodied cognition framework we assume that the revision is based on a mental model that is spatial in nature and relies on an actual movement-like variation process. Thus the mental process is assumed to reflect a time-distance relationship resembling the physical moving of an object (i.e. the further an object has to be moved from its initial to its final position the longer the process takes). We will present a first process-oriented description of the revision of mental models and some future research directions.

Evolutionary Psychology and Massive Modularity

Malte Dahlgrün

Institut für Philosophie, Humboldt-Universität zu Berlin

The idea that the human mind is pervasively modular is widely regarded as a signature thesis of evolutionary psychology (EP). It is sometimes called the massive modularity hypothesis (MMH). In the first part of this talk, I will distinguish and answer a variety of arguments that have been levelled against the MMH from different disciplines in the past two decades.

More often than not, these arguments misconstrue their target. Many critiques of the MMH have rested on identifying EP's notion of modularity with the narrow notion of reflex-like mechanisms developed by Fodor (1983) for perceptual input systems. This is an easily demolished strawman when it comes to the entire mind. A generalized commitment to such modules makes no evolutionary sense, nor is it suggested by the writings of leading evolutionary psychologists such as Tooby, Cosmides, Buss, and their academic progeny.

The most interesting challenge to actually existing statements of MMH lies in charges of triviality recently voiced by philosophers such as J. Prinz, R. Samuels, or Fodor. Statements of the MMH from within EP tend to be extremely broad, requiring little more than functional specialization. This raises a question: Does the MMH endorsed by EP form an interesting and distinctive thesis at all, or does it merely reflect a scientifically uncontroversial commitment to functional decomposition?

This question sets the agenda for the second part of the talk. I will claim that EP does harbour a distinctive, interestingly modularist view of the mind, and that evolutionary psychologists have merely neglected to spell it out appropriately. The modules characteristic of EP are (i) domain-specific in an ecological sense that goes beyond functional specialization simpliciter and (ii) developmentally channelled.

Both features will be illustrated and related to the debate on EP and modularity. I will argue that deliberate eschewals of developmental canalization in defining EP-modularity are not well-motivated. They are in fact incompatible with the fundamental commitments of EP.

Assigning Plausibilities to Probabilistic Representations for Information Selection

Stephan Ehrenfeld[1], Andreas Alin[1], Jannik Fritsch[2], and Martin V. Butz[1]

[1] Cognitive Modeling, Computer Science, University of Tübingen
[2] Honda Research Institute

Both humans and robots typically perceive information about their body and the environment from multiple sensory modalities. Additionally, internal state estimates are maintained. Information from one modality is typically transferred to another modality using knowledge about the body schema to infer current reference frame relations. In this way, multiple sources of information can be combined effectively. If the data from different sources of information deviate significantly, however, the integration of these partially contradicting representations poses a big challenge. The sensor contradictions may stem from sensor errors, body schema errors, or contradicting behavioral forward models. To cope with this challenge, we present a plausibility measure that can estimate the accordance of one representation in comparison with all others.

As both humans and robots face high uncertainty due to sensory noise, motor noise, and model uncertainty, it is crucial for them to represent their states in a probabilistic way. Accumulating evidence suggests that the current body state and the environment are represented probabilistically by means of distributed population codes in the human

brain. Robots typically use probabilistic representations with closed-form probability distributions, such as Gaussians. Using either of those probabilistic representations, the states can be easily maintained over time by adding a forward model and applying a Kalman filter approximation.

In this work we use both Kalman filtering and probabilistic population codes in two different tasks: Simulated arm tracking and simulated automotive tracking, where we encode spatial uncertainty with respect to different modular modality frames or for alternative behavioral patterns, respectively. The resulting competing state estimations are then exploited to infer a measure of accordance with respect to all other state estimations, which computes the plausibility that the respective information is correct given all other information. We use the derived plausibility measure to detect and adaptively avoid sensor failures or to select the most plausible behavioral pattern out of multiple possible alternative behaviors, respectively. We believe that the pursued rigorous Bayesian approach of computing plausibilities given redundant information sources will be applicable in even more domains in the future.

Hand Motion Affects Allocation of Covert Attention

Yariv Festman and Martin Fischer
Psychology, University of Potsdam

Background

Previous research on the interaction between manual action and visual sensitivity has largely focused on the effects of static hand postures (e.g., Abrams et al., 2008) or of hand movement planning (e.g., Baldauf & Deubel, 2010) on attention deployment. However, everyday actions extend over time and we must dynamically update our representation of the visual world during action execution (e.g., Fischer, 1997). Here we investigated how the positional and directional components of ongoing hand movements influence deployment of covert attention. Based on the premotor theory of attention (Rizzolatti et al., 1994), we expected

congruency benefits from both components but had no prediction about their time course.

Method

We combined a visually concealed hand motion with concurrent letter discrimination. In each trial, participants moved their right hand from the right to the left side under a display and back. Visual probes were displayed at one of six times during each movement in the left or right visual field. Probe discriminability was recorded after each trial and exposure times were adjusted after each block to avoid floor or ceiling effects. Eight healthy adults were tested in multiple sessions.

Results

We found clear effects of both hand position and hand direction on attention deployment. Discrimination performance increased significantly with hand proximity and was better for movements towards compared to away from the probes. A reliable interaction signaled that the directional effect was limited to the most distal hand positions. We found evidence for rapid modulation of attention as a function of movement kinematics. These findings support the premotor theory of attention and extend our understanding of the dynamics of attention deployment for on-line action control.

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A Hierarchical View of Grounded, Embodied, and Situated Numerical Cognition

Martin H. Fischer

Division of Cognitive Sciences, University of Potsdam
martinf@uni-potsdam.de

There is much recent interest in the idea that we represent our knowledge together with the sensory and motor features that were activated during its acquisition. This paper reviews the evidence for such embodiment in the domain of numerical cognition, a traditional stronghold of abstract theories of knowledge representation. The focus is on spatial-numerical associations, such as the SNARC effect (small numbers are associated with left space, larger numbers with right space). Using empirical evidence from behavioral research, I first describe sensory and motor biases induced by SNARC, thus identifying numbers as embodied concepts. Next, I propose a hierarchical relationship between grounded, embodied, and situated aspects of number knowledge. This hierarchical conceptualization helps to understand the variety of SNARC-related findings and yields testable predictions about numerical cognition. I report several such tests, ranging from cross-cultural comparisons of horizontal and vertical SNARC effects (Shaki & Fischer, 2012) to motor cortical activation studies in adults with left- and right-hand counting preferences (Tschentscher et al., 2012). It is concluded that the diagnostic features for each level of the proposed hierarchical knowledge representation, together with the spatial associations of numbers, make the domain of numerical knowledge an ideal testing ground for embodied cognition research.

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Comparing Automated Pain Classifiers with Human Performance

Johannes Folger[1], Michael Siebers[1], Miriam Kunz[2], Stefan Lautenbacher[2], and Ute Schmid[1]

[1] Cognitive Systems Group, Faculty Information Systems and Applied Computer Science, University of Bamberg

[2] Physiological Psychology, Faculty Human Sciences and Education, University of Bamberg

Facial expressions play an important role in the communication process. They usually support the spoken words of communication partners. We investigated the question whether facial expressions on their own are sufficient to recognize the feelings of other persons. If this is the case, the identification of certain emotions could be automatized. We compare the accuracies of automated classifiers with human rater performance. Our work is divided in two parts. The first part describes an empirical study that examines how well subjects estimate the shown emotions of other people. Subjects (n=60) are required to rate whether the person shown in an image are in pain, in disgust or in a neutral state.

The second part covers the application of machine learning algorithms (Support Vector Machines and Decision Trees) to the problem of classifying facial expressions. Only two categories of expressions are considered, namely pain and disgust, in order to reduce complexity. The selection of relevant features is based on psychological considerations and dimensionality reduction mechanisms. We expect that machines will outperform human raters.

Percept Choice Dynamics of Stochastic Self-Oscillator Model Dominates Percept Reversal Rate Characteristics under Periodically Interrupted Ambiguous Stimulus

Norbert Fürstenau
Inst. of Flight Guidance, German Aerospace Center
norbert.fuerstenau@dlr.de

A stochastic nonlinear dynamics model is presented which explains published experimental results with periodically interrupted ambiguous stimulus[1][2]. The model is related to the synergetic order parameter approach of Ditzinger & Haken [4] and was recently used for explaining long range correlations of the percept reversal time series[3]. Delayed perception state feedback via an attention control parameter (adaptive gain) is used, which in turn is modulated through a slowly varying bias (memory). A mapping of the perception, attention, memory (PAM) equations to basic Thalamo-Cortical reentrant loops was suggested.

Experiments with the Necker cube with stimulus-off times toff < 1 s exhibit a maximum of the percept reversal rate of Rmax =ca. 36 1/min at toff =ca. 200 ms (with on-time = 300 ms) [1][2]. According to [1] for toff > 200 ms the percept is stabilized with increasing toff due to recovery from neural fatigue. Within the present model the percept choice or stimulus-onset dynamics during the ambiguous stimulus off-on switching turns out to dominate over fatigue with increasing toff in agreement with Noest et al.[5].

This onset dynamics is induced by the off-on switching of the stimulus ambiguity parameter which correspondingly modulates the feedback. Onset-bifurcation of the perception state at the critical ambiguity parameter value (percept choice) adds to the phase oscillator self- oscillations and to the effects of stochastic attention noise (a fluctuating Langevin force). Numerical simulations are based on the dynamical coupling of the behavioral PAM-variables with delayed feedback. The toff-value at Rmax and the absolute reversal rate values are determined by the time constants (fatigue, recovery, feedback delay = 40 ms) and by the attention noise power as parameters of the nonlinear PAM-state space equations. A linear approximation in the form of a second order

Langevin equation allows for an analytic estimate of the percept reversal rate (Rmax = 30 - 40 min-1) and of the perceptual damping time constant (tauv =ca. 5 s). Within a thermodynamic equilibrium approximation the Fluctuation-Dissipation theorem (or Einstein diffusion coefficient of Brownian motion) relates the noise power spectral density and damping to an index of cognitive inertia and a cognitive perceptual energy value of at least 16 orders of magnitude above the thermal noise level at body temperature.

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Perceiving Other Minds: How Embodiment Matters in Social Cognition

Nivedita Gangopadhyay

Center for Mind, Brain and Cognitive Evolution, Ruhr-Universität Bochum

Successful social interaction is the key to all aspects of our modern life, from everyday activities to highly complex cultural, technological, and economic phenomena. One central research question, spanning philosophy, psychology, neuroscience, psychiatry and anthropology, therefore is: how do we understand other human beings? Some current interdisciplinary literature in social cognition discusses an immediate, non-theorizing, form of understanding other minds under the title of empathy. However, there seems to be little agreement as to what exactly the term empathy stands for or what best characterises the phenomenon of

empathy. Two main current approaches to understanding empathy are simulation theories of mindreading (ST) and some recent phenomenological philosophy inspired accounts of direct perceptual understanding of other minds (PT).

This paper proposes to address the issue of a basic, non-theorizing, form of understanding other minds by developing an original theoretical framework which focuses on understanding the significance of ones perceptual knowledge of the others embodied intentionality or skilful bodily engagement with the world. Two main aims of the paper are as follows:

1) understand the significance of ones perceptual knowledge of the others embodied intentionality for attributing mental states to the other with particular focus on unravelling the mechanisms of perception-action coupling to investigate the role of motor cognition in ones immediate perceptual access to the others embodied intentionality

2) uncover the nature of empathy as an immediate form of experiential access to other minds by perceptually understanding the others embodied intentionality, and specially focus on cognitive mechanisms of action-understanding which draw on ones own interaction abilities.

The general aim of the paper is to develop a theory of basic forms of intersubjectivity as active engagement between embodied social agents and to clarify how the understanding of others depends on one's own abilities of interaction. The paper combines conceptual analysis of the issues and interpreting recent experimental data from the field of social –cognitive neuroscience and psychology.

Reconstructing Mental Concepts by Analyzing Object Reference

Linn Gralla[1], Thora Tenbrink[1], and Elena Andonova[2]

[1] Bremen University
[2] New Bulgarian University

It has long been recognized that speakers flexibly adapt their object references to their addressee's presumed attention focus. However, interacting with objects may also change speakers' concepts about them. We address object reference in think-aloud protocols in a self-assembly task

and in assembly instructions. Whereas indefinite references signal the unfamiliar status of an object, definite references and pronouns signal familiarity, e.g. based on general knowledge or presence in the current situation (Mangold-Allwinn et al., 1995). Nouns vary in lexical specificity and with respect to the conceptual domain.

52 participants were given 13 wooden parts to assemble. The degree of prior knowledge about the goal object was varied so as to assess its influence on reference production. Participants were either told to assemble a sensible object or a dollhouse, or they were shown a picture of the dollhouse that they were asked to assemble. In a second study 20 instructions on the dollhouse assembly were recorded. Reference forms were coded based on video recordings. Nouns were classified as house-specific ('roof') or general ('object'). Participants without prior knowledge were assumed to use general nouns in initial reference. Participants who had already seen the target dollhouse were expected to use definite, house-specific references as they knew about the objects' function. Over time references were assumed to become more specific.

Results reveal a range of significant patterns. Participants who saw the picture frequently used pronouns in initial reference, reflecting the integration of a specific object into an existing mental representation. As expected, participants without prior knowledge used general nouns signaling an unspecific mental concept of the goal object. In the communicative situation, instructors used more nominal forms in initial reference to objects. Adapting references to the uninformed addressee, they used more general nouns than participants who received some domain knowledge in the self-assembly task. In both studies subsequent mention was predominantly pronominal.

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LISA gets Moral – Extension of the Analogy System LISA for Moral Decision Making

Peter Großmann

Cognitive Systems Group, Faculty Information Systems and Applied Computer Sciences, University of Bamberg

Each culture has its own moral values. A moral value of the western world can be viewed as immoral in countries such as India and Iran and vice versa. So-called 'sacred values" are part of the most important moral values of a culture. A 'sacred value' constitutes a moral value that has a very high significance in certain culture and is not negotiable. If one or more 'sacred values' exist in a certain scenario, people often decide not to utilitarian, but according to deontological considerations. Faced with the choice to hurt one or more 'sacred values' or to seek the largest (usually your own) benefit, utilitarian theories cannot explain the decision of the majority. However, most models for decision making prefer utilitarian approaches. Therefore new models must be developed to realize the deontological characteristics of moral decision-making. Dehghani et al. found in experiments that moral decision making is heavily influenced by stories from the respective culture (Dehghani et al. 2009). The results of the experiments also strongly indicate that analogies play a major role in the process of moral decision making. Therefore, it is obvious to develop a model for moral decision making that is based on analogies. The system 'MoralLISA' uses analogies to model moral decision making, extending the hybrid analogy model 'LISA' developed by Hummel and Holyoak (Hummel & Holyoak 1996). 'LISA' is used, because it not only considers structural, but also semantic properties for analogical inference. The ability to process semantic properties, allows 'MoralLISA' to consider 'sacred values' for analogical inference. Further semantic understanding is achieved through the use of the lexical database 'WordNet' (Miller, 1995). Applied on a number of scenarios, 'MoralLISA' seems to be a more plausible model for moral decision making than Dehghanis 'MoralDM' (Dehghani et al. 2008).

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Implicit and Explicit Learning of Artificial Grammars from Letter Strings, Visual, and Visual-Motor Patterns

Jacqueline Hofmann, Tobias Kaiser, and Ute Schmid

Cognitive Systems Group, Faculty Information Systems and Applied Computer Science, University of Bamberg

We present experimental data and an ACT-R model to examine the influence of different modes of presentation on implicit and explicit learning. Specifically, we were interested in differences between learning artificial grammars from strings vs. from graphical representations. Our material was based on an artificial grammar investigated by Dienes et al. (1991). The grammar was modified such that each string could be composed from a set of four letters. The letters were interpreted as directions in a two-dimensional grid. Graphical representations were either presented in a passive mode – analogous to the string condition – or supplemented by a motor-task where the given pattern had to be reproduced with the cursor keys. In the implicit condition subjects were instructed to memorize the presented items for a later test, in the explicit condition subjects were instructed to try to detect the rules which are common to all items. 55 subjects participated in the online-experiment. Subjects were split into 6 groups with each group getting either letter, passive graphical or active graphical presentation and implicit or explicit intruction. After the learning phase, subjects ran through a testing phase consisting of a classification test, a pattern completion (SLD) test and free reporting of learned (explicitly known) rules.

In all groups, accuracy was significantly higher than guessing probability, indicating that an implicit learning process took place in all conditions. There was a weakly significant difference between the string-

presentation and visual presentation: subjects in the two-dimensional group performed better than subjects in the string group. However, this could only be observed for the classification-test in the group with implicit information, and for the SLD-test in the group with explicit information. A reinforcing influence of the motor-task could not be observed.

The experimental conditions are currently modelled in ACT-R to reproduce results for the classification test. Strings are represented as transition rules. Visual patterns are represented as grid coordinates. Motor patterns are represented as associations. Classification of test items is based on utility for strings, on positional similarity for visual patterns and on association strengths for motor patterns.

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Size Matters! How Value Organizes Our Perception of Art

Martina Jakesch[1], Stefan Ortlieb[2], Marius Raab[2], and Claus-Christian Carbon[2]

[1] Department of Psychological Basic Research and Research Methods, Faculty of Psychology, University of Vienna
[2] Department of General Psychology and Methodology, University of Bamberg

It's one of the most famous findings in psychology: the perceived value of an object influences how we internally represent that object. What Bruner and Goodman (1947) have shown for coins—rich and poor children showed significant differences in their judgment of coin sizes—should also hold when value is a question of highly ideosyncratic appreciation.

For works of art, there should consequently be a connection between one's appraisal of a given artwork (e.g., a painting) and an estimation of that artworks 'real' size. Art experience is said to be linked with emotions; and paintings are, in contrast to coins, rarely part of every-day

routine. Consequently, we expect size estimation in the domain of aesthetic appreciation to be even more linked to personal value.

As a matching process between the painting's real dimension and its cognitive representation can only take place in the rare occasion of a museum visit, reflecting on a painting is a highly constructive process, and bound to be moderated by value (i.e., appreciation) and personality. To our knowledge, this alleged relationship has not been explored for artworks or paintings. So far, the principle "the bigger the better" was only shown for preferences for alphanumeric or Chinese characters, symbols and abstract stimuli (Silvera, Josephs, & Giesler, 2002).

We selected a range of paintings that are typical for their respective genres (surrealism, impressionism, ...) and at at the same time widely known (tested in a pre-study). Furthermore, only paintings of comparable dimensions were selected. Paintings are presented to test subjects via a high-definition projector (212x118cm projection size) in random order, each image starting as a small thumbnail; subjects are asked to scale each painting "to the size the original artwork is". As input device, we use a computer racing wheel; wheel position is smoothly and instantly mapped to the dimensions of the artwork's projection. Afterwards, for each painting we ask for a rating of appraisal (1-7) and hand out the BFI-K personality test.

We expect subjective appraisal to be a strong predictor for the cognitive task of estimating an artwork's size; moderated by art-related personality traits like 'openness'.

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Behavioural and Neural Differences in Social Engagement during Cross-Cultural Interactions

Katharina Krämer[1], Gary Bente[2], Iva Barisic[1], Siyang Luo[3], Shihui Han[3], and Kai Vogeley[1,4]

[1] Department of Psychiatry and Psychotherapy, University of Cologne
katharina.kraemer@uk-koeln.de
[2] Department of Psychology, University of Cologne
[3] Culture and Social Cognitive Neuroscience Lab, Department of Psychology, Peking University
[4] Cognitive Neurology (INM3), Institute for Neuroscience and Medicine, Research Center Jülich

The expression of emotions is an important part of nonverbal communication in social interaction (Bavelas et al, 1986). The cultural background in which a person grows up has a significant influence on the development of these emotions. This not only accounts for behavioural differences in the expression and recognition of emotions (Elfenbein and Ambady, 2002), but also for differences in the neural activity during the perception of emotions from people of different cultural groups (Han and Northoff, 2008). Additionally, there are differences in emotion perception depending on whether one is involved in an interaction compared to merely observing an interaction (Schilbach et al., 2006). In order to study these differences, faces of Chinese-looking and German-looking avatars were generated based on photographs of Chinese and German people using the software FaceGen. In 3-second video sequences these avatars express happiness and anger while they either gaze at the subject directly or at another invisible avatar. In a behavioural study, participants from two cultural groups, China and Germany, assessed the perceived valence of the emotions on a four-point rating scale. The results show that participants perceived both emotions as more pronounced when being directly looked at compared to being the mere observer of the interaction. Analyses of the interaction of the participants' Nationality, the avatars' Cultural Background, and the expressed emotions revealed that participants perceived emotions expressed by avatars from a different cultural group as more pronounced.

To characterize the neural correlates of these differences, we are currently performing an fMRI study with German participants using the

same paradigm. We expect neural activity in the medial prefrontal cortex during the perception of emotions in general. We also expect a more dorsal part of the medial prefrontal cortex to be activated when participants are gazed at directly compared to when participants just observe the interaction (Schilbach et al., 2006). As the behavioural results indicate that participants perceive emotions expressed by avatars from a different cultural group as more pronounced, we hypothesize that the activation in the respective brain areas will be more pronounced when participants observe emotions expressed by members of a different cultural group.

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Constructing Meaning in Up or Down Situated Sentences:

Is a sentence more than the sum of its words?

Martin Lachmair, Carolin Dudschig, and Barbara Kaup

University of Tübingen

The present study is concerned with the process of meaning construction from the perspective of the experiential-simulations view of comprehension. According to this view, words automatically re-activate memory traces stemming form experiencing their referents. During sentence processing, these traces are presumably combined to yield simulations consistent with the meaning of the sentences (Zwaan & Madden, 2005). From a study by Lachmair et al. (2011) we know that processing nouns with referents that are typically located up or down in vertical space (e.g., 'bird' vs. 'worm') facilitates the planning of congruent

movements (e.g., upwards for bird). The present study exploits this word-based compatibility effect to shed some light on the processes of constructing meaning in sentence comprehension.

Participants were presented with pairs of sentences, consisting of a context and a target sentence, the latter always ending in an object noun with a typical location in the upper part of vertical space (e.g., bird). The context either supported or reversed this location. Thus, for supporting sentence-pairs, the target object was located in the upper part of vertical space (e.g. "Anna looks to the sky. There she sees the bird"), and for reversing-pairs, in the lower part of vertical space ("Anna looks to the ground. There she sees the bird"). Sentence pairs were presented auditory, expect for the last word which was presented visually in one of four colors to which participants responded with an up- or down-key press. We found a significant interaction of sentence-type and response. For supporting pairs, up-responses were faster than down-responses, whereas for reversing pairs, down-responses were faster than up-responses. As both types of pairs ended in the same nouns, this result suggests that the observed differences reflect processes at the sentence or discourse level. To rule out the possibility that the words mentioned in the context sentences (e.g., "sky" vs. "ground") are responsible for this effect, we are currently conducting an experiment in which participants respond to the target words after reading a context word that is associated with either an up- or a down location. If no context effect occurs in this experiment, we can conclude that the observed interaction effect indeed reflects processes beyond the word level.

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Levels of Cognitive Extension

Holger Lyre
Philosophy Department, University of Magdeburg
lyre@ovgu.de

Ideas about cognitive extension have flourished in recent years and quite a debate about the general pros and cons of the hypothesis of extended cognition (HEC) has taken place. While opponents to HEC have mainly focused on the, as they see it, fallacious argument from coupling to constitution, most supporters of HEC adopt an extended functionalist point of view, where the couplings between system and world as well as between subsystems are all that matters to bring about cognitive functionality in extended cognitive systems. Hence, coupling has been noticed as important and the quality and bandwidth of coupling as sufficient for cognitive extension. But what has seldom been discussed is the question whether different levels of cognitive extension must be distinguished and what the corresponding different coupling conditions or coupling mechanisms are. The present paper wants to fill this lacuna. My thesis is that four levels of cognitive extension must be distinguished, which relate to cognitive extension into (1) the body, (2) the physical environment, (3) the social environment, and (4) the information environment. They are roughly motivated by ideas of embodied cognition and dynamicism (1&2), social cognition and theories of meaning (3) and situated cognition in general (1-4). The most complex level is perhaps the third level which may further be divided into three sub-levels pertaining cognitive extension into other minds (3.1), into "we-space" (3.2) as well as into full language communities (3.3). Each level comes equipped with its own type of coupling conditions and mechanisms, and it will the main task of the paper to disentangle and scrutinize them in greater detail. What will be crucial for our discussion is, moreover, the fact that we must not only distinguish coupling conditions on the different levels but also conditions which solely pertain the vehicles of cognition as opposed to conditions pertaining cognitive content.

Anxiety, Working Memory and Analogical Reasoning

Alexander G. Perrone[1] and Tarek R. Besold[2]

[1] ILLC, University of Amsterdam
Alexander.Perrone@student.uva.nl
[2] Institute of Cognitive Science, University of Osnabrück
tbesold@uni-osnabrueck.de

A series of experiments was designed to explore the quantitative relationship between anxiety, working memory (WM), and analogical performance in a picture-based analogy task. Experimental results obtained from an initial exploratory series of tests indicate deviations from the theoretical paradigm assumed in the literature:

Eysenck's (Eysenck, 1979) working memory theory predicts that anxiety causes a reduction of the available capacity of working memory, always reducing processing effectiveness.

Tohill and Holyoak (2000) hypothesized that anxiety exerts its effect on analogical performance solely through a restriction on WM and reported an analogical shift from relational to attribute mappings for participants in the anxious condition, though no measure of WM was provided. Replicating this experiment produced the same anxiety-inducing effect, but no analogical shift.

Waltz, Lau, Grewal, and Holyoak (2000) report decreased analogical mappings for participants under a WM load. Replicating this experiment, again no analogical shift was found.

In the first exploratory series of tests, correlational measures revealed a strong negative correlation between anxiety (as measured by the state portion of the STAI (Spielberger et. al., 1970)) and WM (as measured by a digit-span task) for participants in the non-anxious condition, but the opposite relationship held for participants in the anxious condition. A relatively loose relationship held between WM and analogical performance as a whole. For participants in the non-anxious condition, Eysencks working memory theory closely predicted the observed relationship between anxiety and analogical performance, but not for participants in the anxious condition.

We conclude that the classical theory is only partially confirmed, and that the anxiety-inducing task influences analogical reasoning in a way not accountable by WM alone.

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Mind or Machine? – Assessing the Experience of Engagement in Social Interaction in a Combined Eye-Tracking and fMRI Paradigm

Ulrich Pfeiffer[1,2], Leonhard Schilbach[1], Bojana Kuzmanovic[3], Bert Timmermans[1], Gary Bente[4], and Kai Vogeley[1,2]

[1] Neuroimaging Lab, Department of Psychiatry, University Hospital Cologne
[2] Cognitive Neuroscience, Institute of Neuroscience and Medicine, Forschungszentrum Jülich
[3] Ethics in the Neurosciences, Institute of Neuroscience and Medicine, Forschungszentrum Jülich
[4] Institute of Media and Social Psychology, Department of Psychology, University of Cologne

To investigate social interaction in real-time, we have developed an interactive eye-tracking paradigm allowing participants to engage in gaze-based interaction with an avatar. In a non-verbal Turing test, participants were asked to decide based on the avatar's gaze behavior whether he had been controlled by another participant or a computer while, in fact, the latter was always the case and the other participant a confederate. The probability of gaze-following as compared to gaze-aversion was modified by varying the maximum number of gaze-following reactions ranging from zero to five out of five trials. The test was conducted in two conditions while eye-movements and neural activity were measured in an MRI scanner. In the naïve condition, the confederate was

introduced as naturally reactive and unaware of the participant's task. In the cooperative condition, the confederate was introduced as cooperative and aware of the task. Behavioral results indicate that the ascription of humanness increases with higher degrees of gaze-following in the naïve condition. Contrastively, humanness was also ascribed in cases of high degrees of gaze aversion when the confederate had been introduced as cooperative, thus indicating an expectation of more complexly coordinated behavior from a cooperative interaction partner. In the naïve condition, humanness ascription correlated with activation of the nucleus accumbens – a brain region considered to be a vital part of the brain's reward system. In the cooperative condition there was additional activation of the medial prefrontal and orbitofrontal cortices, two areas known to be implicated in thinking about the mental states of others. This demonstrates that in unconstrained social interaction the experience of interacting with a human interaction partner is guided by reflexive, reward-related neural activity. In a cooperative context, the same experience correlates with higher-order reflective processes in the mentalizing system. This study constitutes the first empirical approach to investigating the experience of being engaged in non-verbal social interaction with another person 'online' and isolated from non-social interaction.

An Operational Model of Joint Attention – Timing of the Initiate-Act in Interactions with a Virtual Human

Nadine Pfeiffer-Leßmann, Thies Pfeiffer, and Ipke Wachsmuth

SFB 673 Project A1, Artificial Intelligence Group, Faculty of Technology, Bielefeld University

Joint attention has been identified as a foundational skill in human-human interaction. In our research, we use virtual humans to evaluate cognitive models, here, enabling them to engage in joint attention. This requires an operational model with precise information on natural gaze timing. We aim at substantiating our model of joint attention (Pfeiffer-Leßmann & Wachsmuth 2009) by studying human-agent inter-

actions and present results on the timing of referential gaze during the initiation of joint attention.

Our operational model of joint attention covers four phases: initiate-act (1), respond-act (2), feedback phase (3), and focus-state (4). It is implemented in the cognitive architecture of our virtual agent Max. For the evaluation of the model in interaction with humans, investigations on timeframes, human expectations and insights on how humans actually perceive Max' behaviors are indispensable.

In the present study we focus on phase 1. We let the participants engage in joint attention with Max in an immersive virtual reality environment, which provides a highly controlled experimental setup. The experiment had two conditions: in one the participants took the role of the initiator, in the other Max was the initiator. We found that participants accepted the same kind of gaze patterns produced by Max using our model as natural as they themselves performed when they had the initiative. Thus, under both conditions we found a mean dwell time of 1.9s for the referential gaze act, which is compatible with related findings in human-human interaction.

The applicability of our human-agent approach to investigate cognitive modeling was confirmed in three ways. First, the participants attested a high level of presence both to themselves and to the agent. Second, there was no significant difference between produced and accepted timings in the two conditions. And third, the obtained results are compatible with those from literature. Thus Max appears to be accepted as an interaction partner. Motivated by the success of this approach, we will iteratively investigate further phases of our joint attention model.

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Motion and Emotion: Using Kinect to Force Ideomotor Empathy

Marius Raab[1], Vera Hesslinger[1], Claudia Muth[1], and Sibylle Enz[2]

[1] Department of General Psychology and Methodology, University of Bamberg

[2] Group for Interdisciplinary Psychology, University of Bamberg

According to Enz (2009) motor impulse is an important component of empathy ('ideomotor empathy'), along with cognition and emotion. This is in line with the notion of cortical 'mirror neurons', and with theories about so-called 'ur-emotions' (Parrott, 2010) that stress activation and action readiness as foundations of higher cognitive and emotional experiences. Yet, appropriate methods to measure ideomotor empathy need to be found as, e.g., self-reports and questionnaires are not suited for on-line measurement and suffer from the difficulty of rating motor involvement on questionnaire scales.

In the present experiment, we assess the impact of 'forced ideomotor empathy', i.e. the effect of a coerced combination of perception and action by imitating performed movements, on emotional state and empathy. Further, we address the above mentioned methodological problem by testing whether the commercial off-the-shelf sensor Microsoft Kinect can serve as a more valid and reliable device for measuring motor involvement.

For the first part of the experiment, participants were assigned to one of three experimental conditions: In condition (1) they watched a video showing an actress who performed pronounced gestures while speaking a highly emotional monologue ('monologue scene'). In condition (2) and (3) they were additionally asked to synchronously re-enact the actress' gestures while watching the same monologue or this scene performed without speech ('gesture scene') with the actress wearing a sports outfit, respectively. Participants' positions and postures were tracked via Kinect and rendered as a simple moving skeleton on the scene. Thus, participants were driven to focus on the actress' gestures and their own movements at the same time and to check for congruency of their limb positions with the actress' gestures. In the second part of the experiment, participants performed a visual sorting task via Kinect; speed and precision were measured. Finally, data on emotional state

(PANAS; Thompson, 2007) and empathic behavior (Enz, 2009) were gathered.

Comparing conditions (1) and (2), we expect to determine the impact of forced ideomotor empathy on emotional state and empathy. Condition (3) serves as a baseline revealing the influence of the movement task alone. Furthermore, by comparing the PANAS-results, the empathy scale outcome, and the performance in the sorting task, we evaluate whether there is an increment in validity and reliability when measuring ideomotor empathy via Kinect as compared to common questionnaire instruments.

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cVIS – Combining Visualization and Cognition

Michael Raschke and Thomas Ertl

Institute for Visualization and Interactive Systems, University of Stuttgart

To study the perception and cognitive processes when users are working with visualizations we are developing the cVIS framework with three modules. The three modules are: eye tracking analysis, semantic visualization models and a cognitive simulation based on ACT-R. Visualizations are for example bar charts, pie charts or scatter plots. The cVIS framework aims at providing a simulation framework for the optimization of visualizations from a user centered perspective.

We have performed several eye tracking user experiments, which show that general eye movement strategies can be found when participants are solving tasks by using data visualizations. Beside heat maps and scan path visualizations we have used the Parallel Scan-Path Visualization technique to find common scan paths in our user experiments. This new eye tracking visualization technique provides an AOI based

graphical representation for a large number of scan paths in one diagram without visual clutter [1].

Today the development of data visualizations is mostly driven by a technical perspective. However, new approaches optimize the data visualization from a cognitive perspective. One approach is to annotate graphical elements with semantic information from visualization ontologies. This annotation supports the eye tracking analysis by studying the semantic structure of the scan paths and allows adapting the graphical layout to the cognitive skills of the users [2].

Using these two techniques we are getting two types of information for a simulation: first, completion time values and information about common geometrical structures of scan paths; second, a basis for a knowledge processing model of visual perception by studying the temporal order of focused semantic entities. Our aim is to use this information to develop an ACT-R based model which describes mental processes when working with simple visualizations.

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Time and Space in Possible Worlds

Klaus Robering

University of Southern Denmark

robering@sitkom.sdu.dk

The logical analysis of reasoning relating to perception and action often requires the consideration of possible courses of events (“possible worlds”) which differ with respect to their spatio-temporal properties. An example at issue is the case of the Ames room illusion (cf., for instance, Metzger 1975, 241-244, 253f): The obsverver sees a person growing and shrinking while that person is moving from one corner of a room to the other. It is of course knwon to the observer that such rapid

changes of body size is (physically, though not logically) impossible. The observer thus recognizes a discrepancy between two possible courses of events: namely, between that what is seen and that what is (known to be) actually the case. These two courses of events are systematically connected to each other by a certain relationship between their internal geometries, which (together some facts of geometrical optics) "explains" the illusion.

Logics based upon classical possible worlds semantics are not able to deal with such situations in the most direct way since their possible worlds are not provided with any geometrical infrastructure. Here, instead, a many-sorted mereological framework will be proposed for explicitly reasoning about both spatial and temporal features of possible courses of events. That framework is based on a modification of Tarski's (1937) axiomatization of ("atomistic") mereology. Possible worlds - i.e., entire courses of events - are mereologically maximal individuals within the logical sort of "occurents" and their minimal counterparts are "point events". Occurents are considered to have both temporal and geometrical extencsion; hence we deal with the "geometry" of 4-dimensional entities. Since some applications of the framework will require worlds differing in their internal geometries (for example: euclidean vs., perhaps, spherical or hyperbolic), geometrical structure is stepwise added upon the mereological layer: first axioms of a topological character will be added which are followed, then, by postulates governing the properties of "convex" occurents thus opening the way to affine geometry; cf. Coppel (1998).

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Cognitive Mechanisms of Systematic Enumeration in Positional Number Notation

Stefan Schneider, Benjamin Angerer, Alexander Blum, and Sven Spöde
Institute of Cognitive Science, University of Osnabrück
{stefschn, bangerer, ablum, sspoede}@uos.de

Systematically enumerating numbers in positional notation (PN) cannot be learned by memorisation. It exceeds early numerical competence and requires the cognitive realisation of an algorithmic structure which imposes order on numerical thought that is indispensable regarding actual tasks. In contrast to the precision and sparseness of formal definitions, there is ample evidence that numerical cognition rests upon a plethora of redundant, intuitive and also metaphorical structures. As it remains unclear how humans realise such a system, we used a combined qualitative/quantitative approach to investigate the fine-grained, inductive processes of constructing an unfamiliar enumeration algorithm.

As a qualitative case study, 12 semi-structured interviews with 1st-year students were conducted. Their task was to learn a camouflaged quaternary system with the symbols A, B, C, D (instead of 0, 1, 2, 3) by way of example, and to intermittently explain their ideas. A quantitative online study with 60 subjects confirmed the subjects' preferences towards different continuations, and aspects that they perceived to be central.

As was expected, the system's unfamiliar presentation effectively prevented subjects from recognising that it was PN at all. Instead, they derived rules from the given examples and made up a generative structure from scratch. Interestingly, many subjects had problems understanding the mechanism of zero ("A") which in general lead them to try diverse strategies incorporating perceived inconsistencies as a rule. Further points of interest were the discovery and arduous instantiation of analogies and the emergence of comprehensive metaphors.

Based on the analysis of the protocols we hypothesise that the enumeration algorithm is cognitively implemented by a rich assembly of interlocking structures, which dynamically adapt and apply to given situations. Several mechanisms are discussed: Continuous re-approaches to the task yield multiple variants of perceived structures, enriching the understanding and making it more flexible. In order to solve conflicts,

hypotheses of smaller and wider scope are formed which are locally applied and tested. Subjects either change their hypothesis (accommodation) or reinterpret the stimulus (assimilation). This results in a detailed understanding of enumeration through a modularisation of differing scopes. Even after having learnt the system, the subjects' remarks show that their conception remains in development.

Modelling Adaptation Effects as Similarity to Dynamic Prototypes

Michael Siebers[1], Johannes Folger[1], Simone Schineller[1], Dominik Seuß[1], Stella Faerber[2], and Ute Schmid[1]

[1] Cognitive Systems Group, Faculty Information Systems and Applied Computer Science, University of Bamberg

[2] Department of General Psychology and Methodology, University of Bamberg

Every day we have to make decisions: what to do, what to wear, what to buy. Many of these decisions are based on aesthetics. The similarity of objects to the individual's prototype for the objects' category is a fundamental decision criterion (Rosch, E., 1978). However, prototypes are dynamic and change with experience. To investigate this prototype shift we conducted an experiment using the Repeated Evaluation Technique (Carbon, C. C. & Leder, H., 2005). As stimuli we used 2D images of forks. As forks are everyday objects it is ensured that every subject has an already established prototype. However, the amount of commercially available models leads us to expect a great variance in prototypes. To reduce complexity we restricted the stimuli variations on two dimensions: the overall roundness and the length of the handle.

As first experiment step subjects are required to model their prototypical fork within the given variability. Then subjects rate a presented set of fork variated on both dimensions. Rated are the typicality, the innovativeness, and the attractiveness of the presented fork. Then subjects will be presented an adaption set of forks with extreme values on both dimensions. Using diffent tasks subjects are forced to engange with the unusual fork models. Finally subjects again have to rate the initially presented forks and to model their prototypes.

We expect a shift of subjects' individual prototypes in the direction of the unusual objects. This should also be reflected by the final attractiveness ratings: In the last phase objects that are extreme are expected to receive higher attractiveness and typicality ratings than they did in the first rating step. On the other hand innovativeness is expected to decrease.

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Generalizing Schemas in a Complex Scenario – Can Analogy-Based Training Material Trigger the Acquisition of Solution Principles in Chess?

Christoph Sonnenberg

Cognitive Systems Group, Faculty Information Systems and Applied Computer Science, University of Bamberg

christoph.sonnenberg@uni-wuerzburg.de

It is empirically established that analogical problem solving can lead to an abstraction of the common solution structure. This phenomenon is known as schema induction or generalization of schemas. The acquired solution principle can facilitate the transfer for similar subsequent problems. Previous studies used simple tasks which were easily manageable for the participants. In contrast, I chose chess as a test environment in order to find evidence for generalization of schemas in a domain which is more representative for complex cognition. Moreover, a direct comparison of three kinds of teaching material - including two different analogy scenarios - is another novelty in my experiment and addresses the question which type of analogy is more useful to the learner.

A between subject design was used to investigate which type of teaching material can efficiently trigger schema induction. 33 participants received one of three trainings on two different solution principles for chess positions. The varying training conditions were 'abstract rule',

'analogy within the domain of chess' and 'analogy between military and chess'. In the following they had to work on a series of chess tasks which all could be solved by the trained solution principles. In detail, the participants had to select all chess pieces which they regarded as essential for the problem structure (in order to measure the schema quality) and to specify a solution. Previous knowledge and current motivation were surveyed for being possible influencing variables.

In general, the results showed an advantage for the within analogy group. The group differences were, however, only statistically significant for one of the two solution principles. Previous knowledge of the participants appeared to be an influencing factor on performance, whereas the current motivation in the learning situation was not. Furthermore, the schema quality could be identified as a predictor for the solution frequency. This points to the importance of knowing the solution structure in the used problem solving domain.

A Functionalist Approach to the Concept of 'Delusion'

Patrice Soom and Gottfried Vosgerau
Institute of Philosophy, University of Düsseldorf
{patrice.soom, vosgerau}@phil.uni-duesseldorf.de

Delusions are key symptoms of many severe types of mental disorders. Even though the empirical research made considerable progress towards etiological and reductive accounts of delusions, an adequate theoretical definition of this concept is still to be offered. This contribution aims to use the theoretical tools of analytic philosophy of mind in order to provide a functional definition of the concept of 'Delusion', and to show how this definition may be used to set up a sub-type classification of delusions.

Starting from a critical evaluation of the DSM-IV definition of delusions, we shape a positive account of what delusions are from a functional point of view. According to this analysis, the criteria of i) falsehood, ii) inadequacy with the beliefs spread within the surrounding social community, iii) firm sustainment and iv) that delusions are about the external reality, are inadequate because they describe unnecessary

conditions for delusionality. In fact, the content of delusions and its epistemic relations to the world and to the beliefs of others are inadequate to define delusions. We argue that from a functionalist point of view (see Soom, Sachse, & Esfeld, 2010, for a methodological analysis of functionalism), delusions are essentially characterized by an asymmetrical inferential profile, which explains their immunity to revision in the absence of medication. Accordingly, delusions might impact on other beliefs of the patient, whereas they are not inferentially affected by the latters. This view is supported by arguments according to which delusions do impact on other beliefs, that normal beliefs are revisable and that assuming that delusions stand on a continuum with normal beliefs leads to intractable theoretical difficulties.

Building on from the above functional definition, we consider etiological and reductive accounts of delusions. According to the latter, there are two factors at play here: (a) tokening a problematic belief while (b) preventing rejection of this belief in spite of its inconsistency with evidence (Coltheart, Langdon, & McKay, 2011). In turn, this suggests that all delusions share a specific inferential profile and that the specific etiology of different delusions might contribute to individuation of (functional) sub-types of delusions. An empirically informed taxonomy of delusions might be established on that basis.

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Mental Models of Spatial Cognition: Toponyms and Orientation

Martin Thiering

Max-Planck-Institute for the History of Science
Humboldt-Universität zu Berlin

This paper focuses on mental models of topographical coordinates in two unrelated languages. Eipomek is spoken in the central mountains of the Province of Papua (West New Guinea), and Dene Chipewyan,

spoken in the prairies of Cold Lake, Alberta (Canada). The paper explores the degree to which environmental experience of landmarks and spatial orientation is reflected as cultural-specific mental models (Hutchins 1983, 1995; Thiering 2012). The hypothesis is that non-linguistic information as cultural practice has its impact upon spatial language and mental models (Mark et al. 2011). Furthermore, topographical information of the immediate environment in particular is represented as mental models constituting gestalt-like representations (Thiering 2011). Field data from the author using different visually-based elicitation tools and different ethnographic grammars, texts, and films (Heeschen 1990, 1998) serve as empirical background showing the influence and constructive process of environmental landmarks upon shaping of spatial categorization. Hence, the general aim is to survey some fundamental spatial notions based on regional landmarks. Landmarks are defined as any kind of cultural-specific environmental external reference points, e.g., mountains, river, house, or a tree. Landmarks are point references external to the person. In a city, landmarks may be distant buildings or geographical features that can be seen from many angles and distances, or they may be primarily local such as buildings, signs, trees, storefronts, doorknobs, or other urban details. A personÕs account of his/her spatial orientation and navigation generally begins with mental models of landmarks, and these mental models are strategic foci to and from which the person moves or travels (Hutchins 1995). Hence, landmarks are used as proximate course-maintaining devices in the encoding of figure-ground asymmetries (Thiering 2011). It is argued here that these landmarks shape and determine a detailed topographical mental model of the environment as externally represented via language and practices. Indeed, the presented data show a dense linguistic system of topographical mental models represented, e.g., in toponyms (Mark et al. 2011). Hence, the overall focus of this paper is on the intricate interplay between language and culture and mental models.

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Making the Most of Affordances?

A. Tillas, T. Seuchter, and G. Vosgerau

Department of Philosophy, University of Düsseldorf

atillas@phil.uni-duesseldorf.de

The notion of affordances is one of the most controversial notions in psychology and cognitive science. Our target is to secure the explanatory role of affordances in understanding behavior while avoiding the controversies of ecological psychology. Traditionally, it has been argued that the explanatory role of affordances could be secured by appealing to their objective nature and their direct perceivability. We appeal to the methodological merits of empirically informed analytical philosophy of mind in order to suggest that the explanatory role of affordances could be secured on different grounds. We argue that affordances are relational properties, ascribed to objects by agents not by being perceived directly but on the basis of the feedback information received when subjects interact (even unintentionally) with their environment. Here affordances are seen as inherently linked to unintentional movements and possible intentional actions. More specifically, it is argued that in virtue of the linkage between affordances and intentions one could account for the infinite number of affordances that any given object could have. Furthermore, perception of affordances and in turn their explanatory value could be secured by appealing to objective systematic contingencies between movements and perceptual inputs that provide the actor with information about the effects of his/her actions on the environment. It is courtesy of these systematic contingencies that affordances acquire their objective aspect and are thus perceived universally. For instance, a simple unintentional contact with a solid surface suffices for any subject

to gather information about solid objects affording bumping into them. On the basis of such unintentionally acquired affordances, other affordances could be acquired through intentional movements. That is, once a subject has acquired knowledge of solid objects affording bump-on-ability, for instance, s/he could use this knowledge in fulfilling his/her intentions of using a rock as a doorstopper. In this sense, perception of bump-on-ability of solid objects is complementary to perception of door-stop-ability of a rock. Note here that affordances perceived on the basis of unintentional movements are neither necessary nor sufficient for perception of affordances perceived on the basis of intentions. It is just that, as it happens, the latter are perceived by making use of knowledge acquired on perception of the former.

Motor Imagery of Interpersonal Coordination

Cordula Vesper[1], Günther Knoblich[1,2], and Natalie Sebanz[1,2]

[1] Donders Institute for Brain, Cognition, and Behaviour, Center for Cognition, Radboud University Nijmegen

[2] Department of Cognitive Science, Central European University

Many of our actions are not performed in isolation but together with other people. When performing such joint actions, we often need to closely coordinate the timing of our own actions with a partner's actions in order to achieve a shared goal. This study investigated the mechanisms underlying interpersonal coordination by using a novel motor imagery paradigm. The task was based on an earlier study (Vesper, van der Wel, Knoblich, & Sebanz, 2012) in which pairs of participants synchronized the landing times of simple forward jumps. If performance in the present imagery task were to resemble actual performance, this would provide evidence in favour of a motor simulation account for joint action (e.g. Wilson & Knoblich, 2005; Wolpert, Doya, & Kawato, 2003) according to which co-actors use their own motor system to predict and adapt to others' actions. Individual participants were asked to imagine performing jumps either alone or together with another person and to indicate the timing of their take-off and landing by pressing a key. By varying the difficulty of their own and the imagined other's actions, we could determine to what degree and under which conditions individuals adapted their actions in the service of coordination.

The results suggest that, first, imagery of interpersonal coordination resembles performance during actual interaction and that, second, participants achieved coordination by integrating predictions about the timing of their own and their partner's actions. These findings are consistent with a motor simulation account for joint action.

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Perceiving Through Moving? A Conceptual and Empirical Critique of Enactivism

Arne M. Weber

Institut für Philosophie, Heinrich-Heine-Universität Düsseldorf

According to Noë's enactive theory of sensorimotor contingencies (Noë 2004; O'Regan & Noë 2001) sensorimotor processes are constitutive for perception. An obvious problem here is that the sensorimotor basis is seen just as a constitution condition, but not as an acquisition condition of perceptual abilities. This critique is based on conceptual considerations of and empirical evidence for a theory focusing on the interdependencies of motor control and action-related cognitive processes like thinking about an action or perceiving an action.

For Noë perceptual experience – especially vision – derives from acquaintance with sensorimotor contingencies depending on the visual apparatus, bodily activities and properties of the world. Perceptual awareness depends constitutively on the perceiver's sensorimotor knowledge, an implicit know-how of the way sensory stimulation varies with movement. Thus, for Noë perception is fundamentally shaped by the motor abilities of the perceiving body. A specified approach – call it grounded action cognition – can provide a theory of the relation be-

tween motor control and action-related cognitive processes by distinguishing between grounding qua acquisition and grounding qua constitution. This approach is also empirically supported by studies concerned with motor disorders and related cognitive or perceptual impairments as in ALS or Parkinson's disease and proprioceptive deficits like deafferentiation.

According to representative studies, motor abilities are constitutive of some action-related perceptual abilities, but not of others previously acquired; impaired motor control mechanisms influence the perception of actions, such that it is degraded but not lost altogether. Movement is thus not necessary to maintain certain perceptual abilities. Moreover, some perceptual abilities can be counted as part of the motor control domain and the action cognition domain. Thus, the domains overlap to a certain degree, but can still be empirically distinguished. The fact that the domains mere partially overlap is also an indication for a partial independence of these domains.

Given that a breakdown of motor abilities does not result in a complete breakdown of perceptual abilities, Noë's approach is at odds with the empirical evidence and his claim that perception solely depends on motor abilities falls short. Instead, a distinction between constitution and acquisition of cognitive abilities fosters a more accurate understanding of the mind.

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Cognitive Linguistics as a Framework to Study the Evolution of Language from a Cognitive Science Perspective

James Winters[1] and Michael Pleyer[2]

[1] Independent Researcher
wintzis@gmail.com
[2] University of Heidelberg
michael.pleyer@hggs.uni-heidelberg.de

Studying the evolution of language and its underlying cognitive mechanisms is an important topic in cognitive science, requiring a highly interdisciplinary approach (Tallerman & Gibson 2012). In this talk, we argue that Cognitive Linguistics (CL) (Evans 2012), which sees language as relying on general cognitive abilities, can make significant contributions to language evolution research. As CL actively seeks converging evidence from other disciplines in cognitive science in its analyses and explanations, we claim that it presents a theoretical approach ideally suited to integrate cognitive science and research on the evolution of language.

We will illustrate this proposal in terms of the three timescales relevant in accounting for the structure and evolution of the complex adaptive system of language (Kirby 2012):

1. The ontogenetic timescale: individuals acquiring language
2. The glossogenetic timescale: historical language change
3. The phylogenetic timescale: the biological evolution of the species

On the ontogenetic level, studies within the framework of CL have demonstrated the importance of social, cultural, interactive and cognitive processes in the acquisition and learning of language (Beckner et al. 2009). Concerning the diachronic level, work in CL is beginning to unravel the interaction of general cognitive mechanisms and cultural transmission in influencing language change and the emergence of structural patterns through processes of grammaticalization.

Lastly, CL can inform accounts of the phylogenetic evolution of language by specifying the representational and cognitive abilities that need-

ed to evolve to support the dynamic processes of interactive meaning construction fundamental to language.

In our talk, we will present case studies from these timescales to illustrate that CL promises to be a highly fruitful framework for elucidating the factors and cognitive mechanisms involved in the evolution of human language from a cognitive science perspective.

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Posters

A Framework for Computer Simulations of Motivated Behaviour on the Base of a Cognitive System of Motivation (COSMO)

Andreas Ammann
Didactics of Biology, Martin Luther University Halle-Wittenberg

Due to the ambition for a more holistic view on human behaviour in cognitive modeling, the implementation of motivational concepts in this field is progressing. A recent example -amongst others- is the cognitive architecture CLARION (e.g. Bach, 2009; Sun, 2006) where motivational concepts are implemented as integrative elements. A disadvantage of this approach is that a substantial disarray in the classification of motivation concepts (e.g. Spinath, 2008) is directly transferred from motivation psychology to cognitive modeling. To solve this problem an analysis of the motivation elements itself from a cognitive perspective has to be taken into account. The results of such an analysis constitute a valuable theoretical support for the classification of motivation in the field of motivation psychology thus improving the cooperation of these two fields.

For this purpose a concept of a cognitive system of motivation (COSMO) was constructed. It focuses on the question to what extend motivation like mechanisms are effective problem-solving-strategies in the context of complex environments. A set of interrelated mechanisms was developed that shows parallels to a broad range of motivational concepts. This parallels span basic motivation concepts as well as complex approaches on human behaviour (e.g. competence motivation and cultural activity theories), goal orientated and non goal orientated concepts (e.g. performance motivation and intrinsic motivation) and biological orientated approaches such as evolutionary psychology. Based on these results, suggestions are derived for functional relationships between concepts of motivation psychology. A framework for computer simulations based on COSMO was designed. The intention of this framework is to test the optimization mechanisms with respect to their problem-solving abilities.

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How to Bring Down an Airplane: Inverting the Word-Action-Compatibility-Effect in Phrases

Eduard Berndt, Fritz Günther, Jonathan Gabriel Maier, Monica De Filippis, and Barbara Kaup

Department of Psychology, University of Tübingen

According to the experiential-simulations view of language comprehension, understanding language is tantamount to mentally simulating the experience of the described objects, situations, or events (e.g., Barsalou, 2008). Presumably, words automatically re-activate traces in memory stemming from experiencing their referents. Indeed, previous studies showed compatibility effects during word processing between the vertical location of a word's referent (roof: up; cellar: down) and the response that was required by the experimental task (up vs. down). Responses were faster in compatible conditions (up response to roof, down response to cellar) than in incompatible conditions (down response to roof, up response to cellar; Lachmair et al. 2011; see also Dudschig et al., in press). With respect to sentence processing, the experiential simulations view holds that the re-activated memory traces are combined to yield a simulation consistent with the meaning of the whole sentence (Zwaan & Madden, 2005). In the current study we aimed at investigating this hypothesis by extending the compatibility effects already observed with single words to two-word phrases.

Participants were presented with adjective-noun combinations in a sensibility-judgment task. All experimental nouns had referents with a typical location in the upper part of vertical space (e.g., airplane). Each noun was combined with four different adjectives: (a) an adjective that was associated with an up-location and supported the refer-

ent's up-location (e.g., flying airplane), (b) a neutral adjective that supported the referent's location (e.g., red airplane), (c) a neutral adjective that changed the referent's location from up to down (e.g., parking airplane), and (d) a neutral adjective that made no sense in combination with the noun (e.g., hairy airplane). Participants were instructed to judge the phrases sensibility by pressing an up- vs. a down key. For half of the participants the yes-key was up, for the other half the yes-key was down. The results provided strong support for the experimental simulations view: For combinations with up-supporting and neutral-supporting adjectives, up-responses were significantly faster than down-responses. In contrast, for combinations with neutral inverting adjectives, down-responses were significantly faster than up-responses. These results go beyond previous studies in showing that comprehenders had indeed combined the adjective and the noun to yield a simulation consistent with the whole phrase.

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Neuronale Veränderungen durch Schriftspracherwerb im Erwachsenenalter

Melanie Boltzmann[1] und Jascha Rüsseler[2]

[1] Abt. Neuropsychologie, Institut für Psychologie II,
Otto-von-Guericke-Universität Magdeburg
melanie.boltzmann@ovgu.de

[2] Professur für Allgemeine Psychologie, Institut für Psychologie,
Otto-Friedrich-Universität Bamberg
jascha.ruesseler@uni-bamberg.de

Funktionale Analphabeten weisen große Defizite im Lesen und Schreiben auf; sie verlassen die Schule in der Regel mit Fähigkeiten, die mindestens drei bis vier Jahre unter dem zu erwartenden Niveau liegen. Einer aktuellen Studie zufolge gibt es in Deutschland 4,1 Millionen funktionale Analphabeten mit deutsch als Muttersprache.

In der vorliegenden Studie wurden die neuronalen Korrelate der Schriftsprachverarbeitung bei 20 erwachsenen funktionalen Analphabeten mit fMRT und mit ereigniskorrelierten Hirnpotenzialen untersucht. Vor und nach einem achtmonatigen, spezifischen Lese- und Rechtschreibtraining wurden den Teilnehmern Wörter, Pseudowörter und Buchstabenketten präsentiert.

Mit standardisierten Lese- und Rechtschreibtests konnte bei allen Teilnehmern eine deutliche Verbesserung im Lesen und Schreiben nachgewiesen werden. Die N170-Komponente des ereigniskorrelierten Hirnpotenzials differierte in ihrer Amplitude vor dem Training nicht zwischen Wörtern und Symbolen; nach dem Training konnte eine erhöhte N170 Amplitude für Wörter beobachtet werden. In den beiden Kontrollgruppen (funktionale Analphabeten ohne spezifisches Training und reguläre Leser) trat keine Veränderung in der N170 für Wörter auf. Analog zu diesem Ergebnis wies bei funktionalen Analphabeten der linke Gyrus fusiformis (einschließlich des visuellen Wortformareals) nach dem Training größere Aktivierungen als vor dem Training auf. Weiterhin konnten trainingsabhängige Aktivitätserhöhungen in präfrontalen Hirnarealen beobachtet werden.

Die Ergebnisse zeigen, dass auch bei erwachsenen funktionalen Analphabeten Verbesserungen in der Schriftsprache mit neuronalen Veränderungen einhergehen. Nach dem Lesetraining wird unter anderem

verstärkt das visuelle Wortformareal aktiviert, welches als eine beginnende Automatisierung der Worterkennung interpretiert werden kann. Insgesamt sprechen die Ergebnisse dafür, dass sich bei erwachsenen funktionalen Analphabeten eine Spezialisierung für Wörter entwickelt, die vergleichbar mit der Entwicklung bei Leseanfängern im Kindesalter ist.

The Limits of Cognitive Assistance – The Limits of the Inferential Model?

Gerhard Chr. Bukow and Bernhard Will
Department of Philosophy, University of Magdeburg
bukow@ovgu.de

If cognitive agents are able to use cognitive models/theories of other agents for prediction and explanation, then they have basic theory of mind-abilities. They are able to assist other agents in a cognitively informed way, i.e. both rational norms and psychological formats of assistance are given. Generally, assistance in such a way is the usual case in man-man-interaction, but it is also desirable for man-machine-interaction. Especially, the ability of thought-following over several changes of agents' belief states is desirable to manage complex interaction.

The standard solutions in man-machine-interaction are typically based on certain very strong normative rationality assumptions that limit cognitive assistance to the inferential change of belief states, or (less often) the inferences on possible perception. These changes happen in very comfortable "spaces" fulfilling properties like consistency, coherence, closeness, etc. We call this the inferential model of cognitive assistance. The inferential model reduces Theory of Mind in the realm of man-machine-interaction to a seemingly comfortable syntactical view. However, this implicates several problems:

1. Deficits: Is it legitimate to set certain norms like the consistency-assumption as "the" norms and to declare everything else (e.g. actual humans) as deficient?

2. Lacks: We daily assist in a cognitively informed way in these areas:
   a. Inconsistency in belief systems
   b. Indeterminacy in truth values
   c. Perception of impossible objects
   d. Non-extensional semantics and pragmatics of communication

We present a new model of cognitive agency that locates the limits of cognitive assistance at these four much more "anarchic" places: human-level agents are typically able to thought-follow in e.g. inconsistent cases. However, this requires a re-analysis of the requirements of cognitive assistance and the specification of construction methods for agents. Based on the assumptions that Theory of Mind-using agents develop theories in order to assist, we use methods from philosophy of science to characterize Theory of Mind-theories with respect to these four areas, e.g. reduction, observability, conceptual parts, properties like consistency or closeness, and "natural" limits given by syntax/semantics and pragmatics.

Which Parts of the Body Schema are Influenced by the Rubber Hand Illusion?

Martin V. Butz, Esther Kutter, and Corinna Lorenz

Cognitive Modeling, Department of Computer Science and Department of Psychology, Faculty of Science, University of Tübingen

martin.butz@uni-tuebingen.de,
{esther.kutter, corinna.lorenz}@student.uni-tuebingen.de

To successfully invoke the rubber hand illusion (Botvinick & Cohen, 1998), the dynamics of the concurrently applied strokes on hand and rubber hand need to match. However, also the position of the rubber hand and the orientation of the strokes are important. This suggests that the felt stroke is compared with the visually perceived one by projecting the tactile perception into a visual frame of reference or vice versa.

Other research has shown that our brain continuously maintains a body schema over time (c.f. Hoffmann et al., 2010, for a comprehensive review). It appears that the body's pose itself is estimated by continu-

ously comparing and adjusting various sensory modalities. Given inconsistent information, either sensory plausibilities or the current body schema needs to be adjusted. In the rubber hand illusion, participants partially perceive their hand at the rubber hand's position. Thus, the current body schema of the hand appears affected. However, for maintaining a consistent body image, it may be necessary to adjust the complete body pose.

We are currently investigating if the perception of the elbow angle is affected by the rubber hand illusion. To do so, we are invoking the illusion, but we are asking the participants to estimate their elbow posture rather than the position of their hand. Elbow angles are estimated by adjusting the relative orientation of two lines on a screen. In a preparatory study we are also evaluating if the participants can estimate their elbow angle reasonably well at all.

We expect that the angular pose of the elbow can be estimated with reasonable accuracy. Moreover, we expect that the rubber hand illusion will affect this self-perception in that the elbow angle will be estimated closer to an angle that matches the position and orientation of the rubber hand. By manipulating the synchrony and orientation of the concurrent strokes, we expect angular estimation dependencies. Given success, the evidence will point out that the rubber hand illusion indeed affects the perception of the whole arm and that the brain tries to continuously maintain a coherent mental body image.

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Semantic and Syntactic Interaction in a Morpho-Syntactically Complex Language: Evidence from Event-Related Potentials

Gulay Cedden and Aykut Eken
Department of Foreign Language Education, Middle East Technical University

Kim & Osterhout (2005) have proposed that language comprehension is served by partially independent but highly interactive streams of semantic and syntactic processing machinery. Electrophysiological measures are well suited to shedding light on the neural mechanisms of language processing, Our first aim was to examine ERP responses (N400, LAN, P600) elicited by single morphosyntactic and semantic violations using the Turkish language. Our second aim was to investigate the interaction between syntactic and semantic processes by comparing the ERP responses to single violations with the ERP responses to combined syntactic and semantic violations. Three hundred sentences consisting of five words were presented visually to 46 right handed, native Turkish speaking volunteer participants. Three hundred sentences served as filler sentences and did not follow any predetermined linguistic pattern. Three hundred sentences following a fixed grammatical pattern [NP + word2 +word3+ word4+V(fin)] served as stimulus sentences. Four variations of stimulus sentences were used: correct sentences, sentences with a morphosyntactic subject-verb agreement violation, sentences with a semantic expectancy violation and sentences with a combined morphosyntactic and semantic violation. All types of linguistic violations were situated into the high frequent finite verbs (with three suffixes), thus creating strong and local incongruences between the verb and the subject noun phrase (NP).

Contrary to the standard view, that lexical-semantic conflicts elicit a centro-parietal negativity occurring approximately 400 ms post stimulus onset (Kutas and Hillyard, 1984; DeLong et al., 2005) and morphosyntactic violations engender later parietal positivity effect, P600, (Hagoort et al., 1993; Osterhout & Holcomb,1992) we obtained a biphasic pattern in reaction to all three conditions – an N400/LAN followed by a P600 effect.

According to the principle of superposition a clear nonlinear summation of LAN, N400 and P600 components in the combined syntactic and semantic violation paradigm would imply that an interaction was going on during the processing. Taking together the findings that a P600 component was found in the semantic violation paradigm and that all three components elicited by the combined violation were found to summate non-additively, we conclude that in a morpho-syntactically complex language syntactic and semantic processes are interacting interdependently during sentence processing.

An Awesome Party or a Horrible Tragedy: Approach and Avoidance Mechanisms can Tell Us More about Meaning-Composition Processes

Irmgard de la Vega, Mónica De Filippis, Carolin Dudschig, Martin Lachmair, and Barbara Kaup

Department of Psychology, University of Tuebingen

A well-known phenomenon in psychological research is the connection between the approach / avoidance motivational systems and emotional concepts: People want to approach positive and avoid negative stimuli (Lang et al., 1990). This is reflected in shorter RTs when participants respond to a positive (negative) word by making an arm movement towards (away from) themselves (Chen & Bargh, 1999), even if the valence of the word is irrelevant to the task (Neumann & Strack, 2000).

We employed this phenomenon to investigate whether an interaction between the motivational system and the valence of linguistic stimuli emerges when readers process sentences with a positive / negative valence, and where in the sentence such an interaction shows and how it develops over time.

Two types of sentences were used, one containing a positive adjective and a positive noun (e.g., Susi sees a beautiful beach on the photo.) and one containing a negative adjective and a negative noun (Tom sees a repugnant snake on the branch.). Sentences were presented on the screen

word by word in a self-paced moving windows technique. Participants controlled the presentation by pressing keys on a modified keyboard located vertically in front of them. Thus, they made, key press by key press, an arm movement either away from their body or towards their body to get from the beginning of the sentence to its end. RTs were obtained and analysed of every key press.

An interaction between the movement direction and the valence of the sentence emerged at two points during sentence presentation, namely on the word just after the noun and on the very last word of the sentence. The fact that the effect took some time to develop and showed only after the respective noun phrase was completed, and again in the sentence-wrap up, may be taken as indication that the effect is not word-based but rather reflects meaning-composition processes at the phrase or sentence level.

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Distinguishing Between Valence and Location: Does "sun" facilitate upwards-responses because of its typical location or because of its valence?

Carolin Dudschig, Irmgard de la Vega, and Barbara Kaup

Universität Tübingen

Traditionally language processing was assumed to take place in a separate system in the human brain, whereby language relies on amodal computations of meaning. Recently there has been converging evidence that language understanding is grounded in the sensorimotor system

and relates to spatial processing. Interestingly, hereby both words referring to concrete objects and words having a negative or positive valence relate to the vertical spatial dimension. Words referring to entities typically located in the upper visual field facilitate upwards movements, in contrast words referring to entities in the lower visual field facilitate downwards responses (Lachmair et al., 2011). Similarly, it has been shown that if words are judged as positive, subsequent visual target discrimination in an upper screen location is facilitated and the opposite holds for negative words (Meier & Robinson, 2004). In the current experiments, we investigated if both word categories automatically interact with vertical motor responses. In the first experiment, word meaning was fully task irrelevant. Participants saw a word and performed an upwards or downwards movement according to word-color. Words referring to entities with a typical location in the world facilitated movements towards the congruent location. In contrast, positive or negative words did not have any effect on responding. The second experiment was conducted in order to investigate, whether emotional words interfere with responding, if the valence of the words becomes task-relevant. The experiment was identical to experiment 1, with the difference that participants were instructed only to respond if the words were emotional in nature. The results showed a clear compatibility effect, hereby positive words facilitated upwards responses and negative words facilitated downwards responses. In summary, spatial features are automatically activated by words that refer to entities with a typical location in the world (see Lachmair et al., 2011). In contrast, emotional words only interact with vertical responses if word valence is task-relevant.

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How cognitive is Content-based Grammar?

Daniela Elsner
Ruhr-Universität Bochum

With this poster we want to compare two grammatical theories: Content-based Grammar, which was primarily developed by Weisgerber from the 1920s on, focuses on basic questions concerning the relation between grammar, semantics, and pragmatics. They are also fundamental to Langacker's Cognitive Grammar as well as to other grammatical frameworks. Cognitive Grammar analyses language with reference to the daily experiences we make, and argues that grammar is inherently meaningful. The grammatical meanings though are abstract, so their essential import resides in construal. The Cognitive Grammar enterprise started developing in 1976, that is decades after Content-based Grammar has been established. Interestingly one can quickly find parallels when comparing Cognitive with Content-based Grammar. Just as Content-based Grammar Cognitive Grammar postulates that language is not organized in a modular way but is regarded as a general cognitive process. Following the symbolic thesis, form can not be studied without reference to meaning, which leads us to the conclusion that there is no categorical difference between syntax and semantics.

We can adhere to the fact that Content-based and Cognitive Grammar show specific affinity. Sylla (2009:178) ascertains that a resemblance between 'Sprachinhaltsforschung' (content-based language research) and Cognitive Linguistics has only been hinted at in the research literature but has not yet been fully investigated. Many appeals to Weisgerber's ideas do not show any connection to his Content-based Grammar (cf. Sylla 2009:271). With the poster we want to answer the question how cognitive Content-based Grammar really is. A close look at both theories shows that they share the same philosophical background but diverge with respect to their goals, their assumptions concerning language and thought and the function they ascribe to language.

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Right Hemispheric Involvement in Recognition of Proper Names? A Reaction Time Experiment with Broca Aphasics

Cornelia Geukes and Horst M. Müller

SFB 673 - Experimental Neurolinguistics Group, Bielefeld University

{cornelia.geukes, horst.mueller}@uni-bielefeld.de

Within the class of concrete nouns, proper names represent a distinct group based on linguistic and neuropsychological findings. Furthermore, proper names seem to have a cortical representation possibly different from concrete nouns. A few case- and EEG-studies [1, 2] discuss an additional right hemispheric involvement during comprehension of proper names. To test this, we completed a reaction time study (lexical decision task) with patients diagnosed with Broca aphasia who had damaged left hemispheres. Speech healthy persons show a clear shortened decision time for proper names (PN), even though they exhibit a low word frequency, in comparison to common nouns (CN). In general, Broca aphasics show a lower score in reaction time tasks than controls [3, 4]. However, if Broca aphasics demonstrate a decision time for PN that is less impaired than their decision time for CN, the hypothesis of an additional right hemispheric recognition of PN would be supported.

We investigated 12 Broca aphasics between 49 and 89 years (classification of Aachener Aphasie Test, AAT) and 12 matched speech healthy persons. All participants were right-handed. The study was divided into two sections. 1. Reaction time: to determine the reaction time in general, participants were asked to push a button when they heard simple sounds; 2. Lexical decision: we presented 165 two-syllabic acoustic stimuli (25 proper names, 50 common nouns, 42 pseudo words, 48 distractors), while participants pressed a button for each real word (not pseudo word).

1. Reaction time: Broca aphasics show a significant lower response time in general when hearing simple sounds in comparison to speech

healthy persons (Broca: 478,1 ms; controls: 280,2 ms). 2. Lexical decision: even Broca aphasics show a faster decision for PN (Broca: 977,6 ms; Controls: 876,2 ms) than for CN (Broca: 1079,4 ms; Controls: 919,2 ms). In comparison to speech healthy persons, Broca aphasics show a selective lower impairment for PN than for CN, particularly in relation to the significantly low reaction time for simple sounds. One possible explanation is the optionally right hemispheric support while recognizing PN. A slower response time for CN within the group of left hemispheric damaged aphasics in comparison to the speech healthy control group could suggest that the intact right hemisphere does not support the left hemisphere in recognizing CN at all, or at least much less than it supports the left hemisphere in recognizing the class of PN. In addition, while PN have no conceptual meaning, semantic processes during conceptual meaning constitution of CN could explain why PN could be faster classified and comprehended.

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PsiCasso: Simulating the Dynamics of Aesthetic Appreciation

Mike Imhof, Marius Raab, and Claus-Christian Carbon

Department of General Psychology and Methodology, University of Bamberg

Aesthetic appreciation is not stable. As everyone knows from personal experience, how much we like something—say, a work of art, a piece of music, a movie—depends on our current mood. On a much larger scale, what is considered good design (shown by Carbon, 2010, for cars) is Zeitgeist-dependent and subject to oscillate over the years and decades.

To establish a psychological foundation for this so-called "cycle of preference", we propose the PsiCasso model. It combines the cognitive-emotional-motivational PSI-theory by Dörner (1999) with the MINERVA2 memory model by Hintzman (1988). Employing an unsupervised artificial neural network (ANN), the agent has "eyes" to perceive visual stimuli. The ANN translates the stimuli's features (like color, contrast etc.) into arbitrary (but reproducable) numerical vectors.

This agent, proposed in Raab et al. (2011), was now implemented in JAVA and is able to use frequency and similiarity judgements (utilizing the MINERVA2 model) to decide if any given stimulus is considered as novel, familiar, or somewhere in between. Novel stimuli (i.e., pictures that don't match with existing memory content) are considered a source of uncertainty and thus thought to repel the agent. After some more novel pictures of the same type, the agent should get familiar with them. These pictures now become a source of certainty and are considered pleasant—until, again after some more pictures of the same type, the familiarity is so strong that these pictures are considered as boring.

In test runs with different image sets, we measured arousal and needs of the agent. When preference is considered as a function of novelty and emotional state (which follows from Dörner's theory), the agent shows the predicted "cycle of preference". The model grasps phenomena like the mere-exposure-effect (Zajonc, 1968) and theories about processing fluency (e.g., Reber et al., 2004)—and at the same time relates perception to the agent's inner state, allowing for long-term changes in "taste".

In future research, we will extend the architecture to incorporate what Fechner (1876) called "associative factors": That is, image content will be related to the agent's needs, so in a state of "hunger" images that depict food would get valued higher. While keeping the set of assumptions sparse, we expect the agent to exhibit motivational patterns resembling the dynamics we know from every-day life.

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Knowledge-Based Approach for a Context-Aware Augmented Reality Assistance System

Darko Katić[1], Simone Brandstädter[2], Anna-Laura Wekerle[3], Hannes Kenngott[3], Beat Peter Müller-Stich[3], Rüdiger Dillmann[1], and Stefanie Speidel[1]

[1] Humanoids and Intelligence Systems Laboratories (HIS), Karlsruhe Institute of Technology
darko.katic@kit.edu
[2] Institute for Psychology, University of Heidelberg
simone.brandstaedter@psychologie.uni-heidelberg.de
[3] Department of General, Abdominal and Transplantation Surgery, University of Heidelberg

Augmented reality is a very promising paradigm for intraoperative assistance in minimally-invasive surgery. However, information overflow caused by advanced assistance functions and visualizations has emerged as a new obstacle in bringing such systems into clinical application. For instance, the display of information about vital structures like nerves or vessels is desirable when those structures are in danger of being harmed. In other cases such visualizations only convey unnecessary or even distracting information. To avoid mental overload of the surgeon, it is necessary to restrict the display to relevant information, depending on each phase of the surgery. Based on the principal ideas of Neumann and Moeller (2008), we aim to automatically interpret the ongoing surgery and recognize the current phase. With this contextual information, we can provide an intelligent selection of visualisations.

This type of man-machine interaction promises a more intuitive workflow with complex assistance systems. Only relevant information is displayed by observing and interpreting the surgery progress without the need for explicit interaction between surgeon and software system.

For recognizing the current situation, intraoperative sensor data undergoes knowledge-based analysis and interpretation. Elementary contextual cues like distance or speed are extracted and stored in an OWL-based knowledge base using Description Logics. According to the differentiation of declarative and procedural knowledge in human cognition, we use a combined approach for knowledge representation. Declarative knowledge is represented as hierarchical knowledge base, which contains information about surgical instruments, activities and anatomical structures. For procedural knowledge, a rules-based system is implemented which represents meaningful relations between all relevant entities, like instruments and the anatomical structures they act upon. The rule-based approach is founded in real annotated case studies.

For evaluation, clips of real surgeries are assessed by medical experts and their phase interpretations are compared to those predicted by the system, i.e. computing the detection rate. We are going to introduce the system and discuss first evaluation results regarding the special benefit of context-sensitive knowledge-based approaches for complex assistance systems.

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Properties and Mechanisms of Sensory Enhancement

Sabine U. König[1], Vincent Brunsch[1], Manuel Ebert[1], Sebastian Fleck[1], Ricardo Gameiro[1], Sebastian Gasse[1], Caspar Goeke[1], Manuel Hanke-Uhe[1], Kai Kaspar[1], Johannes Keyser[1], Carina Krause[1], Aleksey Lytochkin[1], Robert Muil[1], Alisher Numonov[1], Bianca Sieveritz[1], Maria Schmitz[1], Susan Wache[1], Saskia K. Nagel[1], Frank Schumann[1], Tobias Meilinger[2], Heinrich Bülthoff[2], Thomas Wolbers[3], Christian Büchel[4], and Peter König[1,5]

[1] Institute of Cognitive Science, University Osnabrück
[2] MPI for Biological Cybernetics, Tübingen
[3] School of Biomedical Sciences, University of Edinburgh
[4] Department of Neurophysiology and Pathophysiology, University Medical Center Hamburg Eppendorf
[5] Institut of Systems Neuroscience, University Medical Center Hamburg Eppendorf

Enacted theories of consciousness conjecture that perception and cognition arise from an active experience of the regular relations that tie together sensory stimulation and associated motor actions [1,2]. By employing the technique of sensory substitution [3] and sensory augmentation [4] previous experiments explored this assumption. In this study a sensory augmentation device delivered global orientation information by mapping directional information of a compass to a set of vibrators around the waist, activating the element pointing north (feelSpace belt) [4]. Here we use it to investigate the impact on cortical plasticity sensory processing, and spatial cognition. Therefore we want to answer the questions how the brain is able to integrate and use new sensory input, where this processing takes place and whether the newly supplied directional information can be used by the subjects for enhanced orientation and navigation leading to many useful applications.

Out of fourteen subjects (age 19–32y, seven female, five controls) nine were wearing the belts during all waking hours over a period of six weeks. We compared belt-on and belt-off conditions in a series of measurements including homing, fMRI, and subjective methods before, during and after training.

(1) In the homing task using polygons of varying complexity we observed a slight reduction of the systematic error and a larger reduction of the stochastic error in belt-on condition after the training period. (2) Most areas that were reported in a previous fMRI study on navigation [5] could be replicated in our subjects. Furthermore, we observed widespread cortical activation induced by the belt in the pretraining baseline measurements which is more localized and less intense after training. (3) Subjective reports indicate that by training with the feelSpace belt the scope of perceived space grows wider and includes areas that are not within reach or directly visible; subjects feel more secure in known as well as previously unknown environments; and navigational abilities improve and emphasize an egocentric reference frame.

The data provide evidence for an integration of the newly supplied signals in sensory integration (homing), cortical processing (fMRI) and spatial cognition (subjective methods). However, further analysis is needed to elucidate significant individual variations.

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Physiological and Behavioral Consequences of Delayed System Responses in Human-Computer Interaction

Christin Kohrs[1], David Hrabal[2], and André Brechmann[1]

[1] Leibniz Institute for Neurobiology
[2] Medical Psychology, Ulm University

Even after decades of stunning enhancements in computer science, research on psychological effects of delayed system response time (SRT) has not lost its topicality. Especially in times of network based computing, uncertainty in providing immediate system response remains. When delays in SRT occur, the user's expectancy about the temporal course of an interaction is interrupted which may be interpreted as irritating.

The current study investigates the physiological effects of unexpected delays of 0.5s, 1s, or 2s on skin conductance (SC) and heart rate (HR). The naïve participants (n = 23) performing a two-choice auditory categorization task expected the system to respond immediately after their input, but 20% of all trials contained delayed SRTs to maintain the unexpectancy of delayed feedback. The aim of the current study was to directly measure the SC and HR in response to a single delayed system response. In detail, we wanted to investigate if a small delay of no more than 500ms is sufficient to elicit a physiological reaction and if this response increases with longer delays lasting 1s or even 2s. Furthermore, we analyzed the behavioral consequences of delayed SRTs by measuring the dynamics of the participants' button presses and inquired the emotions of our participants at the end of the experiment.

The results indicate that a delay which increases the uncertainty about the temporal course of interaction with a computer system induces emotional and physiological changes. The physiological data reveal an increase in SC response and a deceleration of HR. Even delays of only 500ms are sufficient to trigger these physiological changes which seem to be characteristic for the negative emotions of uncertainty and annoyance reported by our participants at the end of the experiment. Furthermore, the button press results confirm the negative effect of delayed

SRTs as subjects tend to press the button with more intensity and longer durations following delayed feedback. In addition, the button press dynamic is able to differentiate between correct and incorrect trials and therefore might be a useful tool to infer the uncertainty of a user's decision.

To conclude, the results of the current study verify the recommendation to use only very short and constant SRTs during human-computer interactions.

Beware of Blue: Background Colours Differentially Affect Perception of Different Types of Ambiguous Figures

Jürgen Kornmeier, Kirsten Wiedner, Michael Bach, and Sven P. Heinrich

Institute for Frontier Areas of Psychology and Mental Health

When we observe ambiguous figures our percept changes spontaneously, while the figure stays unchanged. The dynamics of this perceptual instability is modulated by cognitive factors. Recent studies indicated effects of surround colour on cognitive task performance. In the present study we studied the influence of surround colour on the perceptual dynamics of ambiguous figures.

14 subjects viewed the Necker cube and Rubin's Face/Vase stimulus on a white background with three different surround colours (light red, dark red and blue) and indicated perceptual reversals manually. We analysed initial percepts, reversal rates and durations of stable percepts ("dwell times").

Results: For the Necker cube we found a preferred initial percept (top-view orientation, 89%). This perceptual variant also showed longer and more variable dwell times. The preferred initial percept for the Face/Vase stimulus was the face variant (75%). No effects on dwell time were observed. Blue backgrounds reduced the dwell time effect in the case of the Necker cube and the initial percept bias for the Face/Vase stimulus (54%).

Discussion: Surround colour influences the perception of ambiguous figures. Especially the blue colour seems to weaken the a-priori perceptual biases, but differentially for the two types of ambiguous figures analysed.

Investigating Dynamic Changes in Visual Working Memory Content

Johannes Lohmann[1], Lars C. Kipferl, Gregor Hardieß[2], and Martin V. Butz[1]

[1] Department of Cognitive Modeling, University of Tübingen
[2] Department of Cognitive Neuroscience, University of Tübingen

A recent study on strategy usage in visual working memory (VWM) tasks [1] applying a block-copying paradigm [2], revealed that memory usage depends on stimulus complexity and the length of the retention interval. Participants adopted a memory-intensive strategy for long retention intervals and simple stimuli. For more complex stimuli and shorter retention intervals, acquisition-intensive strategies were observed more frequently. A direct comparison between the simple and complex stimuli revealed that the memory capacity for simple stimuli is 1.5 times higher than for the complex ones. We are currently replicating this experiment with a change detection paradigm.

The stimulus material consists of colored images of block configurations, similar to the physical block patterns applied in the original study. We vary presentation duration and ISI to manipulate the memory load of the participants. We are also collecting the scan-paths of the participants to investigate if stimulus complexity affects eye movements. We hope to find significant interactions between stimulus complexity, presentation duration and the number of fixations. These interaction would reflect the different strategies observed in the original study. We will model the data with a computational model of VWM that we developed recently as an extension of the theory of visual attention (TVA [3]). The model can be described in terms of differential equations that allow to model encoding and maintenance of information in VWM. Our model predicts that stimulus complexity, presentation duration of the stimuli, and ISI have a significant impact on the amount of preserved informa-

tion in VWM and hence on change detection performance. We expect that the model will reveal similar correlated complexity estimates for the respective stimuli used in [1]. The successful application will confirm that our model provides a quantitative model of VWM that fully integrates sensory memory, short-term memory, and visual attention.

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Neurolinguistic Investigation on Turn-Anticipation in Dialog

H. M. Müller, H. Wesselmeier, and S. Jansen

SFB 673 "Alignment in Communication" & EC "Cognitive Interaction Technology" (CITEC), Experimental Neurolinguistic Group, Bielefeld University

Interlocutors in a conversation are able to anticipate when the current turn is going to end in order to avoid gaps and overlapping speech (Magyari & De Ruiter 2008). Even though we know that a number of manipulated signals that listeners use, such as syntax, semantic and prosody, can hamper turn-anticipation, it is still unknown what exact combination of these signals enables turn-anticipation with such high accuracy. A previous EEG-study has shown that brain areas involved in estimating the timing of a turn-end are part of the same functional network that subserves sentence and discourse-level comprehension processes and control (Magyari et al., 2011). To analyze turn-anticipation related ERP's, 30 right-handed healthy participants (14 men, 16 women, ages 21–35 years) volunteered in our EEG experiment. The stimuli consisted of 24 auditorily presented sentences (including 1/3 sentences that were semantically and 1/3 that were syntactically violated), 35 auditive questions and 40 declarative sentences, where the participants had to anticipate the end of each utterance. The Experiment consisted of

3 parts, where the participants had to 1. give short answers, 2. reacted with a verbal cue "Ja" to the end of the turn, and 3. reacted with a button-press to indicate the anticipated end of turn.

The readiness potential (RP) of the verbal responses was identified in order to be compared to the RP of the button-press responses of the declarative sentences. For analysis, we compared ERP's during syntax/semantic violations, sentence endings and responses, and tried to correlate them with expected brain signatures. We expect comparable RP's for button-press and verbal cue. For syntactic and semantic violations we expect reduced and/or delayed RP's for responses.

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From Cognition to Corpus, from Corpus to Cognition: How Corpus Research in Child Language can Benefit from Research in Developmental Psychology, and Vice Versa

Michael Pleyer and Martin Zettersten

University of Heidelberg

michael.pleyer@hggs.uni-heidelberg.de,
Zettersten@stud.uni-heidelberg.de

Cognitive Linguistics (CL) is a fast-growing school in cognitive science that explains linguistic phenomena by relating them to general human cognitive capacities (Geeraerts & Cuyckens 2007). This has important implications for our understanding of how children learn language: From the perspective of CL, children employ general cognitive skills to construct a language from the linguistic utterances used around them (Tomasello 2003). Research in child language acquisition must therefore involve the study of children's actual language use on the one hand

and children's cognitive development on the other. The creation of a public corpus of child language has made it possible to analyze a vast amount of children's speech production in various stages of development (CHILDES; MacWhinney 2000). We offer the theoretical proposal that research in cognitive development needs to be taken into account both when generating hypotheses for corpus studies and when interpreting corpus data. A researcher investigating metaphors in child language can only construct and analyze a corpus study adequately by considering the developmental trajectory of cognitive skills that underlie understanding metaphors, such as analogy.

However, analyzing large child language corpora can also benefit the field of developmental psychology by investigating linguistic phenomena that correlate with the emergence of specific social cognitive skills. One such correlation that has received increased attention is the connection between theory of mind and language (Astington & Baird 2005). Child language corpora offer a powerful tool to investigate linguistic phenomena that relate to false-belief understanding. These include semantic measures such as the usage of cognitive terms like 'think' and 'want', as well as the related syntactic phenomenon of sentential complement constructions.

We therefore argue that an interdisciplinary perspective in corpus studies of child language can benefit both the field of language acquisition and developmental psychology.

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Back to the Roots: Measuring Motoric Correlates of Ur-Emotions

Marius Raab, Nato Shengelia, and Claus-Christian Carbon
Department of General Psychology and Methodology, University of Bamberg

Emotions have been a key research topic of psychology ever since; yet, what emotions really 'are', and what the underlying structure—across people and cultures—really 'is', remains a matter of debate. Kafka (1950) has postulated four so called "Ur-Affekte" (ur-emotions), referencing Karl Bühler, and sees basic motoric responses of an organism at the heart of these emotions. Following Kafka, one can try to bring oneself nearer towards or further away from an object; or can try to bring this object nearer or further away. This concept has been taken up, e.g. by Parrott (2010), searching for "underlying structure[s] or abstract feature[s] of an actual emotion" (p. 20).

At the same time, current approaches to measure emotions all have their drawbacks. From verbal reports to EDA, EEG and fMRI—there's no method that is able to measure emotions with high temporal resolution 'in' the situation while providing a clear relation of data and emotion at the same time. To overcome these drawbacks, we propose posturography which we employed with low cost commercial hard- and software. The utilized setting (a Nintendo Balance Board) shows high temporal resolution (100Hz) and is capable of reliably tracking a person's balance control. A pilot study (n=5) showed high and distinct postural responses to visual emotional stimuli. In a further study (n=21) we presented 23 distinct high-quality images (selected in a pre-study, rated for emotional intensity and value) in randomized order, each preceded and followed by an isoluminant mask, while the subject was standing on the balance board.

With these data, we can relate the motoric responses—intensity and direction, as a pattern over each picture's presentation time—to the emotional content. This combination allows new insights into the basic states of action readiness that go along with the perception as well as with the cognitive and emotional appraisal of visual stimuli.

Once this relation is established and refined in further research, the 'emotional footprint' can serve as cost-effective measurement device in aesthetic research; and at the same time stimulate the research about

emotions, about the basic motoric roots of cognitive and affective processes.

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The Role of Causal Models in Causal-based Categorization

Anselm Rothe and Ralf Mayrhofer

Department of Psychology, University of Göttingen

Research about how people categorize exemplars with causally linked features has found two competing effects. The causal-status hypothesis proposes that people consider causally more central features (e.g., a cause in a common-cause model) more than causally less central features (e.g., the effects in a common-cause model). In contrast, the coherence hypothesis claims that people often focus upon feature patterns that are more or less coherent with respect to the causal relations between the features (i.e., a cause and its effect are both present or both absent). According to coherence, individual feature values are not important for people when categorizing exemplars with causally linked features. We conducted experiments to analyze the conditions that influence the strength of the causal-status and the coherence effect. Following up on the proposal that categorization can be seen as inference to the best explanation (e.g., Murphy & Medin, 1985), we propose that causal models might serve different explanatory roles. First, a causal model can serve as an explanation why the prototype of a category is as it is. Second, a causal model can also serve as an explanation why an exemplar might deviate from the prototype. Depending on role, we expected a stronger causal-status or a stronger coherence effect, respectively.

In the experiment, our participants learned non-real world categories as used by Rehder (2003) and others, including the causal links between category features (i.e., the category's causal model). They, then, had to give a category membership rating for 16 exemplars that were presented

sequentially. In two between-subject conditions, we manipulated the causal model in the instruction phase. In one condition, typical feature values were described as causally active and atypical feature values as not active. In the other condition, atypical feature values were causally active and typical feature values were not. The results showed huge differences in the category membership ratings. More specifically, we clearly found a causal-status effect in the first case and a coherence effect in the latter one. The strong influence of our manipulation might serve as an important explanation for the varying strengths of the causal status and the coherence effect found in the literature. Therefore, we believe that causal-status as well as coherence effects are both faces of the same coin.

Self-Motivated Learning of a Flexible Motor Control System

Konstantin Schmid and Martin V. Butz

Cognitive Modeling, Department of Computer Science and Department of Psychology, Faculty of Science, University of Tübingen
konstantin.schmid@student.uni-tuebingen.de,
martin.butz@uni-tuebingen.de

In our everyday life we perform a mere infinite number of different movements. Most of them are executed in an automatic, unconscious way – hardly requiring any attention. Thus, the underlying control system needs to be both highly flexible and easy to invoke.

Here we focus on learning such a control system, based on insights gained from neurobiological research (Shadmehr & Wise, 2005). Learning is accomplished unsupervised, or self-supervised. For flexible behavioral control, the architecture supports the flexible generation of manifolds of behavioral policies for particular targets. This flexibility is a basic requirement for the online consideration of obstacles and other behavior-relevant constraints, such as broken limbs. Finally, to choose the currently most appropriate behavior, redundancy resolution mechanisms need to be applied.

We are developing an autonomous, self-motivated, self-supervised learning system, based on the SURE REACH architecture of human arm

reaching (Butz, Herbort, & Hoffmann, 2007) and techniques for the self-motivated learning of behavior-oriented spatial representations (Butz, Shirinov, & Reif, 2010). The system is currently being tested on a three degree- of-freedom arm in a two dimensional environment. Given kinematic motor commands as well as angle and location sensors about the arm state in simulation, self-supervised learning is applied. Redundant arm space representations are encoded by population codes, which are learned by growing, self-organizing neural network techniques. Redundant forward and inverse kinematic mappings are learned by means of temporal Hebbian learning techniques. Motivations inherent in the system guide the self-supervised learning process and also goal-oriented planning, by flexibly inducing priorities and constraints into the developing network architecture. Some of the simulated motivations can be related to the body morphology of actual biological systems, thus moving the arm, for example, in an effort-saving way. The developing architecture can execute goal-directed actions progressively more effectively. The strong motivation to reach a particular hand location, for example, results in the activation of overlapping location neurons. The learned inverse kinematic mapping consequently induces corresponding neural goal posture activities. In turn, these priorities are laterally propagated in posture space, generating a prioritized motion plan. Evaluations have confirmed the effectiveness and flexibility of the resulting self-motivated planning and control architecture. At the moment, we evaluate to which extent curiosity-based motivations in posture space and in hand location space can speed-up the learning process.

In the near future, the architecture will be further modularized for scaling it to seven degrees of freedom in three dimensional space. Moreover, resulting behavior will be compared with actual behavioral data from psychological experiments. Finally, the combination with fast direct inverse learning techniques is aimed at (Rolf, Steil, & Gienger, 2011).

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Automatic and Intentional Level 1 Perspective-Taking in Adults with High-Functioning Autism

Sarah Schwarzkopf, Leonhard Schilbach, Kai Vogeley, and Bert Timmermans

University of Cologne

Perspective taking is a fundamental aspect of social cognition. The ability to decide what another person can or cannot see is referred to as visuospatial "level 1 perspective taking" [1]. This is thought to be a process that we can make use of intentionally, but which may also take place automatically [2].

The diagnostic group of patients with high-functioning autism (HFA) is characterized by impairments of social interaction and deficits in perspective-taking [3]. Interestingly, they are able to take the level 1 perspectives of other persons.

To investigate whether persons with HFA also automatically adopt the level 1 perspective of others, we made use of an established perspective-taking paradigm [2] to test autistic and control participants. Participants were looking at virtual scenes with a virtual character and had to decide as quickly as possible by button press how many objects either they or the virtual character saw. Our results indicate that both persons with HFA and controls cannot suppress the other's level 1 perspective even when this goes against ostensible task demands, demonstrating that the perspective taking was to a large degree automatic. Thus, patients with HFA not only can take others' level 1 perspectives, but also do so automatically. Furthermore, we find that only participants with HFA have difficulties if they intentionally try to take others' level 1 perspective. If we measure level 1 perspective taking implicitly they seem to take it even automatically. This shows that even if level 1 perspective taking is intact, in people with HFA other processes seem to have an influence on this ability if it is used intentionally. We argue that difficul-

ties, persons with HFA have with this task, come from a more general problem they have with attention shifts and we discuss the underlying cognitive processes of perspective taking.

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Scaffolding Hypermedia Learning through Student's Self-Created Metacognitive Prompts

Christoph Sonnenberg and Maria Bannert

Institute of Human-Computer-Media, Educational Media,
University of Wuerzburg
christoph.sonnenberg@uni-wuerzburg.de

Research in self-regulated learning with hypermedia shows that learning processes of participants are often not very strategic and goal orientated. Learners have difficulties in performing adequate metacognitive activities spontaneously, which – as a consequence – results in lower learning outcomes. Hence, it is necessary to develop effective instructions in order to support the learner in reflecting upon his own way of learning and activate his repertoire of metacognitive knowledge and skills. These interventions are called metacognitive prompts.

Several studies provided evidence for the effectiveness of different types of metacognitive prompts in hypermedia learning scenarios. However, the specific influence varies to a significant degree: only half of the sample dealt with the metacognitive support in an optimal manner and interviews showed that participants felt restricted in their own way of learning by demand activities. Therefore, it is important to investigate how the compliance of the participants can be increased and how the effectiveness of metacognitive prompts can be further enhanced.

In a research project funded by the German Science Foundation (DFG: BA 2044/7-1) we want to analyze the effects of a new kind of metacognitive support on learning processes and on learning outcomes of university students who have to face a hypermedia learning scenario. In a pre-post between subject design the experimental group is instructed to create their own prompts and has to learn with them afterwards (control group: learning without prompts). Think-aloud data is collected during the experiment in order to investigate the quality of the learning process of both groups.

An enhancement of the compliance of the learners is expected by using these self-created metacognitive prompts. Moreover, an enhanced use of the provided support should also result in an increase of learning and transfer.

EcoSphere – A New Paradigm for Complex Problem Solving Assessment in Adolescence

David Alexej Tobinski

Institute for Psychology, University of Duisburg-Essen

The assessment of complex problem solving (CPS) in adolescence is a challenge for cognitive psychology. As previous research is mainly focused on adulthood and hardly ever uses systems with eigendynamics, we developed the paradigm EcoSphere (ESP). So far, testing devices feature round-based dynamics in time-discrete steps, whereas ESP simulates a momentum for the first time. The ESP technology uses a system of differential equations. The exploration of the system takes place in a vivid simulation and generates a new quality of ecological validity. This fact qualifies the assessment of CPS to provide scenarios with a semantic embedment near the participants' curriculum. The current semantic embedment describes an ecosystem with an animal- and a plant population (BioSphere). This ecosystem consists of four interconnected endogenous (animal, nutrient, plant, water) and two exogenous (bulb, heater) variables with multiple effects, multiple dependences and lateral effects. Further semantic embodiments will be the Gulf Stream (HydroSphere), the system of a glacier (CryoSphere) and space debris (AtmoSphere). The substantial progress in creating curriculum scenar-

ios lies in the possibility to analyze an additional and central factor of complex problem solving: the previous knowledge. A deeper insight into complex problem solving processes is afforded during the exploration and the identification of CPS strategies can be more differentiated. Regarding the importance of knowledge, the ESP technology uses a new, highly standardized computer-based test for causal diagrams. Every testing situation starts with a training sequence for drawing computer-based causal diagrams (CBCD). All participants have to create accurate CBCDs of three instructed models with different complexity. Subsequently, the previous knowledge has to be charted before the exploration sequence of the ecosystem will start. The exploration of a system causes the construction of a mental model of the system. The program closes with the task of drawing a CBCD of the current mental model, which was adapted in the exploration phase. In consideration of the previous knowledge interferences now can be identified in the analysis of the current mental models. A valid model empowers the participant to control the system. The ESP technology provides four different designs: (1) instruction of a complex system; (2) observing a complex system; (3) exploring a complex system and (4) controlling a complex system. In the first design the curriculum-near system will be fully instructed and the CBCD has to be drawn by the participant. There are three types of instruction: verbal (audio), verbal (video) and graphical (animation) plus verbal (audio). Observing a complex system takes place in a graphical scenario without verbal information. In this scenario the experimental group receives additional information from numerical feedback. The animation can present a stable or an instable development of the system. Exploring the system demands the participants to modify the exogenous variables. The system can react directly, e.g. the animals will change to a blue color when the water becomes cold, or the reaction occurs after a delay. Controlling the system requires a goal-directed intervention, which means transferring an instable state of the system into a stable state by changing the parameters. The control performance and the construction of mental models will be tested with different items with de- and increasing complexity, which are going to be developed, and an editorial program for item construction (instruction of a complex system) is going to be available. ESP is the first paradigm for complex problem solving within systems with eigendynamics (CPSSED) and therefore a photo-realistic version is

in planning. The first study focuses on the instruction of knowledge of complex systems and the resulting CBCDs. The ESP technology is prepared for large scale assessment using XML and will be supported by automation processes in R.

Problem Space and Planning Space – Two Types of Error in the Tower of Hanoi

David Alexej Tobinski
Institute for Psychology, University of Duisburg-Essen

The traditional paradigm Tower-of-Hanoi (TOH) has long been an important task environment for research on problem solving in adulthood and reflects the concept of problem-space in a fruitful way (Kotovsky, Hayes & Simon, 1985). One big research question is still the developmental perspective on problem-spaces: when occurs the competency of transforming a problem space into a planning space? The presented study focuses on this aspect of problem solving processes. In order to fill this huge research gap, the TOH has been digitalized in a computer-based version (TOH-D) suitable for young people. TOH-D offers a three, four and five-disk version of the classical task. The application flow is separated into three phases: a motor-skill training, the rules-and-goal instruction and the traditional TOH task. Regarding the effects of extraneous cognitive load every computer-based test material for childhood and adolescence needs special training to reduce motor skill effects on the input devices. Special motor-skill training precedes the TOH task. The training demands the same moves as the following task, e.g. a fish has to be moved from a small glass to another and back. The TOH-D is still introduced as a power test for analytical problem solving but in the background the time is taken for every single move, as a speed test would measure it. Taking the time of the training enables an acceleration of the moves in the task later. Motor effects can be controlled well in the TOH-D this way. Offering a differentiated protocol of every single move, the TOH-D technology opens a completely new theoretical view on this traditional paradigm. The concept of a problem space (Kotovsky, Hayes & Simon, 1985) should be expanded by a planning space.

The problem space covers every possible state of the system, e.g. states when bigger disks lie on smaller ones. This allows having a deeper insight into instructed and non-instructed information flow within the problem solving processes (PSP). In TOH the forbidden states are all instructed. Using another way but the shortest, is an error to avoid. The correct states, the sub-goals, are not instructed and have to be interpolated. Thus taking the 'wrong' way would be more a planning-error than a problem-solving error and should be declared as an inefficiency error (error type II). The more serious error would be to disregard instructed information; this is an ineffectiveness error (error type I). In the classical scenario the error type I has to be avoided completely while error type II is an indicator for planning competencies and shows the grade of efficiency. The concept of efficiency is secondarily new for focusing on participants with the best results. They can be distinguished now by their time values. The data of two studies in childhood (N=47) and adolescence (N=309) accentuates this completely new point of view in analytical problem-solving, old digital versions of TOH even disabled the possibility of producing an error type I, so it has never been measured. The results of the two studies bring up significant age-related effects in the production of the two error-types. Trend analysis reveals age-related patterns and strategy-related patterns either. The concept of differentiation between planning-spaces and problem-spaces leads to an enhancement of the classical paradigm. Getting more insights into error type I the work on an exploring scenario of the TOH is in progress. This version will replace the phase of rules-instruction with an exploration-phase of the rules. In exploring scenarios neither error type I nor error type II can be avoided and the problem solver will have to learn from his error to transform a problem space into a planning space.

Towards a Mereotopological Framework for the Unity of Consciousness

Wanja Wiese[1] and Thomas Metzinger[1,2]

[1] Johannes Gutenberg-Universität Mainz
[2] Frankfurt Institute for Advanced Studies

Mereotopologies are formal theories that define mereological and topological notions in an axiomatic way and specify how these notions are related. Although it is common in philosophical accounts of the unity of consciousness to use mereological and topological notions like "parthood", "overlap", "continuity" or "connectedness", it is uncommon to apply mereotopological theories explicitly and in a rigorous way. We seek to occupy this niche and show that a mereotopological treatment of the unity of consciousness can promote the discussion in at least two ways:

1. Mereotopology can help formulate different philosophical accounts in a clearer and more systematic manner, as well as open paths to new, conceptually coherent accounts;

2. Mereotopology can be used to formulate bridging principles between different levels of description. We exemplify this by showing how mereological and topological notions used in phenomenological descriptions of the unity of consciousness can be given a representationalist reading and thus offer a first step towards a more rigorous treatment which is also more directly amenable to empirical validation.

This emphasizes two specific advantages of mereotopology:

1. Mereotopology brings the notions of parthood ands connection into the focus of discussion on the unity of consciousness, thereby forcing researchers to rethink in what way the notions are related and which is to be regarded as more fundamental regarding the problem at hand;

2. Mereotopological formalisms can be interpreted on different levels of description (like the phenomenological, representational or

neurobiological level) and can therefore be used to formulate a common framework for research on the problem of the unity of consciousness.

Spoken Feedback in Computer-Supported Learning: The Impact of Prosody

Susann Wolff and André Brechmann
Leibniz Institute for Neurobiology

Today, human users interact with cognitive technical systems on a daily basis, using them as companions, conversational devices, or teachers, for instance in language tutoring programs or brain jogging applications. Due to its closeness to the predominant inter-human dialog form, speech-based communication has increasingly gained in importance. Therefore it is crucial to consider the potential effects of prosodic variations in 'spoken' system output. In a computer-supported learning context, we tested whether participants' learning performance would be affected by a) the type of speech generation (i.e. computer-synthesized vs. pre-recorded natural speech) and b) motivational prosodic modulations (i.e. neutral vs. motivating intonation, with the latter sounding either praising or blaming, depending on the correctness of the response).

To explore these questions, we conducted a simple computer-controlled learning experiment which required participants to categorize tonal stimuli according to certain acoustic features. The relevant stimulus properties for the categorization were not known to the participants prior to the experiment, and therefore had to be inferred from the system feedback. To this avail, contingent auditory feedback (e.g. positive: "richtig"; negative: "falsch") was presented following each participant response. One of the experimental groups received this feedback in the form of computer-synthesized speech, one as pre-recorded natural speech with a neutral prosody, and one as pre-recorded natural speech with a motivational (praising/blaming) prosody. Participant performance (% of correct responses) and reaction times (ms) were recorded and analyzed by means of multivariate analyses of variance.

While the reaction time analysis only showed a general decrease in reaction time over the experiment for all experimental groups, the per-

formance analysis revealed a significantly steeper learning curve when the system feedback was pre-recorded from human speakers than when it was computer-synthesized. Furthermore, an additional significant learning benefit was observed when the feedback was spoken motivationally, i.e. when it sounded praising or blaming instead of neutral.

These results demonstrate clearly that prosody is an important factor influencing user performance in computer-supported learning tasks. Factors like the type of speech generation or the adequate use of prosodic modulations should therefore be carefully taken into consideration in future implementations of spoken feedback in cognitive technical systems.

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The German cognitive science conference is an interdisciplinary event where researchers from different disciplines – mainly from artificial intelligence, cognitive psychology, linguistics, neuroscience, philosophy of mind, and anthropology – and application areas – such as eduction, clinical psychology, and human-machine interaction – bring together different theoretical and methodological perspectives to study the mind. The 11th Biannual Conference of the German Cognitive Science Society took place from September 30 to October 3 2012 at Otto-Friedrich-Universität in Bamberg. The proceedings cover all contributions to this conference, that is, five invited talks, seven invited symposia and two symposia, a satellite symposium, a doctoral symposium, three tutorials, 46 abstracts of talks and 23 poster abstracts.

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