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Working from the Metaverse: A Distraction Management Perspective

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ABSTRACT

The innovative potential of the Metaverse for knowledge work has mostly been explored in terms of its ability to enhance remote collaboration. However, this paper takes a distraction management perspective and presents findings from a qualitative study where knowledge workers performed solo tasks using an immersive Metaverse application. We posit that knowledge workers can proactively shield themselves from common distractions in collaborative, private, or public spaces by clearly separating their virtual workplace from their physical environment. However, Metaverse applications may also introduce new sources of distraction, requiring knowledge workers to be aware of and able to customize technology affordances to optimize work outcomes. These findings inform a theoretical model of *virtual workplace distraction management*, emphasizing that we should harness its potential to augment, transform, or replace conventional work environments rather than recreating traditional corporate offices in the Metaverse and their common distractions.

KEYWORDS

Metaverse; virtual reality; workplace technologies; knowledge work; workplace distraction; distraction management

Introduction

Emerging technologies substantially change the way we work [106]. In recent years, knowledge workers—individuals who earn a living using knowledge resources to produce intellectual results [43]—have experienced an exceptionally high number of such changes. This includes working remotely with the support of software applications that contribute to the idea of the Metaverse [28]. The consulting firm *Accenture*, for instance, built its own "Nth floor"[1] Metaverse application, including virtual replicas of their physical offices, allowing employees to *"meet, collaborate, and learn."* Simultaneously, technology start-ups such as Zigbang (*Soma*[2]) or Gather (*Gather.Town*[3]) have entered the market to compete against Meta (*Horizon Workrooms*[4]) and Microsoft (*Microsoft Mesh*[5]) in becoming the leading vendors of immersive virtual office space.

This virtual office space offers knowledge workers an alternative to physical work environments where they can perform various tasks. Typically represented by digital avatars [68, 100] and equipped with virtual workstations and objects [70], they can engage in virtual

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meetings, brainstorming sessions, social "bump into" experiences, well-being spaces, or track the live status of their co-workers [57, 75]. What the current marketing by vendors, applications in organizations, and the scholarly literature have in common is the tendency to envision working from the Metaverse surprisingly similar to working from traditional workplaces (i.e., a corporate office) [8, 14]. However, this vision often neglects the essence of knowledge work, that is, undisturbed and focused work in solitude (hereafter referred to as *solo work*). Metaverse applications and features that can support solo work include augmented reality (AR)-based portable head-mounted displays that are paired with conventional devices, such as keyboards, smartphones, or tablets (e.g., with the *Apple Vision Pro*[6]), and virtual reality (VR)-based immersive desktop solutions (e.g., with Meta's *Horizon Workrooms*), or visualization tools to create and manipulate 3D models (e.g., with *Unity Industry*[7]) [11, 38]. Investigating the potential of the Metaverse to support solo work is essential for two main reasons. First, in a traditional office setting designed to foster prosocial behavior and collaboration, distractions emanating from co-workers and information technology (IT) can impair task outcomes of solo work [31, 65]. However, some distractions may also benefit solo work—if they are relevant to a task [65]. Knowledge work performance is also at risk in remote work because of distractions through heavy IT use that overcompensates the lack of social interactions [46]. Second, in non-work situations, work-related distractions through contemporary IT can harm private life outcomes [17]. In this context, the Metaverse may allow knowledge workers to effectively delineate work and private life domains through immersion. The *Apple Vision Pro* feature to individually and incrementally adjust the degree of immersion on the AR–VR continuum is a prime example that supports both ideas.

We refer to the technologies and platforms that provide immersive, virtual office space as Metaverse applications. They extend physical reality through VR or AR in a particular life domain, such as entertainment, education, or, in this case, work [111]. In general, the idea of the Metaverse refers to a *"decentralized and persistent virtual universe"* [25:14] that combines technological abilities from VR, AR, or the blockchain to integrate physical and virtual worlds [89]. The Metaverse is also seen as a continuously evolving sociotechnical phenomenon that is yet to be defined [26]. Metaverse applications represent the current state of the Metaverse but are still limited in some respects that pertain to the ideal-typical Metaverse traits of realism, ubiquity, interoperability, and scalability [25, 62]. Nonetheless, there is value in understanding the design and nature of solo work in a Metaverse context based on contemporary applications. If Metaverse applications are designed and used as immersive replicas of traditional corporate offices, as we currently see [48, 111], organizations will likely forfeit the solo work performance gains and work-life benefits that can emerge from adopting new ways of working [19, 58]. Therefore, this study aims to investigate the extent to which Metaverse applications can eliminate, introduce, or reintroduce common distractions for knowledge workers during solo work. Based on these considerations, we pose the following research question:

> *Research Question (RQ): How do knowledge workers manage distractions with immersive Metaverse applications for solo work tasks?*

To address this question, we conducted a two-phased qualitative study with knowledge workers (n = 32), consisting of (1) an intervention with an immersive, VR-based Metaverse application where participants conducted solo work tasks under different conditions,

followed by (2) an interview about their experience. Our inductive theory development is based on grounded theory principles [32] and culminated in two main concepts: *Distraction shielding* describes the ability to proactively shape one's virtual work environment and use it to protect oneself from unwanted distractions—including those coming from the physical environment. *Arousal filtering* refers to a knowledge worker's efforts in an immersive Metaverse application to cognitively process and react to stimuli (i.e., potential distractions) from this virtual environment. We combine these concepts and subthemes to develop a theoretical virtual workplace distraction management model. With this model, we explain how knowledge workers experience and deal with distractions during solo work in the Metaverse in its current state. Moreover, we suggest ways to use Metaverse applications to support solo work in complement with the predominant collaboration logic we find in the existing literature.

The contribution of this study to the information systems (IS) literature is threefold: First, we add important nuance to the literature on working with Metaverse applications by establishing a solo work perspective. Second, we provide empirical evidence that collaboration is not merely motivating knowledge workers to use Metaverse applications and their potential to manage distractions and improve solo work outcomes. Third, our concepts and theoretical model can be mobilized to guide IS research in understanding and shaping the individual-level management of distractions in the context of solo work with VR-based Metaverse applications. Because our findings are limited to the context of VR-based Metaverse applications, we discuss potential opportunities for future research to extend the boundaries of our theoretical model to other styles of solo work in a Metaverse context (e.g., involving AR). Although a proclaimed purpose of Metaverse applications is to create virtual work environments that are superior to existing remote work technologies (e.g., video conferencing tools), we posit that the innovative potential of the Metaverse should not be confined to that of collaboration tools or those that virtualize the design of existing corporate offices. Instead, we campaign for research and practice that takes the opportunity of the Metaverse to rethink the workplace altogether.

Background

Working in and from the Metaverse

In Metaverse applications, individuals can use digital avatars to facilitate social and business engagements [27, 67, 72, 113]. In addition, Metaverse applications are designed to reflect or aspire to the four primary traits of the Metaverse: (1) *realism*, that is, creating the feeling of being fully immersed, psychologically as well as emotionally; (2) *ubiquity*, that is, connecting to daily used devices such as phones, tablets, and computers; (3) *interoperability*, that is, providing the technical features to make use of all information that is relevant to the user; (4) *scalability*, that is, delivering the service to many users simultaneously [25, 62]. Contemporary Metaverse applications are predominantly present in the video game sector [35, 68] and, in this context, offer novel ways of "working" as part of Metaverse-native token economies [45]. For example, Metaverse applications such as *Roblox*[8], *The Sandbox*[9], or *Decentraland*[10] allow users to buy and sell digital creations or trade virtual real estate [20]. The earned tokens from these activities can then be spent within the same token economy

or be converted into other cryptocurrencies or fiat money [101]. We understand the work carried out within a Metaverse-native token economy as working *in* the Metaverse.

Working *from* the Metaverse, as we define it, deals with knowledge work supported by a Metaverse application but contributes to common types of employment and business goals outside of Metaverse-native token economies. Existing research that explores the Metaverse as the next stage of AR and VR in the context of knowledge work primarily revolves around Metaverse applications as enablers of more effective collaboration and social computing [24, 55]. The relatively slow adoption of Metaverse applications in the knowledge work sector is often attributed to what is perceived as a lack of social presence provided by the technology in its current stage of evolution [78, 91]. Moreover, the literature paints a picture of Metaverse applications that are full of "natural collaboration" [3] and "social gains" [92]. For example, this is mirrored in McKenna's [60:186] definition of virtual worlds as *"online environments where users create an avatar that enables them to interact with other users."* Along the same lines, Bhagwatwar et al. [8:169] define three-dimensional virtual environments as *"collaboration platforms where group members are represented as avatars and interact in a customizable simulated world."*

From early on, the literature considered the Metaverse a technology with primary capabilities that support communication, rendering, interaction, and team processes [13, 23, 88]. Additional research focused on the role of avatars, specifically their design and perception [73, 96, 110], manifesting the underlying assumption that there is always someone else to perceive one's avatar. In contrast to this extraversion-focused perspective, only a few studies deal with aspects of introversion, such as identity, embodiment, and identification in the context of avatars [85, 86]. Furthermore, research has evaluated the influence of design features of virtual environments on users' perceived effectiveness and trust [116]. The idea of the Metaverse has been discussed in various fields of application, such as e-commerce [72], social networking [29, 87], gaming and sports [118], teamwork [83], and education and learning [50]. Following the notion of the Metaverse as a place of collaboration, scholars advanced VR applications to better enable interaction and knowledge exchange, for example, by optimizing avatars' facial expressions and gestures [3] or by building virtual communities [52]. Individuals who collaborate with Metaverse applications feel more connected to others and experience more natural interactions than video conferencing [115]. They also find this collaboration emotionally arousing [30], presumably due to a strong sense of immersion and a feeling of presence and correspondence [1]. To reap the benefits of this way of collaborating, organizations use Metaverse applications to build brand communities [102] or extend and sometimes replace physical workplaces [66].

If not moving the entire workplace to a Metaverse application, it can serve as a virtual carry-on office to enable individuals to work from anywhere to overcome spatial constraints, for instance, insufficient space for a desk with monitors [38]. This research stream, which focuses on solo work in the context of the Metaverse, pursues the idea of using a virtual workplace to alleviate various limitations of a knowledge worker's physical environment. Because knowledge work involves mainly 2D tasks (e.g., using a desktop computer), scholars began to project these tasks into 3D virtual environments [11], for example, by creating virtual desktops and monitors [9, 70]. Although exposure to natural environment projections during solo work in VR can reduce stress [74], long-term use of VR headsets is associated with discomfort, migraine, and simulator sickness [10]. Although initial evidence suggests that working with VR can reduce distractions for knowledge

workers in open offices [80], one attempt to replace a physical workspace with a virtual one focused on virtually recreating a corporate office experience in the Metaverse. It still included commuting, working during core hours, and maintaining the same spatial division of the virtual workplace into offices, workers' lounges, and meeting rooms [66]. Yet, if the Metaverse only re-creates traditional (and often flawed) workspaces virtually—whether for remote solo work or team collaboration—it will not be able to realize its potential to rethink the workplace in its current form. The following section will explore how Metaverse applications can enhance solo work experiences for knowledge workers.

Table 1. Overview of relevant concepts for this study.

Concept	Description and relevance of this study	Supporting research
Distraction	*Description*: An incident or stimulus that elicits reactions that create conflict with the demands of a task. Distraction can facilitate the performance of simple tasks or impair the performance of complex tasks. *Relevance*: In this study, we define distractions as incidents or stimuli that influence an individual's attention during a knowledge work task. In the context of Metaverse applications, this can include the distractions emanating from the knowledge worker's physical surroundings (e.g., an office) and potential distractions within the virtual workplace (e.g., *Horizon Workrooms*).	Baron [6], Groff et al. [37], Sanders and Baron [81]
Arousal	*Description*: Arousal has a somatic and cognitive dimension. In a behavioral context, it describes the "responsiveness" or "behavioral intensity" toward eternal stimuli. Arousal is often linked to levels of sensory input and can elicit "drive" but also "overload." Arousal can occur because of experiencing distraction. *Relevance*: In this study, we use the concept of arousal for its cognitive dimension. The term enables us to articulate better the cognitive aspects of responding to distractions in Metaverse applications. For example, knowledge workers might experience different arousal levels and react differently to working with other digital avatars (a distraction).	Andrew [2], Baron [6], Coren and Aks [21], Sharar et al. [90]
Affordance	*Description: "The potential for behavior associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors"* [95:69]. *Relevance*: In this study, we use affordances as a lens to understand better and theorize the potential for behavior within a Metaverse application. This includes the question of to what extent these affordances lead to distraction.	Burton-Jones, and Volkoff [15], Dincelli, and Yayla [24], Strong et al. [94]

Technology-Enabled Distraction Management in the Workplace

Achieving knowledge work outcomes does not solely rely on collaboration but also involves uninterrupted solo work [40]. Successful knowledge workers are those who can control an overabundance of information and mindfully manage the interruptions today's workplace technology introduces [77]. IT-mediated interruptions in office work can become distracting and harm flow and productivity if the content of that interruption is not relevant to a task [65]. However, distractions are not harmful per se. If they are relevant to the task at hand, they can positively affect the task performance [37]. Yet, multiple studies report an increase in IT-mediated interruptions in the workplace [4, 97, 107], including those that become an unwanted distraction and lead an individual to divert their attention away from a task [98].

At the same time, the sources of distraction at work are not only limited to IT but also involve in-person social interactions with co-workers. Whereas territorial spaces such as shared open offices create opportunities for social interaction and collaboration, they are linked to unwanted distractions [34]. In this context, segmentation preferences influence individuals' susceptibility to being distracted [7], which can lead knowledge workers to choose remote work arrangements over onsite work [46]. In remote work settings, however, opportunities for IT-mediated distractions increase that can also extend to nonwork life domains [17] and negatively affect psychological transitions between work and non-work [61].

Existing research has attempted to turn the tables and explore IT use to manage workplace distractions. This includes software that blocks notifications or access to websites [56], social media [71], or mobile devices [76]. From existing theory, we know that external stimuli, such as the mere presence of other humans, can cause distractions. Distraction-conflict theory posits that other social actors being present while focusing on an assigned task influences the performance of that task [37]. More precisely, the presence of others can facilitate the performance of a simple task and impair the performance of a complex task [6]. This is because having an audience while conducting a task causes an attentional conflict (i.e., a conflict in terms of responding to the task or other individuals). This, in turn, leads to a state of arousal that either facilitates the task performance or impairs it [6]. For simple tasks, arousal is a form of activation (i.e., social facilitation) [2]. For complex tasks, we can observe the opposite effect, meaning that the arousal from distractions affects task performance negatively (i.e., social inhibition) [81]. This theoretical mechanism is fascinating if we want to better understand solo work in the context of Metaverse applications primarily designed to simulate the presence of others through digital avatars.

Previous research showed that limiting interactivity and vividness in VR can help avert information overload and intense distractions [18, 69]. In line with distraction conflict theory, Liu and Yu [51] demonstrated that a virtual co-actor in VR can cause an individual to experience social facilitation that positively affects the performance of a simple task and social inhibition that hurts the performance of a complex task. Moreover, a literature review on AR systems revealed that increasing mental workload can lead to performance boosts [41]. Apart from other avatars, the literature does not provide answers about the nature and sources of distractions that knowledge workers are exposed to when working with Metaverse applications during solo work. Furthermore, we do not know how these distractions influence knowledge workers' decisions and trade-offs in managing them.

A frequently used theoretical lens to describe user-system interactions in the context of the Metaverse is that of technology affordances [24, 60, 92]. The term affordance refers to *"the potential for behavior associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors"* [94:69]. The way individuals perceive affordances influences how they "actualize" these affordances to support a specific goal [15, 39]. Affordances can be seen as embedded in an IT artifact's design or emergent in practice [42]. For this study, we view affordances as latent potentials for action that require someone who can perform the actualization to have any meaning [93]. Based on existing literature dealing with immersive VR, Dincelli and Yayla [24] identified five affordances relevant to the Metaverse: embodiment, interactivity, navigability, sense-ability, and create-ability. All these affordances are potentially helpful for performing solo work, as they enhance individual productivity, facilitate deep engagement with knowledge work tasks, and provide opportunities to manage distractions through immersion.

Yet, their review also revealed that Metaverse research in management and organizing, which covers knowledge work, is mainly concerned with interactivity affordance. This supports our argument that Metaverse applications tend to be used to promote collaboration rather than solo work. The affordances of contemporary Metaverse applications, however, may also allow knowledge workers to manage distractions in the workplace better and, by doing so, improve solo work outcomes. To explore this possibility, we borrow the terms distraction, arousal, and affordance as clear concepts from existing theory [95] and use them to inform our empirical inquiry. Table 1 provides an overview of these concepts, their definitions or descriptions, and their relevance to our study.

Research Design

To address our research question, we employ a two-phased research design, consisting of (1) an intervention in a Metaverse application where participants conduct solo work tasks under different conditions, followed by (2) an interview about their experience. Our research design is sequential and predominantly qualitative, with the idea of exposing our participants to certain stimuli before interviewing them [22, 99]. We carried out the intervention first and the interview second because interviews can only reveal what interviewees have experienced [63]. Conducting the intervention allowed us to be less restrictive during the sampling, as we provided the necessary experience to answer our questions. Most participants already had experience with VR or Metaverse

applications, though none had conducted knowledge work using a Metaverse application as in our intervention. Only four participants had never used VR or a Metaverse application before. Prior experience was limited to games, simulators, and participation in academic VR experiments. To build a meaningful sample, we acquired 32 full-time knowledge workers who participated in the intervention and a subsequent interview. After drawing a convenience sample with university students for the first wave of data collection, we followed a purposeful snowball sampling throughout the remaining three waves by acquiring knowledge workers interested in our study, which suggested further participants [12, 36]. We aimed to cover a high diversity regarding demographics, previous experience with VR, knowledge-work industries, and typical work arrangements (full-time remote, hybrid, onsite). During the acquisition process, we checked whether suggested individuals could enrich our sample in line with our theoretical sampling; the selection of participants became increasingly stricter throughout the study as our theory developed (see Data Analysis section). We informed each individual about the intervention and possible side effects (e.g., motion sickness) and asked whether they would like to participate. A complete list of participants, alongside information about their demographics, professions, and experience, is provided in Online Supplemental Appendix 1. During the sampling, we noted that mainly younger people (aged between 20 and 32) showed interest in participating in our study. Older candidates declined, stating that they were either not interested in the topic of the Metaverse or did not have time to participate. This is consistent with other research that includes time-consuming studies in the context of the Metaverse [e.g., 5], leading to similar age demographics (e.g., mean age 21.3 years in [5], and 72.8 percent with age ≤30 in [112]). Research concurs that young people are more interested in the technologies related to the Metaverse than older demographics [44]. Rather than trying to persuade older candidates to participate, we embraced this observation as part of our study.

Phase 1: Intervention

The purpose of the intervention phase was to expose our study participants to stimuli in a semi-controlled setting using a Metaverse application. This allows us to create an experience that constitutes the basis for the subsequent interview phase [79]. We used the Metaverse applications *AltSpace VR* (variation A) and *Horizon Workrooms* (variation B-D). To enter the respective Metaverse application, we invited participants to a lab. We equipped them with the *Oculus Quest 1 VR* to access *AltSpace VR* or the *Meta Quest 2* to access *Horizon Workrooms*. Within each Metaverse application, we set up a workroom that the participant could access and mounted a notebook into the virtual environment with which the participants performed solo work tasks. Specifically, the participants could use the notebook's keyboard as usual while the screen was shown virtually. Throughout the study, we decided to switch up the mode of the intervention to satisfy the requirements of theoretical sampling [104]. The four variations of the intervention are shown in Table 2.

We designed the solo work tasks during the intervention according to the distinction between simple and complex tasks made by the distraction-conflict theory [37]. Complex tasks feature multiple path-goal connections, multiple end-state alternatives, subtasks, high information load, and demand high cognitive effort, whereas simple tasks do not have such properties [16, 105]. To control for validity, we queried each participant about the perceived difficulty of the task [59], and they indeed found one task more complex than the other. Moreover, we accounted for the level of external stimuli the participants were exposed to. To this end, we created four intervention variations, with two settings per variation. A participant completed both settings within the variation they were assigned to. They also performed both simple and complex tasks in each setting. To rule out bias from the tasks of the first setting, we varied the task subject in the second setting (e.g., technostress instead of climate change). Having two settings in each variation allowed the participants to experience the contrast of different levels of external stimuli, leading to more nuanced accounts in the interviews. We created the stimuli by exposing the

Table 2. There are four variations of the intervention.

Choice	Variation A	Variation B	Variation C	Variation D
Number of participants	8	10	6	8
Time of data collection	June-July 2022	March-April 2023	May-June 2023	November 2023-January 2024
Hardware	Oculus Quest 1	Meta Quest 2	Meta Quest 2	Meta Quest 2
Metaverse application	AltSpace VR	Horizon Workrooms	Horizon Workrooms	Horizon Workrooms
Task 1 (simple)	Online search for images to use in a presentation (e.g., climate change)			
Task 2 (complex)	Online search for scientific publications (e.g., climate change)			
Setting 1	Solo in the Metaverse application	Solo in the Metaverse application	In the presence of two researchers *not* in the Metaverse application	In the presence of two researchers in the Metaverse application
Setting 2	In the presence of one researcher (as a digital avatar) in the Metaverse application	In the presence of two researchers (audio and video) in the Metaverse application	Solo in the Metaverse application	In the Metaverse application but with individual adjustments regarding the presence of the researchers (audio or video)

participants to the presence of others (i.e., the researchers) via a digital avatar or a video stream. Thus, we were able to gain insights into the participants perception and comparison of four distinct settings: (1) no external stimuli from others while working with the Metaverse application, (2) external stimuli from the presence of others while working with the Metaverse application, (3) external stimuli while working in a physical environment (i.e., the lab), and (4) self-adjusted stimuli while working with the Metaverse application. We will now provide a detailed description of each setting.

In variation A, the participants conducted the two solo work tasks in a virtual private room without any other avatar being around (i.e., setting 1). In Setting 2, the participants entered the so-called *campfire* area. This virtual room was accessible to all users of the *AltSpace VR* application, not only the researchers and participants of the study. The presence and appearance of other avatars and their efforts to interact with the participants were the external stimuli in this setting. However, we noted that unknown users started interacting with the participants by approaching and trying to talk to them through their avatars. The frequency with which our participants were approached and interrupted by strangers was higher than expected in an office or solo work situation. Therefore, we decided to adapt the intervention in the next wave of data collection.

In variation B, we reduced the direct communication of others with the participants to resemble a solo work setting more realistically. To enable more controlled sources of distraction, we selected the Horizon Workrooms Metaverse application in variation B, which required a hardware upgrade to the *Meta Quest 2* headset. *Horizon Workrooms* offers a private virtual room like the previous application and a virtual meeting room, to which access must be granted. First, the participants performed both tasks in the private virtual room without another person.

Based on preliminary data analyses after variation B, we found that participants often compared their experience to what they were used to from working in an office or remote work setting. To further explore the differences between traditional office work, remote work, and solo work with a Metaverse application, we adapted the settings again for a third wave of data collection (variation C). To this end, we transformed setting 2 of variation B into a physical office situation. The participants performed the tasks while two researchers were discussing their work in the same (laboratory) office. Again, the discussion was not designed to involve the participants, and they were told to work on their tasks. Setting 2 of this variation again involved solo work in the Metaverse without the presence of others in the *Horizon Workrooms* private room Figure 1 displays both settings.

After the third variation, our preliminary findings and theorization indicated individual preferences regarding the amount and type of distractions that participants perceived as facilitating or inhibiting. To refine the concepts we had developed by this point, *distraction shielding* and *arousal filtering*, and being able to create a theoretical model that brings those concepts together, we turned to *Horizon Workrooms* again. For the fourth wave of data collection, we replicated variation B's second setting, that is, solo work with the Metaverse application and two researchers being present who discuss their work as the first setting of variation D. In the second setting; we allowed the participants to choose freely whether they wanted to hear or see the researchers, or none of the above.

Figure 1. Private room (left) and private room with researchers displayed on the black virtual screen (right).

Phase 2: Interviews

In the second phase of our research design, we interviewed each participant to learn about their experiences during the intervention [33, 63]. We used a semi-structured interview guide, which included predetermined and open questions that allowed us to dive deeper into topics of interest that emerged at the moment [64]. The interview guide was divided into three main sections. In the first section, we asked participants about their regular activities as knowledge workers and context information about their jobs and typical work environment. An example question for this section is: *"How much work experience in your current position do you have in total?"* In the second section, we queried participants about their experience conducting the solo work tasks during the intervention phase, with questions such as: *"How did you feel when you were alone in VR during this simple task?"* The third section revolved around distractions they experienced while performing the tasks. It also included questions about how they would compare this experience to their working environment. An example question from this section is, *"How did you find completing the tasks in the virtual environment compared to your experience in your regular non-virtual work environment?"* However, the guide evolved with every wave of data collection (i.e., variation of the intervention phase). In the later stages of the study, we added questions that would help us to refine our theorization, for example, concerning our second-order theme of *affordance customization*. An example question for this addition is: *"What would you like to change about the virtual work environment if you were working there alone?"* The complete interview guide and the questions we added over time are provided in Online Supplemental Appendix 2. We transcribed the interview recordings verbatim using a local instance of OpenAI's Whisper, anonymized the transcripts, and translated them from German to English using the AI-based translation tool DeepL.[11]

Data Analysis

Based on principles of the grounded theory method [32], our data collection and analysis activities were intertwined across all waves, including variations A-D of the intervention. Two researchers applied open coding techniques to the interview data. In regular meetings, the resulting open codes were discussed, compared, assessed for relevance to the research question [82], and amalgamated into first-order codes. When new interview data arrived, the open codes from analyzing the new data were compared

with the existing list of first-order codes, which were then extended or amended. We used a list of all first-order codes to build clusters for potential second-order themes and aggregate dimensions [32]. While doing so, we used *distraction, arousal*, and *affordances* as explicit constructs to inform our theorizing [95]. This means that although the first-order codes were developed entirely based on the language and expressions used by our interviewees, the second-order themes and aggregate dimensions were developed based on grouping the first-order codes and our constructs-in-use. Figure 2 shows an example of the data analysis process for the aggregate dimension of *distraction shielding*.

After the third wave of data collection, we integrated our second-order themes and aggregate dimensions into a theoretical model, refined throughout the fourth wave. Based on the data structure (and later the model), which was updated after each wave of data collection, we changed the intervention in line with the theoretical sampling. This means it was less important *who* we added to our sample and *what* additional participants experienced during the intervention phase to inform our theoretical model further [108]. We continued our study until no further insights could be gained from additional data collection. This theoretical saturation was apparent when no new first-order codes could be generated from additional interview transcripts [32]. We developed our final theoretical model around the two aggregate dimensions of *distraction shielding* and *arousal filtering*. Figure 3 shows the complete data structure that resulted from our analysis.

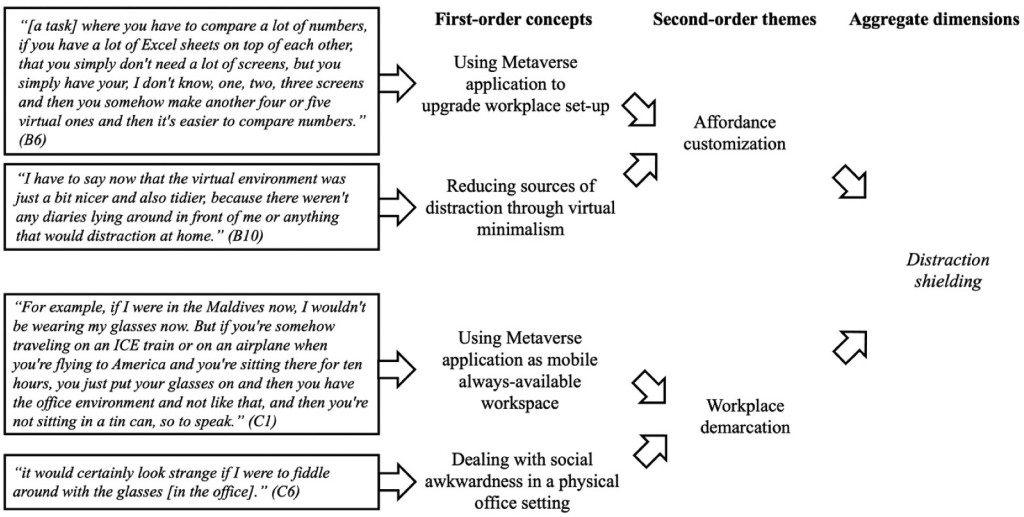

Figure 2. Example of the data analysis process.

Findings

Sources of Distraction for Knowledge Workers in Metaverse Applications

We motivated our study to learn more about the extent to which the Metaverse application removes existing, introduces novel, and reintroduces common distractions for knowledge workers. We then set out the goal to develop a new theory about how knowledge workers can manage these distractions with this emerging technology. The first step towards

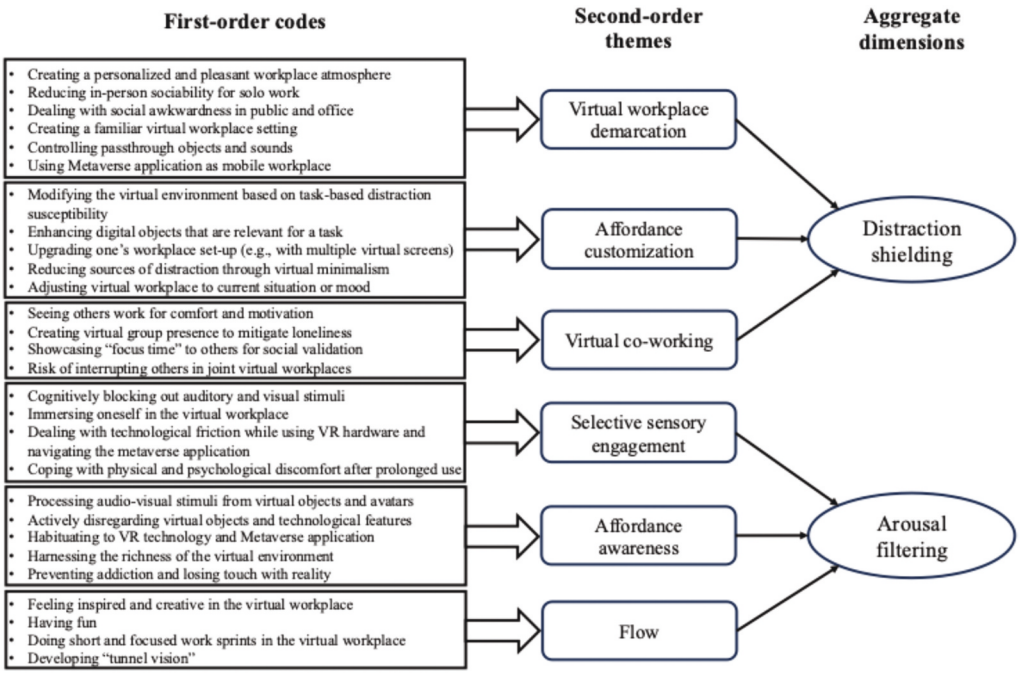

Figure 3. Data structure.

achieving these objectives is identifying the relevant distractions knowledge workers face in this context.

As described in our research design section, we confronted our participants with different types of distractions while performing simple and complex tasks as part of our intervention with the immersive Metaverse application. In the interview stage, we discussed these experiences but also asked our participants to contemplate how their experience during the intervention relates to their typical work settings and the distractions they experience in their day-to-day work lives. In the following, we provide an overview of the most common sources of distraction our participants named from their experience in a regular office and remote work setting, as well as novel sources of distraction that are unique to their experience with the Metaverse application. The overview provided in Table 3 lists these sources of distraction in the respective work environment when performing solo work tasks.

For their experience with the Metaverse application, most participants stated that they felt distracted by the presence of others, regardless of whether others were represented through a digital avatar or a video screen. Some participants reported that they felt overwhelmed by the novelty and variety of affordances awaiting in the Metaverse application, which could steer their attention away from the tasks. The appearance of the virtual environment came surprising for first-time users. They expect his effect to wear off over time, which rules out the visual appearance of the virtual workplace as a permanent source of distraction. However, technological advancements and updates to Metaverse applications might constantly enhance the perceived level of realism and, therefore, introduce new sources of distraction. A third source of distraction while using the Metaverse application

Table 3. Overview of different sources of distraction when performing solo work tasks

Source of distraction	Working in a physical office space	Working in a remote work setting	Working with a metaverse application
Conversations with others	Talking to co-workers in person Instant Messaging	Talking to family members, roommates, or strangers Instant Messaging	Talking to co-workers through avatars Instant Messaging
Visual appearance or presence of others	Presence of co-workers (e.g., in open-plan office)	The presence of family members, roommates, or strangers	Presence of other avatars
Elements of the Work Environment	Devices and tools (e.g., computer, smartphone, cluttered desk, etc.)	Devices and tools (e.g., computer, smartphone, cluttered desk, etc.), home appliances (e.g., for cleaning or cooking), hobby items	Applications (e.g., new features, open worlds, games, etc.)
Technological friction	N/A	Poor internet connection (e.g., in cafés and other public places)	Strain from wearing devices, software glitches, and uncanny valley

refers to the technological friction while conducting solo work tasks. Most participants reported that the hardware controls were not very intuitive, which required some time to get used to them. At the same time, however, most participants expect that Metaverse applications will be part of their work lives once these hardware issues have been resolved. Now that we know what types of distractions are relevant to their experiences of performing solo work tasks, we will explore the role of Metaverse applications in managing these distractions.

Managing Distractions with Metaverse Applications

The first aggregate dimension of our inductive theory development, *distraction shielding*, refers to the proactive exclusion of external stimuli from (1) the physical environment through immersion and (2) the virtual environment through technologically removing sources of distraction. Viewed through an affordance lens, this encompasses customizing the potential of behavior to achieve personalized levels of sensory input that facilitate flow and task performance. The second aggregate dimension, *arousal filtering*, refers to a knowledge worker's "responsiveness" and cognitive ability to regulate (suppress or enhance) the arousal they experience from the distractions inside a Metaverse application. Our affordance lens comprises the ability to be mindful of the potential for behavior that the Metaverse application offers. Table 4 provides definitions and examples for both aggregate dimensions.

Distraction Shielding

Distraction shielding in a *physical workplace* explains how Metaverse applications exclude sources of distraction that emanate from a knowledge worker's workplace environment. In an immersive *virtual workplace*, such as a Metaverse application, distraction shielding refers to modifying that virtual workplace to control what distractions a knowledge worker willfully exposes themselves to. In the following, we report empirical findings from our study that support the concept of distraction shielding and organize them based on the relevant second-order themes that are part of the distraction shielding aggregate dimension.

Table 4. Definitions and examples for the aggregate dimensions "distraction shielding" and "arousal filtering."

Aggregate dimension	Definition	Applicable Environment	Example quotes
Distraction shielding	The proactive exclusion of unwanted stimuli from (1) the physical environment through immersion and (2) the virtual environment through manipulating its affordances	Physical layer (e.g., a corporate or home office) Application layer (e.g., a Metaverse application such as Horizon Workrooms)	"It is simply that you really only have your screen in view and can't access the cell phone, that's already a game changer. Because somehow you look at your phone every now and then just to see the time. I reach for my cell phone and then I see a new message. I think already this focused, one has only in the screen, in the monitor, only that can already help to set focus compared to the real world, where I do not always manage it" (C2). "It's not necessarily that my workplace has changed, but it's a bit like putting on these glasses and then somehow knowing that you're in another room. It's like knowing that you have this other workplace that is now focused on you. [. . .] It's no longer so easy to communicate with other people around you, and then maybe you're more willing to wear these glasses, or you're more involved in the digital workplace, because you know that you're now cut off a bit" (C1).
Arousal filtering	A knowledge worker's cognitive ability to regulate (suppress or enhance) the arousal they experience from the affordances inside a Metaverse application	Cognitive layer (e.g., while being immersed in a Metaverse application)	"I faded them out relatively quickly when I then focused on the screen, on the virtual one" (B9). "I generally find it pleasant when I have background noise somewhere. [. . .] I guess it's because you know that somebody else is there, that is a nice feeling. It's not so quiet, which is maybe why you can't let your thoughts drift away like that. But you didn't talk to me, you talked to each other. In this respect I was not integrated, I didn't have to be, I had my task and could shield that, but I perceived that there was someone there" (B6). "It was pleasant to actually hear other voices, which I was able to completely block out, but I still noticed that I wasn't working alone. Yes, and also that I saw you there or could see you when I looked to the side in my case" (B7).

The first theme in the distraction shielding dimension is *virtual workplace demarcation*. This theme describes using a Metaverse application to create a workplace separated from a physical workspace, for example, a corporate office or a private place in a remote work setting. Many participants, such as B9, emphasized the pleasant work atmosphere and surroundings they encountered in the Metaverse application.

> I live in the city, and when I look outside, I see various people, always something new happening, different sounds, and just generally a lot more life. In the virtual world, it

> was a very appealing view, but yes, it was quiet, so not much happened outside, no people, animals, vehicles, or anything else passing by. I would say that everything is a bit cleaner in the virtual world. There are also things like a fireplace and such, which is visually appealing, but I find it not as distracting as, for example, when I'm in my room and see, okay, there's a messy corner, I want to tidy up a bit, or there's stuff lying around that somehow distracts me. It's a bit more modern and cleaner there. (B9)

The preferences of our participants about the virtual workplace design were highly diverse. Whereas some preferred the clean and quiet environment and reduced sociability, others were relieved to experience more social cues in the subsequent setting of the intervention. For example,

B4 had a better experience resolving his tasks with the voices and visuals of the researchers in the background.

> It was pleasant to actually hear other voices as background noise, which I was not able to follow completely, but I still realized that I wasn't working alone. Yes, and also that I saw you there, or could at least see you, when I looked to the side in my case. (B4)

In situations of remote work that do not occur in a home office, some of our participants came up with scenarios that could not only separate their workplace from a busy and potentially distracting environment but also create a sense of familiarity with the workspace. Here, the Metaverse application can provide a mobile, always-available workspace from which a knowledge worker can expect surroundings that create a facilitating and supportive work environment. Participant B6 imagined this scenario in the context of long-distance travel.

> For example, if I were in the Maldives now, I wouldn't be wearing my glasses now. But if you're somehow traveling on an ICE train or on an airplane when you're flying to America and you're sitting there for ten hours, you just put your glasses on and then you have the office environment, and then you're not sitting in a tin can, so to speak. (B6)

Breaking this strict demarcation is technologically possible through so-called passthrough objects and sounds. For example, having a familiar notebook keyboard projected into the virtual workplace can help to increase familiarity and comfort. Conversely, if not wearing headphones, sounds from the physical environment can be sources of distraction or, if preferred, maintain a connection to the physical environment. As C1 explained, those distractions could be triggers to leave the virtual environment.

> I wouldn't know right now, what points I would use to go back, so to speak. Okay, if you're somehow hungry or the doorbell rings or something else and then you go back to the real world. Otherwise, this is where motion sickness comes into play again, when you just can't stand being in the virtual space anymore, let's say. (C1)

One common concern among our participants was the social awkwardness when using VR equipment and a Metaverse application in a physical office setting. As C6 explained, looking foolish and signaling to colleagues that one wants to be left alone was a serious reason not to use Metaverse applications in a social environment such as an office.

> It would certainly look strange if I were to fiddle around with the glasses. But I think that's the only reason that would stop me, because otherwise, if I really needed something, I could see myself using them. (C6)

The second central theme regarding distraction shielding deals with the ability of the user to modify the virtual workplace and its potential sources for distraction, which we coined *affordance customization*. Here, based on task-based distraction susceptibility, knowledge workers can edit a virtual environment in a way so that it is either porous or impervious to certain types of distraction. For example, B10 articulated this idea quite explicitly.

> I think it can definitely be fun, working in different environments. You can eliminate distractions from the environment by having a tidy working atmosphere. You can also perhaps feel more comfortable than in your real environment. (B10)

Many of the quotes we received in this regard dealt with the ability to make the virtual workplace *less* stimulating than ordinary workplaces such as corporate offices or home offices. This finding is somewhat counterintuitive, considering the bombastic and colorful appearance conveyed by marketing materials and popular culture dealing with the Metaverse. However, this virtual minimalism was vital to meeting the design preferences of the knowledge workers who participated in our study. This is exemplified by our participant B10, who prefers tidiness and minimal stimulation to work effectively.

> I have to say now that the virtual environment was just a bit nicer and also tidier, because there weren't any diaries lying around in front of me or anything that would distraction at home. (B10)

However, the modification of the virtual workplace is not limited to the sources of distractions. Participant B6, for example, explored some functionalities of the *Horizon Workrooms* desktop set-up during the intervention.

> [a task] where you have to compare a lot of numbers, if you have a lot of Excel sheets on top of each other, that you simply don't need a lot of screens, but you simply have your, I don't know, one, two, three screens and then you somehow make another four or five virtual ones and then it's easier to compare numbers. (B6)

In addition to workplace setup and potential sources of distraction, Metaverse applications also allow users to augment digital objects or go around them so that a task becomes more straightforward or the possibilities of performing this task more creatively increase. Participant B1 gave two vivid examples of these task augmentations.

> I have a 3D printer at home, and I also use it to create 3D models. Of course, it's especially cool if you can walk around your model and really look at it in three dimensions. That's something I've only tried briefly so far, but it was pretty cool. Apart from that, I've also tried solar software on my private glasses, where you could go through a virtual solar system and just go from planet to planet and look at it. And simply go from planet to planet and have a look. That just really created tangibility. (B1)

Some participants also assumed a critical perspective when reflecting upon the customizability of the virtual world. It led them to question why their physical surroundings may be suboptimal. For example, rather than having a virtual world as the "perfect" workplace, B3 prefers to improve the physical workplace so that there is no need to be dependent on a superior Metaverse experience:

> I would feel like I was escaping from reality, which can certainly be pleasant at times. Exciting and certainly pleasant for a few hours. But I can't imagine it being permanent. Not only because I have the thing on my head all the time, which would really bother me. It's also because I just

> think differently and simply wouldn't understand why I don't try to make something from reality more beautiful so that I like it better here instead of escaping. (B3)

The third theme we grouped under distraction shielding is *virtual co-working*. Like the other two themes, virtual co-working is not to be understood as a collaborative way of using a Metaverse application but as the potential of opening it up to social cues that facilitate solo work task performance while immersed in a virtual work environment. This applies when solo work preferences involve comfort when others are around.

> Yes, it really is an equivalent situation, so to speak, because I can also work very, very well in libraries [. . .] Because you're sitting there and you know that other people are working there too, you have the feeling that 'okay, I have to work now too.' So, the people aren't there to chat, but you're working here, and others are doing the same. (D2)

A common theme in our data was that the virtual workplace without social cues invoked the feeling of *being alone* for some participants, whereas others described it as *loneliness*. Whereas being alone was typically connoted as positive and facilitating solo work tasks, loneliness was perceived negatively. The following quotes by B10 and B4, who experienced the same setting in the intervention, show this contrast.

> I had my own space to myself, in the virtual world. I actually liked that quite well, too. I had my peace and quiet. Yes, if I now compare that with the second room, I have to say that I was distracted by the fact that you were talking to each other. (B10)

> It was just a big room that you occupied alone, which I occupied alone. I definitely felt isolated. (B4)

The presence of others via video stream or digital avatars helped mitigate loneliness, even without any direct interaction. Being visible to others while engaging in "focus time" might also provide some knowledge workers with social validation. As D4 explained, merely seeing others or their virtual representations working can positively affect a knowledge worker's experience.

> Everyone is sitting at their desks, and everyone is totally focused on their work and is quiet and working on things. I would say that it pushes me to a certain extent. (D4)

Based on our concept of affordance customization and recent developments in artificial intelligence, we were curious whether our participants would feel the same if the social cues came from dummy avatars. This was D4's answer:

> It probably wouldn't affect me so much if I thought to myself, okay, there aren't any real people behind them, they're just sitting there because they're sitting there. (D4)

After asking her what if she did not know if real people were behind the avatars, she replied:

> That's a good question. I would probably be more motivated to work. (D4).

Arousal Filtering

With the second aggregate dimension, *arousal filtering*, we address the cognitive perception and responsiveness to distractions in a virtual work environment. These distractions may occur because a knowledge worker proactively decided to allow them or if the user cannot customize the affordances of a Metaverse application. *Arousal filtering* describes the

cognitive ability of a knowledge worker to (1) suppress distractions that impede their task performance during solo work (e.g., during a complex task) and (2) enhance distractions if they support the task performance (e.g., a simple task). In contrast to *distraction shielding, arousal filtering* begins when the technological means of controlling distractions in the virtual environment are exhausted, and a knowledge worker is left with their cognitive resources.

The first theme we crystallized from the data is *selective sensory engagement*. It represents the experiences our participants reported involving their ability to block out auditory and visual stimuli actively they were exposed to. Some participants had a harder time doing so (*"I was listening more than concentrating on the task at hand."* (B10)) than others (*"That was somewhat strange, but as soon as you concentrated on your task, you just heard it and then it didn't matter anymore"* (B6)). A large contributor to a positive experience while doing the solo work tasks was the extent to which the participants felt immersed in the virtual environment. Most participants did not perceive the design of the Metaverse applications as photorealistic but instead as *"cartoon-like"* (B4), *"funny-looking"* (A5), or *"pompous"* (C3). However, this did not keep them from feeling immersed, as B10 explains.

> Well, it still looks virtual, of course, but after a while you get the feeling that you're really there, because you can see your own arms, and everything feels real. So you see everything the way it feels in real life. I found it a pleasant experience. (B10)

A prohibiting factor of feeling immersed was mainly related to technological friction while using VR hardware and navigating the Metaverse application. Although problems with sharpness, handling, and glitches were the common source of distraction for most participants, these problems will likely diminish over time, as B4 suspects.

> Things were blurry at the edge of the field of vision, for example. Essentially, I often had to move closer to see something. At least a little bit, which isn't the case in real life. But I think this is technology is developing rapidly, so something like this will no longer happen in the future. (B4)

A similar source of distraction is that even in our 60-minute interventions, participants saw initial signs of uncomfortableness from wearing the VR headsets. This led to them being distracted because they had to cope with physiological and psychological discomfort after prolonged use. Here, B6 describes his physiological reactions to wearing the VR headset:

> It simply exerts pressure at various points of the head and is also unbalanced. That means you have a lot more weight towards the front and you either get a headache in your neck at some point because [...] or because the thing is pressed against your face, that you get pressure points somewhere and therefore get a headache. (B6)

The second theme that informs our dimension of arousal filtering is called *affordance awareness*. It reflects the participants' accounts of carefully assessing which possibilities for action a Metaverse application offers are being pursued. Because the virtual workplace has an "open world" character, these possibilities constitute potential sources of distraction, which require a good amount of self-regulation. Digital objects, digital avatars, and the virtual space provide audio-visual stimuli that a knowledge worker needs to process. This challenge is typically more prevalent when experiencing a Metaverse application for the first time, requiring a knowledge worker to habituate to the technology.

> You first have to get to grips with the technology, so that you think, okay, how do I hold my head now so that I can see everything quite well? and are the glasses right, things like that. (B3)

Suppose the Metaverse application is used to perform one or more solo work tasks. In that case, the knowledge workers must actively disregard these stimuli and the potential action they entail. The effort to do so increases with the complexity of the task. Participant B6, for example, compared the situation during the intervention with being in an open-plan office:

> I think I'm really bad at reading something while something else is going on that has to do with language. That was then exactly the same as in an open-plan office, when someone is on the phone and you would like to do your job somehow, it was exactly the same problem. You couldn't concentrate on your text; you were always distracted. One to one. (B6)

In contrast to this process of suppressing distraction, participants also shared their thoughts about harnessing the virtual environment to feel motivated and driven to work. We encountered this infrequently in our interviews. Still, one participant (B4) raised important concerns about a Metaverse that is so appealing, stimulating, and persuasively designed that knowledge workers may develop an addiction at some point.

> It can perhaps even be addictive, I can imagine. Quite extreme, just like video games that you immerse yourself in, in role-playing games, like World of Warcraft or something. The stories in this world are so popular that people neglect reality in favor of the virtual world. And I think the potential with virtual reality is even greater than with 2D. If you just physically sit in front of your screen and immerse yourself in it, I think you have to be careful when using it, so that you don't lose touch with reality. (B4)

Rather than conveyed by this intuitive notion of the Metaverse being excessively exciting, C6 suggested a counterintuitive idea. In his view, one way to use Metaverse applications effectively for knowledge work can be by reducing the stimuli in the virtual environment so much that the task at hand becomes the most exciting thing to do:

> I didn't see anything on my desk that could distract me in any way. And I think it's really good if you always have the task in front of you and aren't distracted by any other things by accident or on purpose. So, this technology could help me focus by the fact that it's boring and there's nothing new to discover, so to speak. (C6)

The final theme we grouped under the dimension of arousal filtering relates to the goal of experiencing *flow* while using Metaverse applications for solo work, which may eventually lead to enhanced task performance and productivity. According to those participants who had a positive experience during our intervention, Metaverse applications can ignite a feeling of being inspired and creative during knowledge work tasks. According to them, this mainly applies to situations in which the physical work environment a knowledge worker finds herself in cannot provide this feeling. As B10 emphasizes, an essential part of becoming inspired is simple but often overlooked: having fun.

> Yes, I had a lot of fun. It's a really nice experience to simply put on put on a pair of glasses and be in a different world. (B10)

Other participants, such as B4, suggested a different approach. They contemplated ways to use Metaverse applications to create a flow experience systematically. They reported that the virtual set-up naturally steered their attention towards the virtual screen because nothing

else in the periphery could distract them. Following our data analysis, represented by exemplary quotes from B4 and D6, we chose the metaphor of developing a "tunnel vision."

> I found that it was perhaps comparable to when I'm working in the tunnel, when I can focus completely. It went in that direction, so what I sometimes do is that I put on noise-canceling headphones and then turn on alpha-waves and then I can work for several hours and hardly notice how time passes, time goes by and I can focus completely and I found that it went in a direction that where I could imagine that this immersion would promote concentration. (B4)

> When you're sitting in the room normally without the VR glasses, I at least look to the left, to the right, you look a bit for distraction and of course, with the VR glasses you somehow don't have that in a certain way— you're already focused, can work through the task, but still notice that you're not alone, so to speak, through the visualization of you in the room. (D6)

If there was one thing that our participants agreed on, it was that using a Metaverse application to perform solo work tasks should be most effective if used for short, focused work sprints. This can be triggered by specific situations, such as being in a place that is unpleasant to work in. However, these time blocks can also be proactively created as focus hours dedicated to working on a solo task.

> I can't imagine it for the entire work time, though, maybe more so for when I have a specific task. Let's say I have to create a campaign or do some research, analysis, whatever, so that I consciously say, okay, now I block this one, two hours for myself. I'll go into my virtual space for that, I can very well imagine that. (B3)

Discussion

Virtual Workplace Distraction Management

To address the research question, "*How do knowledge workers manage distractions with immersive Metaverse applications for solo work tasks?,"* we developed the two theoretical concepts of distraction shielding and arousal filtering. On the *physical layer*, distraction shielding is grounded in the statements of our study participants and findings from previous literature that common workplaces such as corporate offices and home offices are often insufficient in removing distractions from the physical environment [65, 80], which negatively affects their experience of performing solo work [31]. When working from a private place, this relates to sources of distraction that a knowledge worker can hardly control, such as other household members or background noises. However, it also includes the need to self-regulate the use of and reaction to common workplace technologies in phases of solo work, for example, cell phones, email, or chat notifications [17]. Although a knowledge worker is supposedly in control of these sources of distraction, escaping their persuasive design through immersion can be a motivation to use a Metaverse application. In this case, the knowledge worker saves cognitive resources to withstand the distractions coming from those technologies and creates a self-enforced physical barrier to access them. Although it seems counter-intuitive, most participants reported being more distracted in a corporate office than in a private one. The corporate office environment affords the physical presence of and frequent interaction with co-workers, which can be a motivator to practice distraction shielding in an office environment. However, some distractions from the physical environment

may be impossible to manage with a Metaverse application as they pierce into the virtual workspace. This may include uncomfortable temperature, obtrusive sounds, or other sensations that cannot be shielded through a VR device. Distraction shielding primarily applies to intermittent phases of uninterrupted solo work, for which the design of most contemporary offices is counterproductive. Consequently, distraction shielding might be employed following the cyclic nature of solo work and collaborative tasks.

On the *application layer*, Metaverse applications can be used to remove or introduce distractions either by design or through customization of affordances on the user's side. This can be particularly useful for solo work because different tasks elicit different individual preferences for being receptive to distractions [6, 65, 81]. Here, the Metaverse application can adjust affordances (i.e., the potential for behavior) to provide a personalized experience with a preferred dose of distraction for a given task or solo work session. The more customizable the potential for action within a Metaverse application is on the user's side, the more they can engage in distraction shielding on the application layer. This is because the application layer, like the physical one, may be subject to sources of unwanted distractions (e.g., affordances that a knowledge worker cannot customize and fails to ignore, such as checking an e-mail notification while being immersed). One might argue that, during solo work, it is up to the user to refrain from actualizing these potentially distracting affordances. Yet, increasingly persuasive system design often leads to unproductive behavior through IT-mediated interruptions [65, 97]. This is why the Metaverse, as an alternative workspace, provides an opportunity to design applications that persuade knowledge workers not to distract themselves but to engage or stay engaged in a phase of uninterrupted solo work.

On the *cognitive layer*, arousal filtering comes into play. Our participants reported different experiences they had during the intervention under similar conditions. These individual differences of perception render the practice of arousal filtering particularly important for knowledge workers who perform solo tasks with immersive Metaverse applications. The ability to cognitively regulate the arousal that comes from a distraction is what a knowledge worker relies on if, for example, an unwanted distraction has been immune to previous distraction-shielding efforts. Arousal filtering also refers to the knowledge worker welcoming the stimulation from inevitable distractions, for instance, because it facilitates the performance of a simple task. Here, based on the ideas of distraction-conflict theory [6, 81], the Metaverse provides an opportunity to design an optimized virtual environment in which knowledge workers can experience the proper doses and types of distraction required to excel at a given task. This includes a task-dependent (e.g., simple vs. complex) regulation of social cues from co-workers (i.e., represented by avatars) and an activity-based (e.g., collaboration vs. solo work) regulation of affordances at the knowledge worker's disposal.

Whereas distraction shielding relates to using a Metaverse application to manage distractions *ex-ante*, users engage in arousal filtering cognitively *in situ* while being immersed and performing knowledge work tasks. We propose a theoretical model of virtual workplace distraction management based on these temporal aspects of our two concepts and the layers of the solo work experience they apply (Figure 4).

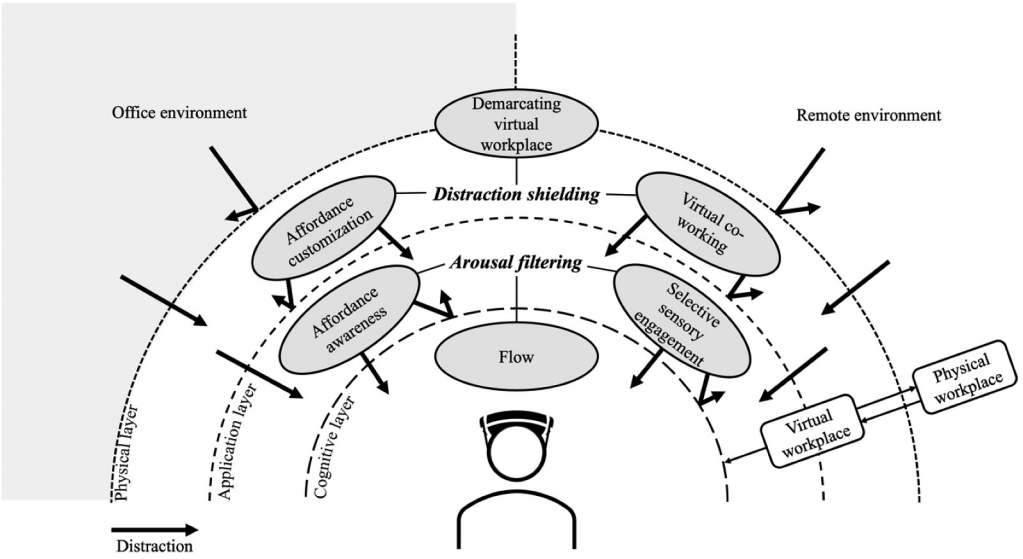

Figure 4. Theoretical model of virtual workplace distraction management.

Theoretical Implications

In the following, we integrate our model with existing scholarship on the Metaverse, IT-mediated interruptions in the workplace, affordances, and distraction conflict theory. Assuming a virtual workplace distraction management perspective, our theoretical model shows that the emerging debate about Metaverse applications need not be confined to the theory that explains this technology regarding remote collaboration and social computing [24, 55]. Our concept of distraction shielding challenges the assumption that knowledge workers who practice unprecedented amounts of remote work these days suffer only from a lack of social interactions [46]. Instead, the opposite—social exhaustion—may also be true [e.g., 109]. The differences in perception of distractions and individual preferences we observed in our study suggest that traditional workplaces and their "virtualized" versions in Metaverse applications, such as Horizon Workrooms, are predominantly designed with *extraversion* as the ideal knowledge worker characteristic in mind. This extends to scholarly theory development and testing in the context of the Metaverse debate, which focuses on social interaction, prosocial behavior, and collaboration [8, 28, 60, 92]. Distraction shielding objects to this notion and puts forth a perspective that buttresses the importance of *introversion* in phases of uninterrupted, focused solo work. Here, our model marks a first foray into the theorization of solo work experiences with Metaverse applications, extending the literature on 1-on-1 interactions with avatars [29, 87], group scenarios [116], and virtual crowds [30].

Our model further speaks to recent literature on IT-mediated interruptions. Arousal filtering, which involves coping with unwanted distractions, underscores the problem that today's workplace technology places unprecedented demands on knowledge workers [77]. If technology vendors and employers continue to reintegrate the same IT-mediated interruptions that are common in traditional workplaces to the Metaverse, solo work outcomes will continue to be impaired by IT [4, 65, 97, 98, 107]. In this regard, our study raises

important questions about work-life boundary management. Especially in remote work settings, the strong demarcation of a virtual workplace from other life domains that Metaverse applications allow might support knowledge workers with high separation preferences [7] and positively affect their psychological transitions between work and non-work [61].

Previous works have developed concrete affordances of Metaverse applications such as embodiment, interactivity, navigability, sense-ability, and create-ability [24]. Although we did not aim to add to that list with our study, our themes of *affordance customization* and *affordance awareness* suggest that Metaverse applications may add a "meta" layer to the affordances users encounter in the context of the Metaverse. Affordances such as embodiment or sense-ability are typically "created" by the vendor of a Metaverse application and can be turned "on" and "off" by changes in proprietary computer code. However, our findings suggest that a critical advantage of the Metaverse over other workplace technologies can be to keep affordances malleable, fluid, and personalized. For this potential to be realized, the create-ability of Metaverse applications must allow users to choose and manipulate the affordances of their virtual workspace [24, 38]. For example, affordance customization could restrict the possibility of interacting with other avatars or navigating to certain parts of a virtual office during focus time. This differs from existing "dysconnectivity" affordances such as notification, volume, or noise-canceling control [49, 53]. Although features that support these affordances are offered (e.g., by the designer of a device) to a user as always present, Metaverse applications may offer knowledge workers the opportunity to make the affordance itself appear or disappear (e.g., deciding before a solo work session that there will be no button to turn e-mail notifications back on for two hours). This would be a helpful design element of Metaverse applications for knowledge work because persuasive system designs make it increasingly hard to resist IT-mediated distractions [77]. Similarly, the awareness of specific affordances (e.g., sense-ability) as a source of distraction may lead users to limit the ability to hear others' conversations in a shared virtual workspace while still being able to see them because the former may be cognitively perceived as a stimulating distraction whereas the latter is not. The idea of the Metaverse and its application in the knowledge work sector mustn't be used to suppress knowledge worker autonomy [106]. Alas, we see the first signs of precisely this, exemplified by live status tracking of workers [75], people analytics [54], and insufficient user privacy [84] in the context of the Metaverse.

Finally, our model speaks to distraction conflict theory [6, 37, 81] as it opens the boundary conditions of this theory to contexts that involve virtual workplaces. The sentiments of our qualitative analysis support previous findings that showed social facilitation effects in VR [18, 51]. We extend this literature by showing that individual preferences and perceptions differ vastly when conducting solo work tasks with a Metaverse application. This means that specific distractions facilitate some knowledge workers, whereas the same distractions impair others from having a productive solo work experience. By considering these mechanisms in our virtual workplace distraction management model, we advance the understanding of how knowledge workers cope with novel distractions being introduced and common distractions being recreated in virtual, immersive workplaces.

The Metaverse presents a unique opportunity to redefine work environments beyond traditional setups. However, if working from the Metaverse evolves to be fully (1) realistic, (2) ubiquitous, (3) interoperable, and (4) scalable [25, 62], we may only succeed in making knowledge work more location-independent without addressing the more fundamental

challenges of modern workplaces. From a distraction management perspective, it is crucial to reflect on how the Metaverse can provide work environments that address the limitations of traditional workplaces and innovate beyond them. This could involve offering knowledge workers and organizations the flexibility to modify intentionally—and even limit—the realism (e.g., lifelike avatars), ubiquity (e.g., 24/7 availability), and interoperability (e.g., integration with other workplace IT) of virtual workplaces. To effectively manage distractions and improve the individual work experience, the Metaverse must enable workplaces that are not just different but meaningfully better.

Practical Implications

Our study has practical implications for employing Metaverse applications in the knowledge work sector. Management offering this experience to their employees should be aware of the additional sources of distraction that a knowledge worker is confronted with in Metaverse applications—if the provided virtual workplace resembles a traditional workplace designed to foster social interaction and collaboration. Technology vendors and managers should give the individual knowledge worker as many customization options as possible to optimize solo work outcomes. We urge managers and software designers not to reintroduce familiar sources of distraction from the physical workspace to the Metaverse. Instead, we encourage them to use the blank canvas of the Metaverse idea to create workspaces that enable knowledge workers to be in control. This includes configuring and customizing their virtual desk, work environment, co-workers' approachability, integration with other workplace technologies, and avatar. Individual preferences, solo work task requirements, and the possibility to manage distractions in a virtual workplace are prerequisites to foster flow, enhance task performance, and ensure worker well-being.

We suggest developing employee training that explores the possibilities of using Metaverse applications for solo work. Moreover, wearing a VR headset in a physical office space should not be stigmatized or interpreted as someone being "antisocial." Rules and norms should be established about dealing with some workers working from the Metaverse while others are physically in the office. A virtual workplace should be rolled out transparently and as a joint activity to prevent employees with less technological affinity from feeling excluded. Particular attention should be paid to addressing all demographics, not only those easily motivated to explore and familiarize themselves with the technology. Older workers may require different or slower training to become savvy in using Metaverse applications or opt out entirely.

Additionally, individual knowledge workers are advised to reflect upon what an ideal work environment should look and feel like to have a satisfactory solo work experience. The learnings from the experience in the Metaverse can then be used to inform the design of *physical* workspaces to make employees favor the in-person experience over the one in the Metaverse.

Limitations and Future Research

This study is subject to limitations. First, the time we spent immersed with our participants in the Metaverse application might not be long enough for them to get used to this new and mostly unknown work environment. Our findings might be biased because they do not

consider adaptation processes over time. Future research can address this by designing longer tasks or repeated interventions so that participants can perceive and assess the virtual environment over a more extended period. Second, we cannot statistically generalize this sample to all knowledge workers. Given that our concepts and their development are based chiefly on young students and professionals with a background in academia, there are opportunities for expanding or refining the conceptual findings by studying knowledge workers from other industries with different types of tasks, for example, the manipulation of a 3D model in VR or a task that involves an AR head-mounted display, which provides different affordances than VR [103]. Furthermore, we primarily focused on one particular type of distraction—the presence of others—whereas other common distractions were not addressed (phone calls, text messages, e-mails, anxiety, etc.). A reader of this article must make their judgment call whether a situation is similar enough if they wish to generalize our findings to a different context [47]. To test our theory, we encourage future research to conduct controlled quantitative experiments with solo work settings in a Metaverse application.

Moreover, future research might evaluate the theoretical concepts we developed in this work. This can shed light on objective performance measures rather than the participants' perception (e.g., actual task performance, correctness of results) and thus contribute to the validity of our findings. Findings may vary for knowledge workers whose primary responsibility is managing others. Managers are likely more open to (and reliant on) specific distractions, such as notifications from communication tools, which would alter their distraction-shielding behavior. Another exciting direction of research could be to control for personality traits of knowledge workers, such as introversion and extroversion, and how this affects their perception of distractions in Metaverse applications. The same applies to age demographics. Older people's attitudes toward and adopting emerging technologies differ [114, 117]. In our context, findings may vary for middle-aged and older demographics because they tend to react differently to distractions and multitasking [119]. Based on *affordance customization*, future research could pursue how specific Metaverse affordances provide customization opportunities and how they align with knowledge-worker preferences. Regarding distraction conflict theory in "Working from the Metaverse," future studies could investigate social facilitation and inhibition effects caused by virtual (AI) avatars.

Conclusion

This study offers a distraction management perspective to the prevailing collaboration-focused viewpoint on Metaverse applications for work. This perspective brings to the fore the essence of knowledge work: undisturbed and focused work in solitude. Our findings from an intervention and qualitative interviews with knowledge workers show that solo work with a Metaverse application raises the possibility of *distraction shielding*, that is, proactively managing distractions that emanate from the physical or virtual workplace. Second, Metaverse applications require knowledge workers to engage in *arousal filtering*, which describes their ability to regulate (i.e., suppress/enhance) distractions within a virtual workplace. Implications for managers and software designers involve the recommendation to avoid reintroducing common flaws of traditional physical workspaces to the Metaverse because this might

jeopardize knowledge worker productivity and well-being. Instead, we encourage fellow researchers and practitioners to view the Metaverse as an experimental space that allows us to rethink the workplace altogether, create virtual workplaces that are in sync with physical ones, and—most importantly—provide creative inspiration.

Notes

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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