# Mind Wandering in Information Technology Use: Scale Development and Cross-Validation

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## Abstract

*Because our minds frequently drift away, an investigation into mind wandering while using information technology (IT) is critical. Despite growing interest in mind-wandering episodes in various domains, the discipline of Information Systems (IS) still lacks a validated measurement instrument that can account for the technology-related facets of the phenomenon. Our work addresses this gap and presents the results of a comprehensively developed scale that is specifically designed for IS scenarios. Using existing literature and the results of a pilot study (N = 35), a field study (N = 364), and a cross-validation sample (N = 336), we developed a new instrument that allows mind wandering while using technology to be measured either as a state (MWS) or as a trait with two subtypes (MWT-D: deliberate, and MWT-S: spontaneous). Whereas MWS captures a momentary mental state or a sequence of mental states that arise relatively freely while using technology in a given moment, MWT-D and MWT-S capture either intentional or unintentional, internally focused thoughts in technology-related settings in everyday life. Our scale is well suited to support future research to investigate the effects of mind wandering in technology-related settings and to study its implications for IS-relevant dependent variables, such as task performance and creativity.*

**Keywords:** Mind Wandering; Spontaneous Thought; Default Mode Network; Scale Development; Information Technology Use.

## Introduction

Mind wandering can be described as a shift in attention away from a primary task and toward dynamic, unconstrained, spontaneous thoughts (Andrews-Hanna et al., 2018; Smallwood & Schooler, 2006) – or as the mind's capacity to drift away aimlessly from external events and toward internally directed thoughts (Giambra, 1989). Given that mind-wandering episodes are considered to represent a failure of attention and control (Baldwin et al., 2017; Drescher et al., 2018; Mooneyham & Schooler, 2013; Smallwood, Fishman, & Schooler, 2007; Zhang et al., 2017), their potential to yield beneficial outcomes has been widely neglected. Only in the last decade have studies highlighted the advantages of mind wandering, which include more-effective brain processing, pattern recognition, and associative thinking as well as increased creativity (Baird et al., 2012; Fox & Beaty, 2019; Smallwood & Schooler, 2015; Smeekens & Kane, 2016). Recent research has shown mind wandering to be a seminal human mode of thinking (and even a desirable one) that allows us to consider future events, solve problems, and form new ideas (e.g., in the digital workplace).

The emphasis on attentional engagement in the research on Information Systems (IS) often follows the implicit assumption that our thoughts are continuously focused (Addas & Pinsonneault, 2018; Agarwal & Karahanna, 2000; Devaraj & Kohli, 2003). However, a growing body of knowledge suggests otherwise – namely, that our minds regularly tend to proceed in a seemingly haphazard manner, with thoughts jumping from one topic to another. More specifically, evidence demonstrates that our thoughts drift away for up to half of the day (Christoff et al., 2016; Killingsworth & Gilbert, 2010; Smallwood & Schooler, 2015) and that the mind is not always tethered to the present moment or task (Golchert et al., 2017). During the current COVID crisis, with people constantly using technology to perform tasks, mind wandering affects nearly everyone: Employees working from home may find themselves thinking about something completely unrelated to the task at hand, and students attending online lectures may become inattentive or bored. Neglecting an investigation into mind wandering thus leaves several phenomena related to the use of information technology (IT) largely unexplored – phenomena that could serve as indicators of various deficits in performance (e.g., in IT management and IT operations), of disturbed team dynamics (e.g., concerning trust and accountability), or of weakened IT security (e.g., with smart-device usage and data management) in addition to phenomena related to enhanced technology-mediated creativity (e.g., in webinars and online workshops). Studying internally directed thought also opens the door to studies in related disciplines, such as marketing, business, and consumer behavior. Against this background, research in complex technology-related contexts can benefit both from a clear conceptualization of the cognitive process of mind wandering and from a comprehensive measurement instrument that can be used to capture the phenomenon.

Because interest in mind wandering has grown significantly in psychological and neuroscientific research (Fox & Beaty, 2019), different measurement scales have been proposed. However, the operationalization of mind wandering in IS-related conditions remains underdeveloped and incomplete (Oschinsky et al., 2019; Sullivan et al., 2015; Sullivan & Davis, 2020; Wati et al., 2014). To the best of our knowledge, existing scales do not distinguish between specific technology-related facets of mind-wandering episodes and have not yet been comprehensively applied in the IS research.

Existing scales are limited in terms of the extent to which they address relevant aspects of mind wandering, including the determination of its stability while using technology (i.e., whether it should be viewed as a trait or a state) (Seli, Risko, & Smilek, 2016a) and of the differences in its degree of intentionality (i.e., deliberate vs. spontaneous mind wandering) (Seli, Risko, & Smilek, 2016b). We examine mental stability more closely because a state is a momentary condition that corresponds to thinking and feeling, whereas a trait is linked to the human personality and can be defined as a habitual pattern of behavior, thought, or emotion. Neglecting stability and intentionality is detrimental to research because it hampers theorization and renders explanatory power unused (Smallwood & Schooler, 2015, for further discussion). Finally, only a few authors have investigated the efficacy of existing mind-wandering scales in the domain of IS research. Since valid and reliable measures are, however, a prerequisite for theory development (Gregor, 2006, 2014; MacKenzie et al., 2011; Moore & Benbasat, 1991), we seek to address this shortcoming by conducting a comprehensive instrument-development and validation procedure.

We contribute to the existing literature by proposing an instrument for measuring mind wandering in technology-related settings. Specifically, we acknowledge the richness of mind-wandering episodes and provide a scale that differentiates between mind wandering as a trait and as a state and that reveals its level of intentionality (i.e., deliberate, or spontaneous mind wandering). As our motivation is to guide future IS research, our instrument opens the door to future studies in various well-researched areas, including research on acceptance, adoption, and design.

To address our objective, the subsequent sections are structured as follows: In section two (Materials and methods), we present our methodological approach. Moreover, we briefly review the current literature on mind wandering. In section three (Results), we show the results of our pilot test, field study, and cross-validation sample. Finally, we conclude by reflecting on our findings in section four (Discussion), which highlights the study's limitations and suggests fruitful avenues for future research.

## Materials and Methods

### Conceptualization

When we work on a task, our thoughts often deviate from it and drift away. Indeed, while reading this manuscript, the reader's attention is likely to switch to unrelated thoughts and feelings. In these mind-wandering moments, we often end up somewhere entirely different from where we intended. The dynamic nature of thought, which allows us to escape from external demands, is reflected in the experience of mind wandering, which can be described as the progression of easy, spontaneous thought experiences that are more constrained than when dreaming but less constrained than when producing creative forms of thought (Christoff et al., 2016). According to Christoff et al. (2016), mind wandering can also be defined as a mental state, or a sequence of mental states, that arise relatively freely due to an absence of strong constraints on the contents of each state (p.719).

Mind wandering predominantly occurs during a resting state, when performing a task-free activity, or in non-demanding circumstances (Buckner & Vincent, 2007; Christoff et al., 2016; Northoff, 2018; Smallwood & Schooler, 2015). In fact, research has found that our minds trail off during up to 50 percent of our waking time (Killingsworth & Gilbert, 2010), at which point they switch to self-generated thoughts and feelings (Smallwood & Schooler, 2015). Although they are familiar to every member of our species (Smallwood et al., 2018), surprisingly little is known about the occurrence of these moments of distraction.

Mind wandering goes hand in hand with both costs and benefits. Its association with unhappiness and its susceptibility to error highlights the high cost with which it can be associated. Mind wandering can be enhanced by stress and substance abuse (Epel et al., 2013; Sayette et al., 2012; Smallwood, O'Connor et al., 2007) and can also be a symptom of losing awareness or control, thereby causing it to be seen as a cause of poor performance, disengagement, or carelessness (Drescher et al., 2018; Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015). Spontaneous mental escape is objectionable in many settings (e.g., when driving) (Baldwin et al., 2017; Zhang et al., 2017), yet is quite natural due to the automaticity that some tasks elicit. Nevertheless, this escape is desired (e.g., when relaxing) or even requested (e.g., when completing creative work) in numerous situations. In creative contexts, our minds wander to our benefit by leading to enhanced moods or to the ability to solve problems (Baird et al., 2012; Franklin et al., 2013; Wati et al., 2014). Mind wandering helps to impart significance to personal experiences and facilitates our planning and pattern recognition (Smallwood & Schooler, 2015). Furthermore, it can provide mental breaks and relieve boredom (Smallwood & Schooler, 2015). Given its complex nature, strategies for minimizing the downsides of mind wandering while preserving its productive elements remain undeveloped.

Mind wandering and external distraction reflect distinct albeit related constructs in which attention shifts away from task-relevant information (Unsworth & McMillan, 2014). When attention is decoupled from the environment and switches to mind wandering, we are less likely to process external information, regardless of whether the distractors are task-relevant or irrelevant (e.g., smartphone flashes or beeps). Although mind-wandering episodes and external distractions provide independent contributions to working-memory capacity and to fluid intelligence (i.e., decoupling theory), what is important is their shared variance because lapses of attention are strongly related both to cognitive abilities and to attention (i.e., attention-control theory). The context appears decisive when dealing with task performance. For instance, Robison and Unsworth (2015) revealed that in noisy rooms, external distractions must be ignored, whereas in silent rooms, zoning-out must be avoided.

IS researchers acknowledge the relevance of mind wandering, which can take many forms and lead to functional outcomes in technology-related settings (e.g., performance) (Conrad & Newman, 2019; Oschinsky et al., 2019; Sullivan et al., 2015; Wati et al., 2014). While using technology, the user's mind can shift away from an ongoing task (e.g., data management) or event (e.g., a video conference) and toward self-generated thoughts and feelings as well as toward internally directed attention. Sullivan et al. (2015) demonstrated that mind wandering influences the functional outcomes of interacting with technology (i.e., creativity). The authors developed a domain-specific definition for technology-related mind wandering as "task-unrelated thought which occurs spontaneously, and the content is related to the aspects of computer systems" and concluded that mind wandering can occur when a user thinks about email, social media, or other online activities instead of solving a work problem (Sullivan et al., 2015, p. 4). Moreover, Oschinsky et al. (2019) revealed a significant difference between the use of the hedonic system (e.g., while playing a mobile game) and of the utilitarian system (e.g., while composing an email) when it comes to mind wandering and concluded that the design of a system influences brain activity, which in turn is known to affect antecedents of IT behavior and thus actual IT use.

Distinguishing between intentional and unintentional mind wandering implies a possible difference in subjective experience. There can, for example, be an uncontrolled and spontaneous shift or a voluntary and thereby deliberate shift of attention (Giambra, 1989). Spontaneous episodes lack a conscious initiation, and during these episodes, participants are likely unaware that they are mind wandering. In contrast, intentional episodes are associated with the aim of beginning mind wandering and metacognitive awareness (Giambra, 1993; Giambra, 1995; Golchert et al., 2017; Seli, Carriere, & Smilek, 2015; Seli, Risko, & Smilek, 2016b; Seli, Smallwood et al., 2015). Whereas the difference between intentional and unintentional mind wandering is well-known to current scholars, the differentiation between the trait and its state is only rarely mentioned (Seli, Risko, & Smilek, 2016a). Spontaneous mind wandering reflects unintentional engagement in internally focused thought, whereas deliberate mind wandering is willful and intentional. However, when studying mind wandering, this distinction is of particular interest because it can traceably occur either in a particular situation at a specific point in time (i.e., while using technology) or as a distinguishing characteristic that belongs to the individual (i.e., in technology-related settings in everyday life). Consequently, to deepen the body of knowledge on mental escapes in IS research, it is necessary to acknowledge mind wandering that occurs both in a specific situation while using technology (i.e., a state) and as a personal characteristic (i.e., a trait).

Despite notable advances in studying mind wandering, its underlying mechanisms remain largely unclear. Although recent neural investigations claim to demonstrate the neural correlations between spontaneous activities that cover various brain regions (including the default mode network (DMN)) (Andrews-Hanna et al., 2014; Golchert et al., 2017; Northoff, 2018; Raichle & Snyder, 2007), conceptualizing spontaneous thought as a consequence of a single brain system's activity appears difficult (Smallwood et al., 2018). Since self-reported measurement remains an efficient and appropriate method of assessing the appearance of mind-wandering experiences, refining the corresponding measurement instruments continues to be an important goal for research in this area (Smallwood & Schooler, 2015). This refinement can be achieved by highlighting the varying levels of stability of the construct (i.e., a trait or a state) and by developing scales that allow for more-detailed future research on phenomena related to mind wandering.

### Development Procedure

We followed existing guidelines of acknowledged IS scholars to ensure that the procedure was comprehensive (MacKenzie et al., 2011; Moore & Benbasat, 1991), and we proceeded in eight steps (cf. Figure 1). After the construct of interest had been defined in the previous section (Step 1), we began the development process by collecting a pool of existing items (Step 2). Next, the content validity of the items was assessed (Step 3). Thereafter, we specified the measurement model (Step 4). Once the measurement instrument had been formally specified, we conducted a pretest to assess the psychometric properties of our instrument's attributes (Step 5). Based on the survey data, we purified and refined the scale by means of an Exploratory Factor Analysis (EFA) (Step 6). We conducted a final assessment of the scale validity by means of a Confirmatory Factor Analysis (CFA) (Step 7). Finally, we cross-validated our results (Step 8).

### Item Generation

In the development of our measurement instrument, we reviewed existing literature to identify scales (an overview is presented in Table 1).

Mrazek et al. (2013) aimed to create a validated scale for measuring the trait of task-unrelated thought. To achieve this goal, they reviewed the Daydreaming Frequency Scale (DDFS), the Attention-Related Cognitive Errors Scale (ARCES), and the Mindful Attention Awareness Scale (MAAS) and studied the interruption of task focus by task-unrelated thought (Study 1). The authors reported on four studies from across different educational establishments (N = 663), which resulted in the development of the five-item Mind-Wandering Questionnaire (MWQ), which uses a

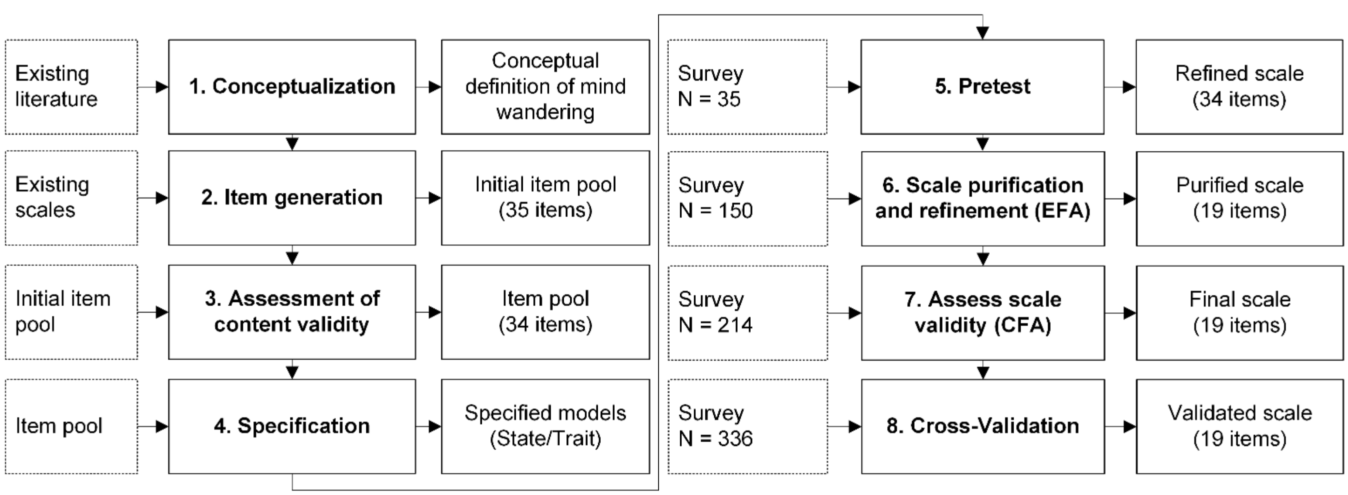


**Figure 1. Measurement-Development Procedure**

**Table 1. Overview of Existing Measurement Scales**

| Stability | Scale | Domain | Items (Scoring) | Instruments | Results (Observations) |
|---|---|---|---|---|---|
| Trait | (Mrazek et al., 2013) | Psychology | 5 (6-point) | Mind-Wandering Questionnaire (MWQ) | α = .850 (N = 663) |
| | (Carriere et al., 2013) | | 4 (7-point) | Mind Wandering: Deliberate (MW-D) | α = .902 (N = 246*) |
| | (Carriere et al., 2013) | | 4 (7-point) | Mind Wandering: Spontaneous (MW-S) | α = .875 (N = 246*) |
| | (Mowlem et al., 2016) | | 15 (4-point) | Mind-Excessively-Wandering Scale (MEWS) | α = .960 (N = 81) |
| State | (Oschinsky et al., 2019) | Information Systems | 4 (7-point) | Adaption of MWQ | α = .810 (N = 90) |
| Trait and State | (Wati et al., 2014) | Information Systems | 6 (7-point) | Adaption of MWQ | α = .934 (N = 84) |

*The results are based on the same sample.

6-point Likert scale. The questionnaire's reliability analysis yielded a Cronbach's alpha of 0.850. Although the scale was the first to demonstrate high internal consistency and convergent validity, the authors did not validate it in adult samples and did not include mind wandering that had occurred during a specific situation or task.

Carriere et al. (2013) developed measures of deliberate and spontaneous mind wandering using both the existing scales in the Spontaneous Activity Questionnaire (SAQ) and the Memory Failure Scale (MFS) as well as MAAS and ARCES (Study 1). However, the measurement of inattentiveness, attentional control, and memory failure fell short as the authors had overlooked a crucial distinction: mind wandering can be a choice to deliberately direct a conscious train of thought away from the task at hand, or it can be a spontaneous focusing of attention on a train of thought that is wholly unrelated to the present experience (as mentioned in Step 1). Accordingly, the authors measured mind wandering via two distinct four-item scales (i.e., Mind Wandering: Deliberate (MW-D), and Mind Wandering: Spontaneous (MW-S)) (Study 2). Both scales were scored using a 7-point Likert scale. An international sample (N = 246) was conducted and yielded a Cronbach's alpha of .902 for MW-D and of .875 for MW-S. The authors replicated the findings of Studies 1 and 2 with an international sample (N = 167) (Study 3) and obtained a Cronbach's alpha of .882 for MW-D and of .842 for MW-S. Based on these results, we expected the two scales to also be meaningful in our study. However, this instrument was not able to evaluate mind wandering that had occurred during a specific situation or task. Instead, it dealt exclusively with mind wandering on a trait level.

Mowlem et al. (2016) validated their newly developed Mind-Excessively-Wandering Scale (MEWS) by considering the distinction between deliberate and spontaneous mind wandering. The scale contained 15 items, which were scored on a 4-point Likert scale. A study consisting of 81 adults with attention deficit hyperactivity disorder (ADHD)—a condition known to lead to a high tendency to daydream (Study 2)—yielded a Cronbach's alpha of .960. Of course, the mental characteristics of the respondents were also considered. Moreover, the measurement instrument was again limited to the trait level and was not able to evaluate the mental condition corresponding to momentary thinking and feeling. Nevertheless, we expected that the scale would be valuable in extending our measurement of trait variables due to its sound psychometric properties.

The first attempt to develop an IS-specific scale was made in 2014, when Wati et al. (2014) measured mind wandering in relation to task performance. The authors used the scale developed by Mrazek et al. (2013) and worded each item to fit in a technological setting. Specifically, they adopted existing items by adding "When I was using the websites to complete the tasks…" to the beginning of the scale. The six items were scored on a 7-point Likert scale. The reliability analysis yielded a Cronbach's alpha of .934. However, in terms of the stability of mind wandering, the scale was noticeably inconsistent. While most items aimed to measure a state of mind in a specific situation in which technology is used (i.e., a state), the statement "...sometimes I have trouble concentrating on the task" implied a more general condition during task completion (i.e., a trait). However, we found the scale helpful, as it was the first to measure mind wandering in a specific situation while using technology (i.e., a state).

In a later paper, Sullivan et al. (2015) also introduced a scale for “mind wandering (technology-related),” which included items for technology-related thoughts, such as “I thought about checking my email” and “I thought about checking my social media (e.g., Facebook).” While this approach can be helpful in specific technology-related settings, we assumed that mind-wandering thoughts are so manifold that the strong emphasis on technology-related thought was likely too limiting for many settings in IS research, and we therefore did not include this scale in our further analysis. Instead, our discussion of this deviating scale led us to conclude that in IS research, using technology (e.g., email, social media, online shopping, online gaming) is the core condition in which to assess the likelihood of mind wandering, whereas the content of the episode is indefinite and not necessarily IS-specific.

Finally, Oschinsky et al. (2019) used the scale developed by Wati et al. (see above) for specific situations in which technology was being used (e.g., booking a railway ticket online). The authors selected four items to be scored on a 7-point Likert scale. The reliability analysis yielded a Cronbach’s alpha of .810. Notably, only the state was measured while the trait was ignored. Consequently, the subtypes of mind wandering (i.e., deliberate and spontaneous) were neglected. However, we valued the scale’s contribution and considered its state-level items.

While acknowledging that the existing scales either had not been applied in the IS domain or had excluded the intentionality of this mental state (i.e., deliberate vs. spontaneous), we saw great potential in comprehensively adapting existing items for our field to allow for theorizing and to provide a more-detailed understanding of mind wandering in technology-related settings. Moreover, after we identified missing components of the scales in our prior research (Oschinsky et al., 2019), we adapted them in a comprehensible manner. For instance, we provided appropriate introductory sentences and presented a technology-related scenario. Our approach was supported by the independent validation of our field study and was also in line with that of prior studies (see in particular the work of Seli, Carriere, & Smilek, 2015). Nevertheless, it would be possible to add additional items in the future as well as to sharpen our understanding of the state dimension.

Based on existing literature, we identified three final dimensions pertaining to the cognitive experience of internally-focused thought in technology-related settings: (1) Mind Wandering as a State (MWS), which was defined as a momentary mental state or a sequence of mental states that arise relatively freely while using technology in a given moment; (2) Mind Wandering as a Trait: Deliberate (MWT-D), which was defined as intentional engagement in internally focused thought in technology-related settings in everyday life; and (3) Mind Wandering as a Trait: Spontaneous (MWT-S), which was defined as unintentional engagement in internally focused thought in technology-related settings in everyday life. Although the distinction between spontaneous and deliberate mind wandering could hold at both the trait (Seli, Carriere, & Smilek, 2015) and the state level, we did not further divide MWS because we did not collect any thought probes that asked the technology-users to report on their momentary cognitive experiences in the laboratory (Seli, Risko, Smilek, & Schacter, 2016); rather, we had collected only self-reports. This method is in line with that of other IS research (Sullivan et al., 2015; Wati et al., 2014). However, future studies should investigate probe-based reports that integrate more context-specific questions to measure the state dimension of mind wandering.

### Assessment of Content Validity

Both the simplicity and the wording of the items were examined using face-validity checks performed by two researchers. We included all 35 items in an initial pool, from which we eliminated one redundant statement (“…my mind wandered”) to ensure content validity (Step 3). To further strengthen the content validity of the items, we next created small adaptations that appeared to fit the construct definition (following the work of Wati et al., 2014 as well as that of Oschinsky et al., 2019) and worded each item to fit with a technological setting (e.g., by adding “While using technology…” to the beginning of the scale). We attempted to assess the construct validity of the various scales and to identify any items that may still have been ambiguous or misleading. The level of agreement in categorizing and wording the items was high, which indicated a high potential for good reliability coefficients. To that end, all researchers also expressed doubt regarding whether the use of the statement “…I use alcohol or drugs to slow down my thoughts and stop constant mental chatter” (Mowlem et al., 2016) was an appropriate way to measure the construct. However, as the item is part of the original scale, we did not discard it from our analysis.

### Measurement Specification

We specified the factors based on their stability (state and trait) (Step 4). To measure mind wandering as both a state and a trait, we split the procedure into two parts: The first part was a scenario-based setting that allowed us to measure mind wandering as a state, whereas the second part was a post-questionnaire that allowed us to raise questions that went beyond the scope of the specific scenario and thereby to measure mind wandering as a trait. The existing measurement instruments identified seven state items and 27 trait items (cf. Table 1). In line with most existing scales, we used a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). Moreover, we followed the existing literature and operationalized each concept as a reflective common factor.

### Ethical Statement and Data Collection

For the data collection, we implemented a scenario-based study whose protocol is approved by the local ethics committee of the University of Siegen (ER-16/2019). It was performed in accordance with the relevant regulations and data-protection guidelines.

In line with previous literature (Oschinsky et al., 2019), the quantitative vignette study comprised five phases. The sample characteristics are presented for each step in the following sections (either in the pretest or in the main studies). First, the participants were welcomed and informed about the general setting and the study's procedures. Second, the participants were assigned to a technology-related scenario and watched a video of approximately 30 seconds about booking a railway ticket online. The video showed the steps of booking the ticket, which began with entering the point of departure (e.g., London) and the destination (e.g., Romford) into the respective fields and ended with paying for and confirming the booked tickets (exhibits are provided in the appendix). Afterward, we conducted a manipulation check that tested whether the participants were able to ascertain what they saw (i.e., "… you were booking a railway ticket."). The participants were watching the task of booking a train ticket as a video recording to account for a uniform handling of the task and to prevent distortions (e.g., common method bias). We aimed to ensure that our results were not influenced by the context of measurement for those who might be unfamiliar with an electronic interface. Third, the participants were asked to complete a questionnaire consisting of the trait- and state items (the full questionnaire is provided in the appendix). On the one hand, the questions addressed the specific technology-related task in the scenario (i.e., a state); on the other hand, they began with the statement "While using technology…," thereby indicating technology use in general (i.e., a trait). Fourth, the participants had to pass an attention check before continuing with the dependent variables and demographics. In the check, we controlled for age, gender, educational level, job title, years of work experience, and honesty while completing the survey. Finally, the participants were thanked and received an online code for financial compensation.

### Results Pretest

Since we adapted several items from related disciplines for IS research, we conducted a pilot study (Step 5) to ensure that the questions were understandable. Moreover, the pilot study allowed us to investigate the psychometric properties of our data, including the distributional assumptions of the items. We assumed that an investigation into mind wandering required some degree of habitual use of technology because if individuals use technology rarely or for the first time, the demands are too high to let the mind wander (Ferratt et al., 2018). In other words, habitual use of technology was expected to lead to some degree of cognitive ease, which is a prerequisite for wandering thoughts (Fox & Beaty, 2019). Consequently, we only collected data from individuals (N = 35) who had indicated that they used their smartphone daily. The participants of the pilot test had an average age of 23 years (M = 23.40, SD = 22.65), 31.4 percent were male, 68.6 percent were female, and they had an average work experience of four years (M = 4.20, SD = 4.73).

The participants were invited to comment on the length, wording, layout, and instructions of the survey. Only very minor changes (e.g., pagination) were proposed. We concluded that the instructions were easy to follow and that the manipulation and attention checks were worded appropriately. Next, we analyzed the descriptive statistics of each item to gain an understanding of the psychometric properties of our instrument's attributes. Specifically, we investigated reliability and checked whether the questions tended to be normally distributed. Cronbach's alpha ranged from between .69 and .94, indicating a sufficient degree of reliability. Furthermore, we investigated the scale range of each item to ensure that the full range (i.e., from 1 to 7) was used. Afterward, we adjusted some items and included "always" (e.g., "…I always lose track of time.") to make participants more likely not to provide moderate answers to avoid skewness. Overall, we found no indication for dropping an item from the pool and kept all items for the field study.

### Scale Purification and Refinement (Exploratory Factor Analysis)

#### *Procedure*

After adjusting the items, the field study was carried out. An online survey was provided to individuals from five English-speaking countries (i.e., United Kingdom, United States, Australia, New Zealand, and Canada). Roughly 34 percent dropped out after failing an attention check, which resulted in a total number of 364 participants.

The analysis was conducted in two steps (Steps 6 and 7), and we therefore randomly assigned observations

**Table 2. Participants According to Their Country**

| | | Study 1 (EFA) | Study 2 (CFA) | Study 3 (Cross) | Total |
|---|---|---|---|---|---|
| Country | Canada | 1 | 13 | 4 | 17 |
| | Other | 7 | 11 | 28 | 39 |
| | UK | 60 | 70 | 3 | 73 |
| | USA | 82 | 120 | 301 | 421 |
| Total | | 150 | 214 | 336 | 550 |
| Age group | 18–30 | 53 | 76 | 70 | 146 |
| | 31–45 | 60 | 96 | 151 | 247 |
| | 46–60 | 27 | 25 | 76 | 101 |
| | 60 | 3 | 4 | 18 | 22 |
| | NA | 7 | 13 | 21 | 34 |
| Total | | 150 | 214 | 336 | 550 |
| Gender | male | 84 | 109 | 179 | 288 |
| | female | 65 | 101 | 154 | 255 |
| | diverse | 1 | 3 | 3 | 6 |
| | NA | 0 | 1 | 0 | 1 |
| Total | | 150 | 214 | 336 | 550 |
| Years of work experience | 1–5 | 31 | 48 | 30 | 78 |
| | 11–15 | 27 | 29 | 52 | 81 |
| | 6–10 | 29 | 35 | 61 | 96 |
| | > 15 | 55 | 85 | 167 | 252 |
| | NA | 8 | 17 | 26 | 43 |
| Total | | 150 | 214 | 336 | 550 |
| Education | Less than High School | 3 | 0 | 4 | 4 |
| | High School/GED[1] | 18 | 24 | 36 | 60 |
| | Some College | 45 | 66 | 61 | 127 |
| | 2-Years College Degree | 20 | 34 | 45 | 79 |
| | 4-Years College Degree | 44 | 64 | 143 | 207 |
| | Master's Degree | 16 | 23 | 34 | 57 |
| | Doctoral Degree | 0 | 1 | 8 | 9 |
| | Professional Degree (JD, MD)[2,3] | 4 | 2 | 5 | 7 |
| Total | | 150 | 214 | 336 | 550 |

1: General Education Diploma (GED)
2: Juris Doctor degree (JD)
3: Doctor of Medicine (MD)

to two sub-samples. One part of our data (N = 150) was used to purify the scale, and the second part (N = 214) was used to assess the validity of the scales. The initial sample was separated into two parts that are both representative of the original sample. A series of t-tests was applied to ensure that the sample remained sociographically homogenous, thereby causing the different parts of our data to be of different sizes.

### *Sample*

The average age of the 150 participants was 35 years (M = 35.15, SD = 11.52), 56.0 percent were male, 43.3 percent were female, and 0.7 percent selected “other” for “gender.” Most participants indicated a daily use of technology (M = 6.80 (7 = “I use my smartphone daily.”)). Participants had an average work experience of 14 years (M = 14.53, SD = 10.48).

### *Results*

The suitability of the selected items for the study was assessed by considering bivariate correlations, inverse correlations, the Kaiser–Meyer–Olkin (KMO) value, and the Bartlett test. The KMO value (> .9) revealed that the partial correlations between the variables were small. In addition, the highly significant Bartlett test ($p < .000$) revealed that the items were uncorrelated with each other. Therefore, the prerequisites for applying an EFA is met (Loehlin, 2004).

To investigate the number of constructs of mind wandering, a principal component analysis was conducted using VARIMAX rotation. Parallel analysis was employed to determine the number of factors. The results of the parallel analysis suggested a three-component solution (cf. Figure 2).

In the next step, we analyzed the extracted factor loadings. Based on the rotated matrix, five items needed to be excluded due to overly high cross-loadings (MWT3, MWT4, MWT22, MWT24, and MWT26). For the sake of purification and parsimony, we refined the threshold and set the minimum correlation between an item and the factor to .7.

Consequently, ten items loaded sufficiently on Factor 1 (MWT9, MWT10, MWT12, MWT13, MWT14, MWT16, MWT20, MWT21, MWT23, and MWT25). MWT11 (“… it feels like I don’t have control over when my mind wanders.”) was not included due to its high correlation with MWT13 (“… I have difficulty controlling my thoughts.”) ($r = 0.78$). We labelled this factor “mind-wandering trait: spontaneous” (MWT-S). Three items loaded sufficiently on Factor 3 (MWT5, MWT6, and MWT7). We labelled this factor “mind-wandering trait: deliberate” (MWT-D). Finally, six items loaded sufficiently on Factor 2 (MWS1, MWS2, MWS3, MWS5, MWS6, and MWS7). MWS4 (“… I was easily distracted by unnecessary information in mind.”) was excluded, because of comments given by participants to avoid misunderstandings. We labelled this factor “mind-wandering state” (MWS). In sum, the EFA resulted in a scale with three factors and 19 items (cf. Table 3 and 4).

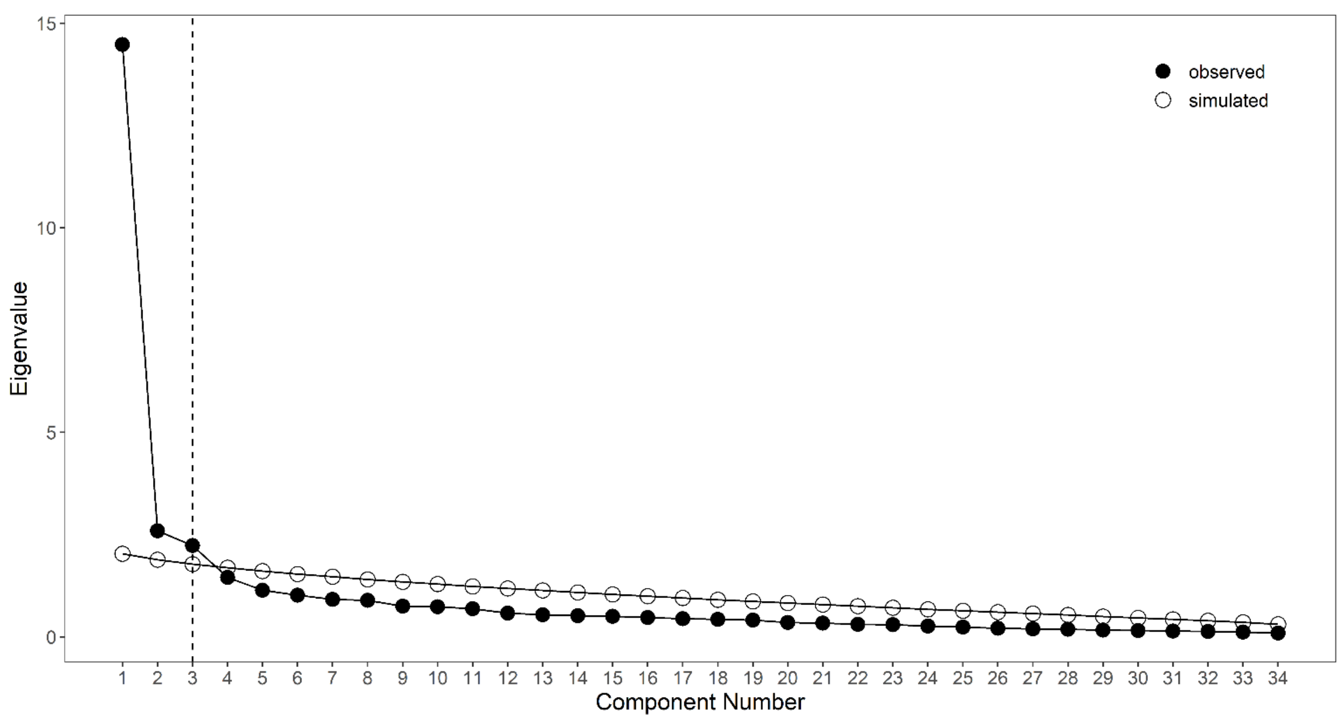


**Figure 2. Results from the Parallel Analysis**

**Table 3. Factor Loadings and Communalities**

| Item | Factor 1 | Factor 2 | Factor 3 | Communality |
|---|---|---|---|---|
| MWT21 | **.787** | .244 | -.026 | .680 |
| MWT13 | **.739** | .207 | .060 | .593 |
| MWT20 | **.739** | .238 | .293 | .689 |
| MWT9 | **.727** | .162 | .299 | .644 |
| MWT23 | **.725** | .293 | .027 | .612 |
| MWT25 | **.708** | .169 | .308 | .624 |
| MWT12 | **.706** | .248 | .375 | .701 |
| MWT14 | **.704** | .192 | .028 | .534 |
| MWT10 | **.704** | .154 | .406 | .684 |
| MWT16 | **.702** | .220 | .201 | .582 |
| MWT11 | .699 | .189 | .155 | .548 |
| MWT1 | **.683** | .292 | .252 | .615 |
| MWT2 | **.663** | .241 | .011 | .498 |
| MWT15 | .630 | .139 | .324 | .521 |
| MWT19 | .629 | .145 | .215 | .463 |
| MWT24 | .601 | .425 | -.048 | .544 |
| MWT4 | .573 | .167 | .490 | .596 |
| MWT3 | .567 | .136 | .402 | .502 |
| MWT17 | .567 | .193 | .365 | .492 |
| MWT18 | .533 | .076 | .162 | .316 |
| MWT27 | .520 | .297 | .021 | .359 |
| MWT22 | .437 | .354 | .238 | .373 |
| MWS4 | .381 | .608 | -.019 | .515 |
| MWS3 | .283 | **.729** | .215 | .657 |
| MWS1 | .264 | **.727** | .169 | .626 |
| MWS5 | .235 | **.862** | .182 | .832 |
| MWS6 | .223 | **.716** | .111 | .574 |
| MWT8 | .219 | .214 | .572 | .421 |
| MWS2 | .214 | **.820** | .218 | .766 |
| MWT26 | .202 | .253 | .263 | .174 |
| MWT7 | .196 | .143 | **.723** | .582 |
| MWT6 | .152 | .144 | **.822** | .720 |
| MWS7 | .071 | **.738** | .208 | .593 |
| MWT5 | .028 | .130 | **.812** | .677 |

*The loadings of the remaining items are printed in bold. MWS4 was not included for qualitative reasons.

**Table 4. Questions and Scales from the Derived Measurement Instrument**

| Item | | | References |
|---|---|---|---|
| MWS | MWS-1 | I thought about something, which was not related to the situation. | (Oschinsky et al., 2019) |
| | MWS-2 | I found myself distracted by other things in mind. | (Wati et al., 2014) |
| | MWS-3 | I had so many things in mind. | (Oschinsky et al., 2019; Wati et al., 2014) |
| | MWS-5 | My mind wandered. | |
| | MWS-6 | I was daydreaming. | (Oschinsky et al., 2019) |
| | MWS-7 | I did not concentrate on the situation. | |
| MWT-D | MWT-5 | I allow my thoughts to wander on purpose. | (Carriere et al., 2013) |
| | MWT-6 | I enjoy mind wandering. | |
| | MWT-7 | I find mind wandering is a good way to cope with boredom. | |
| MWT-S | MWT-9 | I find my thoughts wandering spontaneously. | |
| | MWT-10 | My thoughts tend to be pulled from topic to topic. | |
| | MWT-12 | I mind wander even when I'm supposed to be doing something else. | |
| | MWT-13 | I have difficulty controlling my thoughts. | (Mowlem et al., 2016) |
| | MWT-14 | I find it hard to switch my thoughts off. | |
| | MWT-16 | My thoughts are disorganized and `all over the place'. | |
| | MWT-20 | I find it difficult to think about one thing without another thought entering my mind. | |
| | MWT-21 | I find my thoughts are distracting and prevent me from focusing on what I am doing. | |
| | MWT-23 | I have difficulty slowing my thoughts down and focusing on one thing at a time. | |
| | MWT-25 | I find myself flitting back and forth between different thoughts. | |

## Assessment of Scale Validity (Confirmatory Factor Analysis)

### *Procedure*

In line with the previous results, we specified three different models: a one-factor model for MWS, a two-factor model for MWT (which combined MWT-D and MTW-S), and a three-factor model with all three constructs (MWS, MWT-D, and MWT-S). All constructs were specified as reflective factors. The results of multiple Shapiro–Wilk tests suggested that our data were not normally distributed, and we thus used a robust version of the Maximum Likelihood (ML) estimator with the Satorra-Bentler scaled test statistic (MLM), the R environment (R Core Team, 2018), and the lavaan package (Rosseel, 2012).

### *Sample*

Using data from 214 participants, we conducted a Confirmatory Factor Analysis (CFA) to further evaluate our initial measurement instrument (Step 7). The participants had an average age of 34 years (M = 34.41, SD = 11.64), 50.9 percent were male, 47.2 percent were female, 0.5 percent selected "other" for "gender," and the remaining 1.4 percent left the question blank. All participants indicated that they used their smartphone daily (M = 6.95 (7 = "I use my smartphone daily.")). The participants had an average work experience of 14 years (M = 14.25, SD = 11.45).

### *Results*

We evaluated the three models based on widely used fit measures (Hoyle, 2012): the overall test ($\chi^2$), the comparative fit index (CFI), the Tucker–Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR).

An overview of the fit measures is presented in Table 5. Model 1 appropriately fits the data. Both the overall test ($\chi^2(9)$= 11.479, p = .244 ($\chi^2$/df = 1.275)) and descriptive-fit measures (CFI = .992, TLI = .987, RMSEA = .046, and SRMR = .031) implied a good fit. In terms of Model 2, the overall test was significant ($\chi^2(64)$= 128.085, p = .000 ($\chi^2$/df = 2.001)). Since the literature demonstrates that the overall test is sensitive to the sample size, we further investigated the descriptive-fit measures, which suggested an acceptable fit (CFI = .954, TLI = .944, RMSEA = .079, and SRMR = .055). Consequently, we assumed that the model fit appropriately with the data. Finally, we investigated Model 3. Again, the overall test was significant ($\chi^2(149)$= 230.079, p = .000 ($\chi^2$/df = 1.544)).The remaining fit indices supported an acceptable fit (CFI = .957, TLI = .950, RMSEA = .058, and SRMR = .057). To conclude, all single models yielded satisfactory values. The overall model consisting of MWS, MWT-D, and MWT-S had strong explanatory power and offered discernible added value against the background of the theoretical considerations.

## Cross-Validation

### *Procedure*

To cross-validate our results (Step 8), we collected another sample with N = 336 subjects. An online survey was provided to individuals from five English-speaking countries (i.e., United Kingdom, United States, Australia, New Zealand, and Canada). We specified the three models: MWS, a combination of MWT-D and MTW-S, and a combination of all three constructs (MWS, MWT-D, and MWT-S). We applied the exact same estimation procedure as before.

### *Sample*

On average, the participants were 39 years old (M = 39.45, SD = 11.29), 53.3 percent were male, 45.8 percent were female, and .9 percent did not indicate a gender. The participants indicated a very high level of technology use (M = 6.50, SD = 1.39) and had an average work experience of 17 years (M = 17.67, SD = 11.27).

### *Results*

An overview of the results is summarized in Table 6. The results suggest that all three models fit well with the empirical data. A non-significant overall test ($\chi^2(9)$= 14.246, p = .114 ($\chi^2$/df = 1.583)) as well as the results of the descriptive-fit measures (CFI = .993, TLI = .989, RMSEA = .064, and SRMR = .017) implied a good fit for Model 1. In terms of Model 2, the overall test was significant ($\chi^2(64)$= 223.006, p = .000 ($\chi^2$/df = 3.484)). Nevertheless, the descriptive-fit measures suggested an acceptable fit (CFI = .931, TLI = .916, RMSEA = .107, and SRMR = .050). Consequently, we assumed that the model fit the data appropriately. Finally, we investigated Model 3. Again, the overall test was significant ($\chi^2(149)$= 337.542, p = .000 ($\chi^2$/df = 2:265)). Nevertheless, the remaining fit indices supported an acceptable fit (CFI = .950, TLI = .942, RMSEA = .076, and SRMR = .043).

**Table 5. Fit Indices**

| Model (M) | df | $\chi^2$ | p | $\chi^2/df$ | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|---|---|
| M1 (State) | 9 | 11.479 | .244 | 1.275 | .992 | .987 | .046 | .031 |
| M2 (Trait) | 64 | 128.085 | .000 | 2.001 | .954 | .944 | .079 | .055 |
| M3 (State/Trait) | 149 | 230.079 | .000 | 1.544 | .957 | .950 | .058 | .057 |

**Table 6. Fit Indices (Cross-Validation)**

| Model (M) | df | $\chi^2$ | p | $\chi^2/df$ | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|---|---|
| M1 (State) | 9 | 14.246 | .114 | 1.583 | .993 | .989 | .064 | .017 |
| M2 (Trait) | 64 | 223.006 | .000 | 3.484 | .931 | .916 | .107 | .050 |
| M3 (State/Trait) | 149 | 337.542 | .000 | 2.265 | .950 | .942 | .076 | .043 |

**Table 7. Reliability Coefficients**

| Coefficient | α | | ω1 | | ω2 | | ω3 | | AVE | |
|---|---|---|---|---|---|---|---|---|---|---|
| Study | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| MWS | .863 | .949 | .866 | .950 | .866 | .950 | .865 | .950 | .524 | .760 |
| MWT-D | .810 | .847 | .812 | .849 | .812 | .849 | .810 | .848 | .591 | .655 |
| MWT-S | .944 | .954 | .944 | .954 | .944 | .954 | .943 | .953 | .630 | .675 |
| Total | .916 | .952 | .947 | .971 | .947 | .971 | .960 | .977 | .593 | .700 |

*Study 1: Initial CFA. Study 2: Cross-Validation. MWS = Mind wandering as a state. MWT-D: Mind wandering as a trait (deliberate). MWT-S: Mind wandering as a trait (spontaneous).

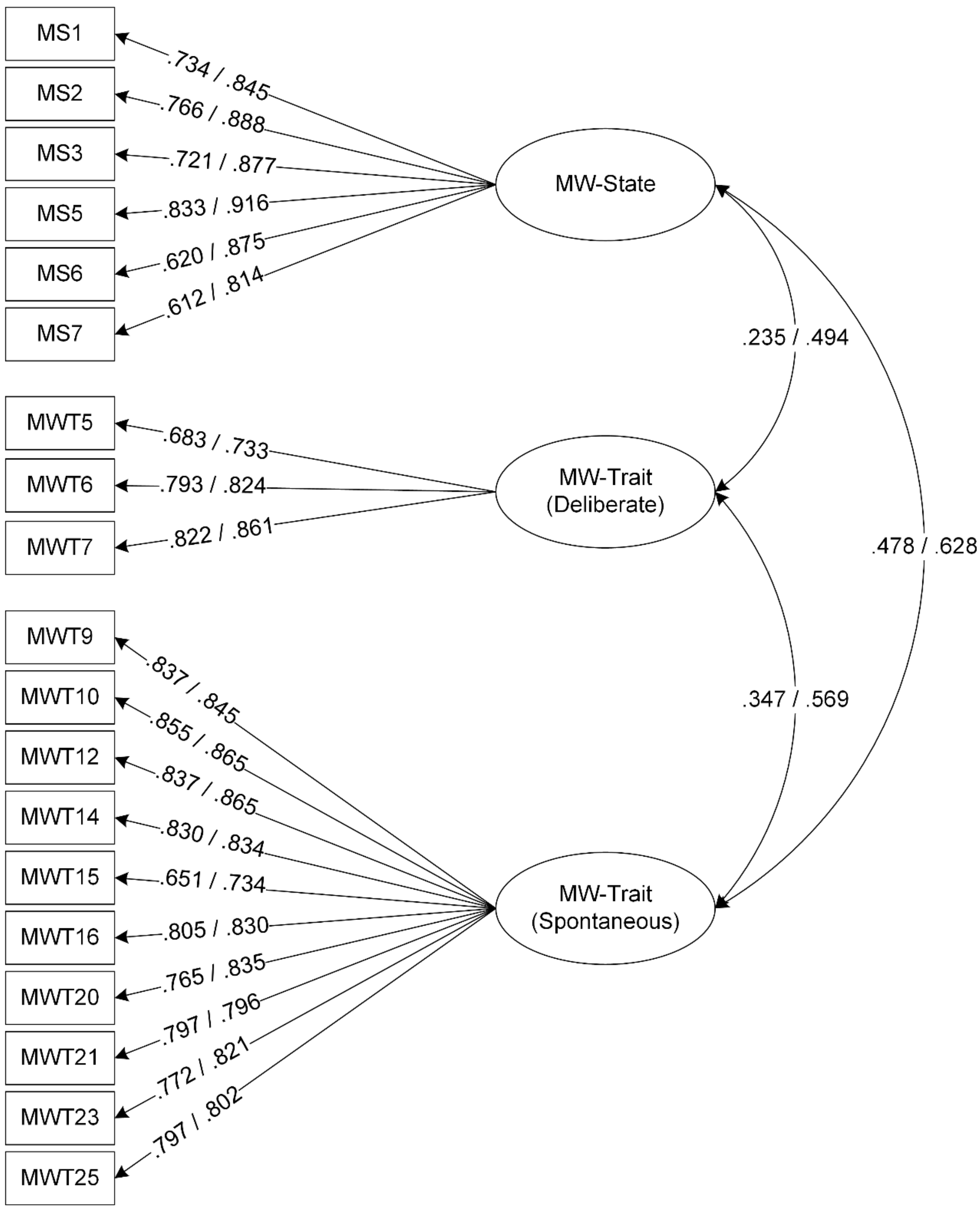


**Figure 3. Item Loadings and Factor Correlations**

### Reliability and Factor Loadings

To investigate the reliability of the factors, we investigated Cronbach's alpha (Cronbach, 1951), the omega of the coefficients (ω1 (Bollen, 1980), ω 2 (Bentler, 1972, 2009), ω 3 (McDonald, 1999)), and the average variance extracted (AVE) (Fornell, C. Larcker, D. F., 1981) using the semTools package (Jorgensen et al., 2018). An overview is provided in Table 7. Since the results of all α and the coefficients ω were above .8, we assumed a sufficient reliability for all factors. Moreover, the AVE (> .5) confirmed this assumption. The results of our factor analysis are illustrated in Figure 3.

We carried out additional tests to reduce the risk of bias effects. More specifically, we tested for the late response bias[1], which belongs to the group of non-response biases. We applied a series of two-sided t-tests between the first and last 10 percent of respondents, with the first representing the initial respondents and the last representing the late respondents. We considered socio-demographic variables (i.e., gender, age, work experience, and education), and the differences between all these variables were all non-significant ($p > .56$). Consequently, we assumed that late-response bias was not a major concern for this study.

## Discussion

### Interim Summary

The present study proposes a validated measurement instrument that will enable future researchers to investigate the concept of mind wandering while using technology and is therefore particularly suited for IS-related scenarios. We included the stability (i.e., a trait vs. a state) and intentionality (i.e., deliberate vs. spontaneous) of the concept. The process included surveying existing instruments, choosing appropriate items, and undertaking a thorough scale-development and validation procedure. Based on empirical data from a pretest (N = 35), a field study (N = 364), and a cross-validation sample (N = 336), our measurement instrument encapsulates 19-items on three sub-scales that offer a high degree of confidence in their content and construct validity. Since we specifically adopted the measurement instrument for IS research, it can now be used for a broad variety of research that is concerned with mind wandering in technology-related settings.

### Research Agenda for Mind Wandering While Using Information Technology

The theoretical implications of our work are manifold. Mind-wandering episodes while using technology can have a significant impact on outcome variables such as creativity and knowledge retention. While interest in this cognitive process has steadily grown in the IS discipline over the past five years, mind wandering while using technology remains largely neglected as a subject of research. As pointed out by Sullivan et al. (2015), the use of technology has become an integral part of work, education, and leisure time in the digital age, and the relationship between mind-wandering episodes while using technology and the outcomes of these episodes (e.g., task performance) requires further investigation. Most notably, it remains unclear how technology-users maintain their attention while interacting with technology and whether this attentional focus is necessary or even promising when it comes to achieving certain results (e.g., creativity). Although studies on how attention can shift between external technology-related stimuli have been frequently conducted in the IS discipline (e.g., Speier et al., 2003), research on how our thoughts can shift between external events and internal off-task items is relatively new (Smallwood & Schooler, 2015). Therefore, our work satisfies the scientific need for additional insights into the understanding of the nature, dimensionality, and effects of mind-wandering experiences while using technology and into the understanding of the technology-related outcomes of such experiences.

As task-unrelated thought is a vital element of the human cognition and constitutes a core area of IS research (Briggs, 2015), this paper offers a significant theoretical and methodological extension to the existing literature. By making an explicit distinction between the stability (i.e., a state vs. a trait) and intentionality (i.e., deliberate vs. spontaneous) of mind wandering, the study allowed for a detailed exploration of technology-related phenomena from different perspectives and therefore opens the door to a more-detailed analysis and a better understanding of technology use in future IS research by accounting for specific human abilities, skills, and characteristics. For example, research on post-adoption behavior that has already applied related cognitive concepts (Sun et al., 2016; Thatcher et al., 2018) can utilize our scales to investigate the role of mind wandering with regard to adoption behavior and the changing nature of technology use. Existing theories in this domain can thereby be extended and further developed. Similarly, research on job-related outcomes – such as innovation behavior and creativity – can be explored in greater detail (Fox & Beaty, 2019). For example, research on explorative behavior while using IT (Bagayogo et al., 2014; Burton-Jones & Grange, 2012) can incorporate mind wandering as a new concept that has the potential to explain behavior associated with the enhanced use of technology (e.g., continuous use). In addition, our study contributes to research on utilitarian and hedonic motives (Lowry et al., 2013; van der Heijden, 2004) as scholars can utilize our instrument to investigate the use of the hedonic system (e.g., in serious gaming or in social media use).

It is important to emphasize that a vast amount of theorization is involved when investigating mind wandering in an empirical setting. In line with previous literature (Seli, Risko, & Smilek, 2016a, 2016b), the present research provides evidence of the manifold nature of mind wandering. Not only can it be used as a state or trait, but it is also inherently different from intentionality. Consequently, future research is encouraged to carefully consider how to investigate both spontaneous and deliberate mind wandering. This consideration is particularly critical as deliberate mind wandering is assumed to lead to positive outcomes (e.g., creativity) (Agnoli et al., 2018), whereas unintentional mind wandering is often associated with negative outcomes (e.g., car accidents) (Baldwin et al., 2017; Zhang et al., 2017).

Our work contributes to practice and management because the use of validated measurement instruments can provide cost-efficient and highly relevant insights into and reflections on the determinants of IT behavior in the workplace (e.g., by focusing on memory distortion, attention, or performance). Our instrument can be used to both discover and promote desired mind-wandering episodes (e.g., while completing creative tasks in the digital workplace) or to detect and reduce unwanted mental states (e.g., during online lectures). The use of our measurement instrument can aid in solving divergent-thinking tasks or in addressing attention loss and can thereby contribute to a more-productive use of working time and resources. In the long run, this contribution can help lead to financial profit as well as more satisfied and more innovative employees.

Our findings are also relevant when it comes to designing IT artifacts with the aim of positively affecting the accomplishment of a specific task (e.g., by increasing an employee's creativity). Future IS studies that distinguish among the different subtypes of mind wandering in technology-related settings have the potential to deepen our understanding of why and how an IT artifact can influence the antecedents of IT behavior or the behavior itself. Among other things, these studies could test the effects of a system's richness. In addition to designing specific hardware or software, researchers could also study how the environment of a technology-user would have to be designed to encourage creative episodes via deliberate mind wandering, which could be tested, for example, in rooms that stimulate soft fascination and that thereby support both perceptual decoupling during mind-wandering episodes and the maintenance of a pleasant train of thought that promotes divergent thinking. Of course, this research becomes even more promising if our measuring instrument is triangulated with neurophysiological data and behavioral measurements. As design-science and NeuroIS research represents an integral field of the IS discipline, our work provides valuable input that can be used to inform appropriate design decisions.

### Limitations

As with every study, the research presented in this contribution has limitations, and future research is invited to further expand on our knowledge of mind wandering. First, within the scope of this initial study, we could only address English-speaking samples, which suggests that the sample was drawn from countries with great cultural similarities. Therefore, we encourage future research to collect additional data from various countries with different cultural backgrounds to obtain insights into the robustness of the mind-wandering scale across countries. This approach is particularly relevant to mental states like mind wandering, because job demands and the habits of technology use can vary significantly across countries (Dinev et al., 2009; Straub et al., 1997). Second, cognitive variables such as mind wandering cannot be fully captured via self-reported measures, as they depend on memory and meta-awareness (Smallwood & Schooler, 2015). Probe-based reports could thus constitute an important subject of future studies, which could also integrate more context-specific questions to capture the state-dimension of mind wandering. Moreover, triangulation is recommended to reduce operationalization bias and increase validity. Neurophysiological measures have great potential to complement subjective measures. Neurophysiological tools – including eye-tracking and brain imaging (Andrews-Hanna et al., 2018; Golchert et al., 2017) – appear promising. This approach is part of a growing strand of research that emphasizes the relationship between the neurosciences and IS research (NeuroIS) (Dimoka et al., 2011; Riedl & Léger, 2016). Furthermore, a validated scale that integrates existing scales and distinguishes between different facets of mind wandering would also prove useful beyond the boundaries of the IS discipline. In fact, related disciplines – such as psychology, educational science, and management sciences – could benefit from our results and use our instrument in various contexts. Our scales could also benefit from more interdisciplinary work, for example, to develop frameworks or models and further push the boundaries of the field.

## Notes

[1] We would like to thank the anonymous reviewer who directed our attention to this potential bias effect.

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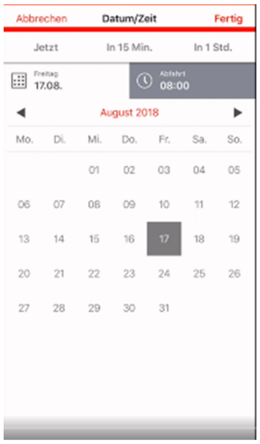
## About the Authors

**Frederike Marie Oschinsky** undertook her doctoral studies at the chair for information systems research at the University of Siegen, Germany. She coordinated the international research consortium of "Eureka - Scheduling Creative Insight." Frederike Oschinsky now works as a senior consultant in a respected global professional services company that specializes in information technology consulting, strategy, and operations. As an adjunct scholar for Dalhousie University, Canada, she still investigates cognitive processes while using technology by using empirical research methods. Her focus is set on estimating cognitive states from neurophysiological signals and on designing digital applications that make use of this information. She is the author of numerous publications which have appeared in *Government Information Quarterly* and *Internet Research*, as well as the leading AIS conferences. She serves as chair, research coach, mentor, and reviewer for conferences and journals.

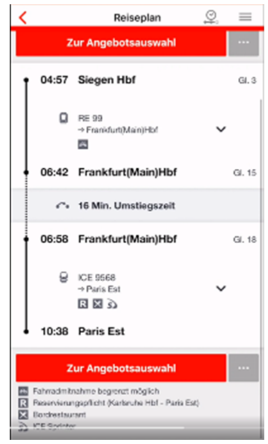
**Michael Klesel** is an experienced IT consultant and a research fellow at the University of Twente, with a specialization in digitalization projects and a particular focus on artificial intelligence, specifically Explainable AI (XAI). His research interests encompass the digitalization of work, with a dedication to exploring and understanding emerging phenomena such as mind wandering, as well as conducting design-relevant research to derive design implications. He utilizes both qualitative methods, such as case studies, and quantitative methods, including survey studies, experiments, and machine learning, to conduct his research. Michael has published his research findings in renowned IS journals, such as *Internet Research* and *Communications of the Association of Information Systems* (CAIS), and major IS conferences, including the International Conference on Information Systems (ICIS) and the European Conference on Information Systems (ECIS).

**Bjoern Niehaves** researches digital innovation and their impact on business value creation and work design. He held visiting positions in Harvard (USA), Waseda University (Japan), London School of Economics (UK), Copenhagen Business School (DK) and the Hertie School of Governance (DE) and is now professor of computer science at University of Bremen. In addition to his research, Professor Niehaves is a keynote speaker and consults leading companies, public administrations, and international organizations. Many of his more than 350 publications have been awarded with research and innovation prizes.

## Appendix A




after 7 sec




after 18 sec

Note: The video covered all phases of the booking process, such as choosing a date, selecting an appropriate connection, or payment.

**Figure A.4. Screenshots of the Booking Process in a National Railway Company (German)**

**Table A.1 Indicator-Correlation Matrix (Exploratory-Factor Analysis)**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MWT1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | MWT2 | 0.69 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | MWT3 | 0.62 | 0.43 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | MWT4 | 0.57 | 0.38 | 0.57 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | MWT5 | 0.23 | 0.06 | 0.39 | 0.42 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | MWT6 | 0.43 | 0.23 | 0.33 | 0.43 | 0.66 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | MWT7 | 0.45 | 0.28 | 0.38 | 0.42 | 0.54 | 0.68 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | MWT8 | 0.24 | 0.16 | 0.4 | 0.4 | 0.42 | 0.39 | 0.38 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | MWT9 | 0.59 | 0.5 | 0.54 | 0.6 | 0.23 | 0.39 | 0.31 | 0.41 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | MWT10 | 0.63 | 0.47 | 0.57 | 0.61 | 0.31 | 0.45 | 0.41 | 0.43 | 0.68 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | MWT11 | 0.57 | 0.47 | 0.44 | 0.5 | 0.18 | 0.3 | 0.26 | 0.35 | 0.68 | 0.57 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | MWT12 | 0.69 | 0.56 | 0.65 | 0.7 | 0.32 | 0.39 | 0.41 | 0.45 | 0.71 | 0.72 | 0.57 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| 13 | MWT13 | 0.61 | 0.49 | 0.45 | 0.46 | 0.12 | 0.2 | 0.23 | 0.33 | 0.62 | 0.58 | 0.78 | 0.6 | 1 | | | | | | | | | | | | | | | | | | | | | |
| 14 | MWT14 | 0.43 | 0.46 | 0.38 | 0.36 | 0.11 | 0.16 | 0.2 | 0.2 | 0.47 | 0.49 | 0.48 | 0.52 | 0.53 | 1 | | | | | | | | | | | | | | | | | | | | |
| 15 | MWT15 | 0.4 | 0.35 | 0.36 | 0.52 | 0.29 | 0.34 | 0.3 | 0.32 | 0.55 | 0.6 | 0.39 | 0.5 | 0.47 | 0.55 | 1 | | | | | | | | | | | | | | | | | | | |
| 16 | MWT16 | 0.58 | 0.49 | 0.48 | 0.51 | 0.22 | 0.3 | 0.27 | 0.32 | 0.53 | 0.59 | 0.54 | 0.62 | 0.5 | 0.52 | 0.57 | 1 | | | | | | | | | | | | | | | | | | |
| 17 | MWT17 | 0.46 | 0.32 | 0.35 | 0.54 | 0.29 | 0.36 | 0.3 | 0.34 | 0.53 | 0.55 | 0.43 | 0.54 | 0.37 | 0.56 | 0.63 | 0.54 | 1 | | | | | | | | | | | | | | | | | |
| 18 | MWT18 | 0.37 | 0.42 | 0.3 | 0.33 | 0.2 | 0.29 | 0.23 | 0.21 | 0.33 | 0.39 | 0.36 | 0.33 | 0.34 | 0.51 | 0.44 | 0.44 | 0.4 | 1 | | | | | | | | | | | | | | | | |
| 19 | MWT19 | 0.38 | 0.41 | 0.37 | 0.42 | 0.26 | 0.29 | 0.21 | 0.29 | 0.44 | 0.49 | 0.42 | 0.46 | 0.42 | 0.58 | 0.57 | 0.58 | 0.59 | 0.46 | 1 | | | | | | | | | | | | | | | |
| 20 | MWT20 | 0.6 | 0.47 | 0.55 | 0.62 | 0.23 | 0.35 | 0.4 | 0.34 | 0.67 | 0.62 | 0.55 | 0.68 | 0.51 | 0.63 | 0.61 | 0.62 | 0.63 | 0.44 | 0.58 | 1 | | | | | | | | | | | | | | |
| 21 | MWT21 | 0.68 | 0.53 | 0.5 | 0.48 | 0.08 | 0.16 | 0.27 | 0.15 | 0.6 | 0.61 | 0.55 | 0.62 | 0.61 | 0.47 | 0.43 | 0.59 | 0.38 | 0.37 | 0.45 | 0.61 | 1 | | | | | | | | | | | | | |
| 22 | MWT22 | 0.37 | 0.32 | 0.31 | 0.44 | 0.22 | 0.26 | 0.36 | 0.3 | 0.41 | 0.38 | 0.3 | 0.39 | 0.35 | 0.32 | 0.51 | 0.4 | 0.42 | 0.24 | 0.47 | 0.54 | 0.44 | 1 | | | | | | | | | | | | |
| 23 | MWT23 | 0.52 | 0.51 | 0.48 | 0.44 | 0.17 | 0.21 | 0.26 | 0.18 | 0.56 | 0.5 | 0.46 | 0.57 | 0.51 | 0.62 | 0.59 | 0.54 | 0.51 | 0.37 | 0.48 | 0.6 | 0.67 | 0.41 | 1 | | | | | | | | | | | |
| 24 | MWT24 | 0.51 | 0.5 | 0.44 | 0.43 | 0.11 | 0.11 | 0.18 | 0.29 | 0.5 | 0.43 | 0.54 | 0.5 | 0.53 | 0.36 | 0.34 | 0.52 | 0.32 | 0.38 | 0.37 | 0.46 | 0.59 | 0.44 | 0.58 | 1 | | | | | | | | | | |
| 25 | MWT25 | 0.59 | 0.49 | 0.59 | 0.56 | 0.23 | 0.38 | 0.35 | 0.34 | 0.62 | 0.7 | 0.51 | 0.65 | 0.56 | 0.51 | 0.6 | 0.53 | 0.51 | 0.36 | 0.46 | 0.66 | 0.58 | 0.45 | 0.55 | 0.41 | 1 | | | | | | | | | |
| 26 | MWT26 | 0.2 | 0.18 | 0.18 | 0.25 | 0.15 | 0.26 | 0.22 | 0.25 | 0.24 | 0.25 | 0.34 | 0.3 | 0.3 | 0.11 | 0.23 | 0.23 | 0.27 | 0.07 | 0.32 | 0.29 | 0.15 | 0.3 | 0.15 | 0.19 | 0.3 | 1 | | | | | | | | |
| 27 | MWT27 | 0.47 | 0.47 | 0.3 | 0.29 | 0.14 | 0.21 | 0.19 | 0.25 | 0.36 | 0.47 | 0.37 | 0.38 | 0.43 | 0.4 | 0.29 | 0.34 | 0.25 | 0.29 | 0.38 | 0.41 | 0.52 | 0.39 | 0.48 | 0.39 | 0.43 | 0.25 | 1 | | | | | | | |
| 28 | MWS1 | 0.44 | 0.42 | 0.29 | 0.39 | 0.28 | 0.27 | 0.23 | 0.28 | 0.41 | 0.29 | 0.36 | 0.45 | 0.33 | 0.32 | 0.32 | 0.35 | 0.35 | 0.25 | 0.32 | 0.45 | 0.35 | 0.37 | 0.43 | 0.38 | 0.36 | 0.34 | 0.36 | 1 | | | | | | |
| 29 | MWS2 | 0.42 | 0.29 | 0.36 | 0.31 | 0.28 | 0.34 | 0.31 | 0.3 | 0.32 | 0.36 | 0.29 | 0.43 | 0.32 | 0.38 | 0.32 | 0.42 | 0.39 | 0.21 | 0.33 | 0.44 | 0.38 | 0.45 | 0.41 | 0.41 | 0.4 | 0.27 | 0.35 | 0.64 | 1 | | | | | |
| 30 | MWS3 | 0.43 | 0.36 | 0.3 | 0.42 | 0.2 | 0.32 | 0.29 | 0.28 | 0.38 | 0.44 | 0.36 | 0.46 | 0.35 | 0.38 | 0.39 | 0.47 | 0.44 | 0.3 | 0.35 | 0.47 | 0.35 | 0.42 | 0.37 | 0.42 | 0.38 | 0.32 | 0.28 | 0.59 | 0.73 | 1 | | | | |
| 31 | MWS4 | 0.35 | 0.3 | 0.26 | 0.38 | 0.14 | 0.13 | 0.22 | 0.22 | 0.29 | 0.3 | 0.41 | 0.36 | 0.44 | 0.41 | 0.33 | 0.36 | 0.33 | 0.23 | 0.37 | 0.41 | 0.45 | 0.39 | 0.48 | 0.51 | 0.35 | 0.25 | 0.37 | 0.5 | 0.55 | 0.46 | 1 | | | |
| 32 | MWS5 | 0.5 | 0.39 | 0.28 | 0.36 | 0.23 | 0.32 | 0.3 | 0.32 | 0.39 | 0.4 | 0.36 | 0.48 | 0.37 | 0.35 | 0.34 | 0.41 | 0.36 | 0.25 | 0.3 | 0.44 | 0.39 | 0.42 | 0.37 | 0.47 | 0.37 | 0.25 | 0.3 | 0.67 | 0.78 | 0.73 | 0.54 | 1 | | |
| 33 | MWS6 | 0.44 | 0.37 | 0.3 | 0.29 | 0.14 | 0.25 | 0.25 | 0.26 | 0.37 | 0.42 | 0.29 | 0.37 | 0.3 | 0.24 | 0.28 | 0.31 | 0.26 | 0.2 | 0.2 | 0.33 | 0.4 | 0.35 | 0.32 | 0.4 | 0.34 | 0.19 | 0.32 | 0.5 | 0.55 | 0.56 | 0.44 | 0.72 | 1 | |
| 34 | MWS7 | 0.33 | 0.17 | 0.31 | 0.26 | 0.31 | 0.25 | 0.18 | 0.33 | 0.25 | 0.27 | 0.26 | 0.33 | 0.25 | 0.24 | 0.24 | 0.22 | 0.29 | 0.13 | 0.19 | 0.28 | 0.19 | 0.21 | 0.34 | 0.37 | 0.25 | 0.12 | 0.25 | 0.54 | 0.61 | 0.51 | 0.41 | 0.66 | 0.5 | 1 |

## Table A.2 Indicator-Correlation Matrix (Confirmatory-Factor Analysis)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MWS1 | 1 | | | | | | | | | | | | | | | | | | |
| 2 | MWS2 | 0.58 | 1 | | | | | | | | | | | | | | | | | |
| 3 | MWS3 | 0.49 | 0.61 | 1 | | | | | | | | | | | | | | | | |
| 4 | MWS5 | 0.62 | 0.61 | 0.59 | 1 | | | | | | | | | | | | | | | |
| 5 | MWS6 | 0.42 | 0.41 | 0.49 | 0.54 | 1 | | | | | | | | | | | | | | |
| 6 | MWS7 | 0.46 | 0.52 | 0.38 | 0.51 | 0.41 | 1 | | | | | | | | | | | | | |
| 7 | MWT5 | 0.07 | 0.02 | 0.07 | 0.12 | 0.04 | 0.14 | 1 | | | | | | | | | | | | |
| 8 | MWT6 | 0.18 | 0.12 | 0.19 | 0.2 | 0.07 | 0.13 | 0.55 | 1 | | | | | | | | | | | |
| 9 | MWT7 | 0.17 | 0.12 | 0.14 | 0.16 | 0.08 | 0.19 | 0.57 | 0.64 | 1 | | | | | | | | | | |
| 10 | MWT9 | 0.35 | 0.26 | 0.31 | 0.33 | 0.26 | 0.16 | 0.13 | 0.32 | 0.27 | 1 | | | | | | | | | |
| 11 | MWT10 | 0.39 | 0.26 | 0.35 | 0.43 | 0.28 | 0.1 | 0.16 | 0.3 | 0.28 | 0.76 | 1 | | | | | | | | |
| 12 | MWT12 | 0.31 | 0.34 | 0.36 | 0.34 | 0.24 | 0.15 | 0.17 | 0.35 | 0.35 | 0.78 | 0.76 | 1 | | | | | | | |
| 13 | MWT13 | 0.28 | 0.22 | 0.3 | 0.32 | 0.27 | 0.17 | 0.1 | 0.22 | 0.26 | 0.72 | 0.71 | 0.7 | 1 | | | | | | |
| 14 | MWT14 | 0.27 | 0.22 | 0.23 | 0.26 | 0.14 | 0.15 | 0.16 | 0.25 | 0.26 | 0.53 | 0.53 | 0.49 | 0.54 | 1 | | | | | |
| 15 | MWT16 | 0.35 | 0.24 | 0.28 | 0.41 | 0.33 | 0.12 | 0.03 | 0.2 | 0.18 | 0.61 | 0.67 | 0.64 | 0.68 | 0.51 | 1 | | | | |
| 16 | MWT20 | 0.31 | 0.26 | 0.32 | 0.41 | 0.3 | 0.18 | 0.1 | 0.2 | 0.2 | 0.63 | 0.66 | 0.61 | 0.59 | 0.61 | 0.65 | 1 | | | |
| 17 | MWT21 | 0.31 | 0.29 | 0.28 | 0.36 | 0.24 | 0.09 | 0.04 | 0.26 | 0.19 | 0.61 | 0.63 | 0.68 | 0.68 | 0.5 | 0.69 | 0.57 | 1 | | |
| 18 | MWT23 | 0.24 | 0.14 | 0.16 | 0.22 | 0.18 | 0.05 | -0.01 | 0.22 | 0.15 | 0.6 | 0.6 | 0.59 | 0.66 | 0.53 | 0.67 | 0.59 | 0.71 | 1 | |
| 19 | MWT25 | 0.35 | 0.25 | 0.29 | 0.37 | 0.26 | 0.07 | 0.05 | 0.26 | 0.2 | 0.65 | 0.69 | 0.61 | 0.61 | 0.54 | 0.67 | 0.65 | 0.65 | 0.69 | 1 |

## Table A.3 Indicator-Correlation Matrix (Cross-Validation)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MWS1 | 1 | | | | | | | | | | | | | | | | | | |
| 2 | MWS2 | 0.76 | 1 | | | | | | | | | | | | | | | | | |
| 3 | MWS3 | 0.75 | 0.77 | 1 | | | | | | | | | | | | | | | | |
| 4 | MWS5 | 0.79 | 0.8 | 0.8 | 1 | | | | | | | | | | | | | | | |
| 5 | MWS6 | 0.7 | 0.77 | 0.77 | 0.82 | 1 | | | | | | | | | | | | | | |
| 6 | MWS7 | 0.67 | 0.78 | 0.71 | 0.72 | 0.72 | 1 | | | | | | | | | | | | | |
| 7 | MWT5 | 0.28 | 0.34 | 0.35 | 0.38 | 0.38 | 0.29 | 1 | | | | | | | | | | | | |
| 8 | MWT6 | 0.32 | 0.32 | 0.33 | 0.37 | 0.33 | 0.24 | 0.62 | 1 | | | | | | | | | | | |
| 9 | MWT7 | 0.37 | 0.4 | 0.35 | 0.42 | 0.39 | 0.29 | 0.62 | 0.71 | 1 | | | | | | | | | | |
| 10 | MWT9 | 0.51 | 0.51 | 0.5 | 0.56 | 0.49 | 0.39 | 0.42 | 0.52 | 0.53 | 1 | | | | | | | | | |
| 11 | MWT10 | 0.49 | 0.51 | 0.54 | 0.55 | 0.5 | 0.41 | 0.38 | 0.41 | 0.47 | 0.8 | 1 | | | | | | | | |
| 12 | MWT12 | 0.49 | 0.51 | 0.51 | 0.52 | 0.47 | 0.39 | 0.39 | 0.41 | 0.51 | 0.8 | 0.8 | 1 | | | | | | | |
| 13 | MWT13 | 0.44 | 0.49 | 0.47 | 0.45 | 0.51 | 0.46 | 0.28 | 0.33 | 0.4 | 0.69 | 0.69 | 0.71 | 1 | | | | | | |
| 14 | MWT14 | 0.35 | 0.33 | 0.37 | 0.39 | 0.36 | 0.25 | 0.27 | 0.36 | 0.38 | 0.59 | 0.63 | 0.58 | 0.65 | 1 | | | | | |
| 15 | MWT16 | 0.4 | 0.44 | 0.46 | 0.44 | 0.44 | 0.39 | 0.27 | 0.31 | 0.37 | 0.65 | 0.68 | 0.69 | 0.7 | 0.64 | 1 | | | | |
| 16 | MWT20 | 0.4 | 0.44 | 0.45 | 0.44 | 0.41 | 0.34 | 0.31 | 0.35 | 0.4 | 0.68 | 0.69 | 0.71 | 0.7 | 0.67 | 0.8 | 1 | | | |
| 17 | MWT21 | 0.41 | 0.43 | 0.42 | 0.43 | 0.46 | 0.42 | 0.22 | 0.26 | 0.37 | 0.6 | 0.64 | 0.63 | 0.73 | 0.57 | 0.7 | 0.67 | 1 | | |
| 18 | MWT23 | 0.43 | 0.44 | 0.43 | 0.45 | 0.47 | 0.41 | 0.21 | 0.26 | 0.37 | 0.63 | 0.67 | 0.68 | 0.73 | 0.61 | 0.7 | 0.65 | 0.76 | 1 | |
| 19 | MWT25 | 0.45 | 0.43 | 0.46 | 0.49 | 0.41 | 0.35 | 0.34 | 0.39 | 0.47 | 0.69 | 0.72 | 0.69 | 0.59 | 0.59 | 0.64 | 0.65 | 0.68 | 0.72 | 1 |

**Table A.4 Full Questionnaire (English)**

**General Introduction**

Dear participant,

Your participation will take approximately 6-8 minutes and will help us to understand the relationship between technology use and daydreaming.

Please note that we treat your answers anonymously and confidentially. The data is exclusively used for this research project. All questions relate to your opinion and assessment. Hence, there are no right or wrong answers. To ensure data quality, we included several attention checks. Therefore, we ask you to be focused while answering. You will receive the financial compensation only if you pass all attention checks and successfully finish this survey.

Thank you very much for participating in this study.

[Box with further information on the General Data Protection Regulation of the European Union]

**State Introduction**

In the following, we present you a video that shows a booking process using a mobile app. Please try to put yourself in the given situation as good as possible. If you are more familiar with similar booking processes (e.g., booking a flight, or booking a hotel) please keep those processes in mind when you answer the following questions.

[Exemplary picture of a train ride from Siegen, Germany, to Paris, France; Source: Google Maps]

**State Video**

[Video of the booking process using the application of a national railway company; see Figure A.4]

| | |
|---|---|
| **Manipulation Check** | |
| To what extent do the statements apply to the situation, you just experienced? | |
| … you were playing a game.<br>… you were using Facebook.<br>… you were booking a railway ticket.<br>… you were writing an e-mail. | 7-point Likert scale (Strongly Disagree – Neutral – Strongly Agree) |
| **State Questions** | |
| When I was booking the railway ticket … | |
| … I thought about something, which was not related to the situation.<br>… I found myself distracted by other things in mind.<br>… I had so many things in mind.<br>… I was easily distracted by unnecessary information in mind.<br>… my mind wandered.<br>… I was daydreaming.<br>… I did not concentrate on the situation. | 7-point Likert scale (Strongly Disagree – Neutral – Strongly Agree) |

**Trait Introduction**

Technology use in general: After this specific situation, we now invite you to answer questions that are more generic and relate to your everyday use of technologies. Please indicate, how often you use the following technologies:

| | | |
|---|---|---|
| Personal Computer (PC)<br>Laptop<br>Smartphone<br>Tablet | | 7-point Likert scale (Never – Neutral – Daily) |
| Other: | *Space for writing* | |
| **Trait Questions** | | |
| When using technology … | | |
| … sometimes I have trouble concentrating on the task.<br>… I have difficulty maintaining focus on simple or repetitive work. | | 7-point Likert scale (Strongly Disagree – Neutral – Strongly Agree) |

… I do things without paying full attention.
… I find myself listening with one ear, thinking about something else at the same time.
… I allow my thoughts to wander on purpose.
… I enjoy mind-wandering.
… I find mind-wandering is a good way to cope with boredom.
… I allow myself to get absorbed in pleasant fantasy.
… I find my thoughts wandering spontaneously.
… my thoughts tend to be pulled from topic to topic.
… it feels like I don't have control over when my mind wanders.
… I mind wander even when I'm supposed to be doing something else.
… I have difficulty controlling my thoughts.
… this is only an attention check. Please just select strongly agree.
… I find it hard to switch my thoughts off.
… I have two or more different thoughts going on at the same time.
… my thoughts are disorganized and 'all over the place'.
… my thoughts are 'on the go' all the time.
… if my mind is 'on the go' at bedtime, I have difficulty falling off to sleep.
… I experienced ceaseless mental activity.
… I find it difficult to think about one thing without another thought is entering my mind.
… I find my thoughts are distracting and prevent me from focusing on what I am doing.
… I try to distract myself from my thoughts by doing something else or listening to music.
… I have difficulty slowing my thoughts down and focusing on one thing at a time.
… I find it difficult to think clearly, as if my mind is in a fog.
… I find myself flitting back and forth between different thoughts.
… I use alcohol or drugs to slow down my thoughts and stop constant 'mental chatter'.
… I can only focus my thoughts on one thing at a time with considerable effort.

**<u>Dependent Variables</u>**

7-point Likert scale (Strongly Disagree – Neutral – Strongly Agree)

**Focused Immersion**
When using technology …
… I can block out most other distractions.
… I am absorbed in what I am doing.
… I get distracted by other attentions very easily.
… my attention does not get diverted very easily.

**Enjoyment**
When using technology …
… I always have fun to interact with it.
… I always have a of enjoyment.
… I always get bored.
… I always enjoy using it.

**Temporal Dissociation**

When using technology …
… I always lose track of time.
… time always flies.
… I am always spending more time on it than I intended.
… time always appears to go by very quickly.
… I always end up spending more time that I had planned.

**Control**

When using technology …
… I feel in control.
… I feel that I have no control over my interaction with it.
… it allows me to control my interaction.

**Curiosity**

When using technology …
… using it excites my curiosity.
… interacting with it makes me curious.
… using it arouses my imagination.

**Creativity**

When using technology …
… I seek new ideas and ways to solve problems.
… I generate ideas revolutionary to the field.
… it is a good role model for innovation/creativity.
… I try new ideas and approaches to a problem.

**Personal Innovativeness**

How do you deal with new technology?
If I hear about a new information technology, I will look for ways to experiment with it.
Among my peers, I am usually the first to try out new information technologies.
In general, I am hesitant to try out new information technologies.
I like to experiment with new information technologies.

**Attention checks [Random assignment to one alternative.]**

Please indicate whether the sum of two and two is four.
Please indicate whether four divided by two is two.
Please indicate whether the sum of two and two is six.
Please indicate whether the sum of two and two is ten.
Please indicate whether the seven minus two is three.

**Demographics**

| | |
|---|---|
| How old are you? (Years) | *Space for writing* |
| What is your gender? | Male, Female, Diverse |
| What is your highest level of education? | Less than High School, High School/GED, Some College, 2-Years College Degree, 4-Years College Degree, Master's Degree, Doctoral Degree, Professional Degree (JD, MD) |
| What is your profession? | Part-time, Full-time, Marginal, Student, Job-seeking, Others: *Space for writing* |
| How many years of work experience do you have? (Years) | *Space for writing* |
| How honestly did you answer the questions? | 5-point Likert scale (Very Honesty – Neutral – Very Dishonest) |

**Further Comments**

| | |
|---|---|
| If you have any further comments, please feel free to add them in the following box. We will be reviewing them and consider them for future research. | *Space for writing* |

**General Farewell**

[Contact information]