Linking the Technology Acceptance Model to Smartphone Use and Smartphone Use Disorder Tendencies: Results from a Survey Study

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Abstract
Background: Despite benefits resulting from smartphone use, evidence increasingly indicates that smartphone use may also have negative consequences, for example when smartphones are used in a disordered manner. One major concept in this research domain is problematic smartphone use or smartphone use disorder. However, factors influencing the emergence of adverse use are not yet fully understood.

Objective: The present study aimed to investigate cross-sectional predictive effects of acceptance of the smartphone, indicated by Technology Acceptance Model (TAM) variables, on smartphone use and tendencies towards smartphone use disorder.

Methods: An online survey with N=693 smartphone users (n=327 men, n=366 women, M_{age}=30.61, SD_{age}=14.98 years, range: 12–76 years) was conducted to study potential relationships. All participants completed a questionnaire assessing several TAM variables: perceived ease of use, perceived usefulness, and intention to use a smartphone in business and personal contexts. Moreover, participants provided information on their daily smartphone use (hours of daily use) for business and personal purposes, and completed a scale assessing tendencies towards smartphone use disorder. Structural equation modeling was used to analyze the data.

Results: The findings revealed that business use of the smartphone was not predicted by any TAM variable. Perceived usefulness positively predicted daily smartphone use in the personal context. All TAM variables in business and personal contexts positively predicted smartphone use disorder tendencies; at least via indirect effects.

Conclusion: Tendencies towards disordered smartphone use seem to be positively associated with acceptance of this technology with regard to its perceived ease of use, usefulness, and deliberate usage intentions. These findings expand knowledge of the new psychological phenomenon of smartphone use disorder tendencies.

Keywords: Technology Acceptance Model, TAM, Smartphone Use Disorder, Smartphone Use, Personal Use, Business Use

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1 Introduction

Presently, around 3.6 billion people use a smartphone for business and/or personal purposes worldwide (Newzoo (2019) as cited in Statista, 2020). Despite the potential benefits that may result from smartphone use (e.g., ease of communication, navigation support, and constant information accessibility), a growing number of scientists point to the "dark side" of the use of digital technology, including phenomena such as Internet addiction (Montag & Reuter, 2015), technostress (Riedl, 2013), and problematic smartphone use/smartphone use disorder (Lachmann et al., 2017). Given the potential negative effects of smartphone use on well-being, we aimed to further elaborate on the putative determinants of smartphone use and tendencies towards its disordered use.

Excessive use of the smartphone has been linked with impairments in mental health (Elhai et al., 2019, 2020), social interactions (Dwyer et al., 2018; Kushlev et al., 2019), and productivity (Rozgonjuk et al., 2020). Most questionnaires examining excessive smartphone use have adopted an addiction framework, hence, tested if excessive smartphone use falls into the category of addictive behaviors (Kwon, Lee, et al., 2013; Lin et al., 2014). But whether smartphone use can be "addictive" is still a matter of debate. Also, excessive use can be (mis)understood as merely time-consuming use. While "addictive" use of the smartphone is positively associated with time spent on a smartphone, time-intensive use is not the same as "addictive" use (Loid et al., 2020; Rozgonjuk et al., 2018). "Addictive" use additionally includes symptoms such as negative consequences on the user's life. The potential negative consequences of digital technology use have also been outlined in the realm of Internet use disorder, and "addictive" use of the smartphone can be seen as a mobile version of Internet use disorder (Montag, Wegmann, et al., 2021; Pontes et al., 2015). However, new work by Elhai et al. (2020) highlights the difficulty in defining clear sets of symptoms which would help diagnose "addictive" use. Of note, we use the term "smartphone use disorder" instead of "smartphone addiction" from now on (see Supplementary Material 1).

The problems regarding clear symptoms of smartphone use disorder are also mirrored in smartphone use disorder not yet being considered an official diagnosis. Therefore, official diagnostic criteria for the condition are not available. For this reason, the present study applies the often-used addiction framework (Kwon, Lee, et al., 2013; Lin et al., 2014) to assess tendencies towards smartphone use disorder, but does not use a categorization involving disordered versus not disordered use. Instead, this work relies on a dimensional approach assessing "tendencies towards smartphone use disorder". This approach also prevents over-pathologizing everyday behaviors such as smartphone use (Billieux et al., 2015).

In order to understand technology use and tendencies towards its disordered use, one can investigate the extent of acceptance of such technologies. A positive attitude – i.e. acceptance of a technology – might reinforce use and may be associated with tendencies towards its disordered use. To investigate acceptance of the smartphone technology, we chose the Technology Acceptance Model (TAM) by Davis (1989). This model, in its basic form, predicts actual technology use by behavioral usage intentions for the technology. Behavioral intentions are influenced by attitudes towards technology use, shaped by perceived ease of use and perceived usefulness of the technology, whereby perceived ease of use influences perceived usefulness. This model is of great interest in the present study as many studies support the explanatory power of TAM (King & He, 2006; Lee et al., 2003; Legris et al., 2003). Several extensions and unifying frameworks of the initial TAM model exist, such as TAM2 (Venkatesh, 2000; Venkatesh & Davis, 2000) and Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). These adaptions were developed to increase the model's predictive power. However, here we focus on the most basic TAM model including perceived ease of use, perceived usefulness, and usage intentions. This decision is based on several studies reporting that perceived ease of use and perceived usefulness positively predict intentions to use a smartphone (Cho & Park, 2014; Joo & Sang, 2013), positively predict self-reported actual use via usage intentions (Kim, 2008), and predict intention to purchase a smartphone (Rigopoulou et al., 2017). In line with these findings, another study found significant positive bivariate correlations for perceived ease of use and perceived usefulness with intention to continue using a smartphone (Park et al., 2013). TAM, importantly, aims to predict technology use in general without conceptualizing tendencies towards disordered use. We are only aware of one study, from South-Korea, relating the TAM variables perceived ease of use and perceived usefulness to smartphone use disorder tendencies. That study found that both TAM variables positively predicted smartphone use disorder tendencies (Park et al., 2013).

In light of the aforementioned literature, it can be assumed that TAM's perceived ease of use, perceived usefulness, and usage intentions are associated with self-reported time spent on the smartphone, and potentially smartphone use disorder tendencies. Given that the smartphone is a multipurpose device, which can be used in business/school/university and personal contexts, we aimed to investigate cross-sectional predictive effects of the aforementioned TAM variables on smartphone use (and disorder tendencies) in both contexts. Given the recent inconclusive results of studies on gender differences in technology acceptance and use of technologies such as the smartphone (Andone et al., 2016; Lachmann et al., 2017; Mitchell & Hussain, 2018; Peterka-Bonetta et al., 2019; Sindermann et al., 2020), as well as those examining associations for age with technology and smartphone use (Lachmann et al., 2017; Mitchell & Hussain, 2018; Peterka-Bonetta et al., 2019), age and gender were additionally included in the models (see Figure 1).

2 Methods

2.1 Sample

A total of N=720 participants completed the German language online survey on technology use and provided data for the project. As an incentive they received feedback on their personality scores and smartphone use (individual feedback was provided anonymously in comparison to the results of all other participants of the study; there was no way for participants to attribute results to other specific participants). The personality scale was assessed for another research purpose but this is not of direct relevance to this study. The study was implemented in the SurveyCoder tool (https://www.surveycoder.com/). It was advertised via various offline (e.g., TV, Radio) and online (e.g., social media) platforms and anyone who was at least 12 years old and had Internet access could participate. Therefore, the present sample is a convenience sample. After data cleaning (see Supplementary Material 1) data of a final sample size of N=693 (n=327 men, n=366 women) participants remained for analysis. The dataset has been uploaded to the Open Science Framework (https://osf.io/v23d7/).

2.2 Ethics

The study was approved by the local ethics committee of Ulm University, Ulm, Germany. All participants provided informed electronic consent prior to participation. Participants between 12 and 18 years of age required consent from their parents or legal guardians prior to participation, which also had to be provided electronically. Therefore, adolescents were asked to inform their parents and to confirm their agreement by clicking a button.

2.3 Measures

Technology acceptance was assessed using perceived ease of use, perceived usefulness, as well as usage intentions and predicted usage with regard to smartphone use both for personal and business/university/school purposes (Sindermann et al., 2020). Of note, predicted usage was assessed for reasons of completeness, because it is one of the questionnaire's scales. However, of primary interest in this work are hours of daily smartphone use in business and personal contexts and tendencies towards smartphone use disorder as dependent variables. Additional results modeling predicted usage of the smartphone are presented in Supplementary Material 2. In total, the questionnaire consists of 9 items to assess perceived usefulness, 9 items to assess perceived ease of use, 2 items to assess usage intentions, and 4 items to assess predicted usage for both personal and business use of the smartphone (48 items in total). For each item, responses can range between "1 = does not apply at all" and "6 = does apply completely". Scale scores were calculated as means of the respective items. Internal consistency estimates (using Cronbach's alphas) for the scales were: smartphone business: .81 (perceived usefulness), .79 (perceived ease of use), .80 (usage intentions), and .86 (predicted usage); smartphone personal: .85 (perceived usefulness), .85 (perceived ease of use), .88 (usage intentions), and .92 (predicted usage).

Moreover, participants were asked to estimate how many hours per day (on average) they spent on their smartphone for both business/university/school and personal use in two separate items. These items were free response items to which participants could respond by inserting any positive number or zero.

Finally, the short version of the Smartphone Addiction Scale (SAS-SV) (Kwon, Kim, et al., 2013; Montag, 2018) was used to assess tendencies towards smartphone use disorder. It consists of 10 items and scores can range between 10 and 60, because each item is answered on a six-point Likert-scale from "1 = strongly disagree" to "6 = strongly agree". Internal consistency (using Cronbach's alpha) was .85 in the study sample.

2.4 Statistical Analysis

Statistical analyses were implemented in R version 3.5.2 (R Core Team, 2018) and R Studio version 1.1.463 (RStudio Team, 2015). Descriptive statistics, gender differences, and associations with age are presented in Supplementary Material 1 alongside correlational analyses of associations between TAM and smartphone use (disorder tendency) variables.

To investigate the main research questions, namely the associations of TAM variables with smartphone use (in hours) and tendencies towards smartphone use disorder, four structural equation models were calculated (see Figure 1 for an illustration of the general model). In separate models the dependent variable was either hours of daily smartphone use for business (predicted by the TAM variables in the business context) or personal purposes (predicted by the TAM variables in the personal context) or tendencies towards smartphone use disorder (predicted by the TAM variables in the business or personal con-

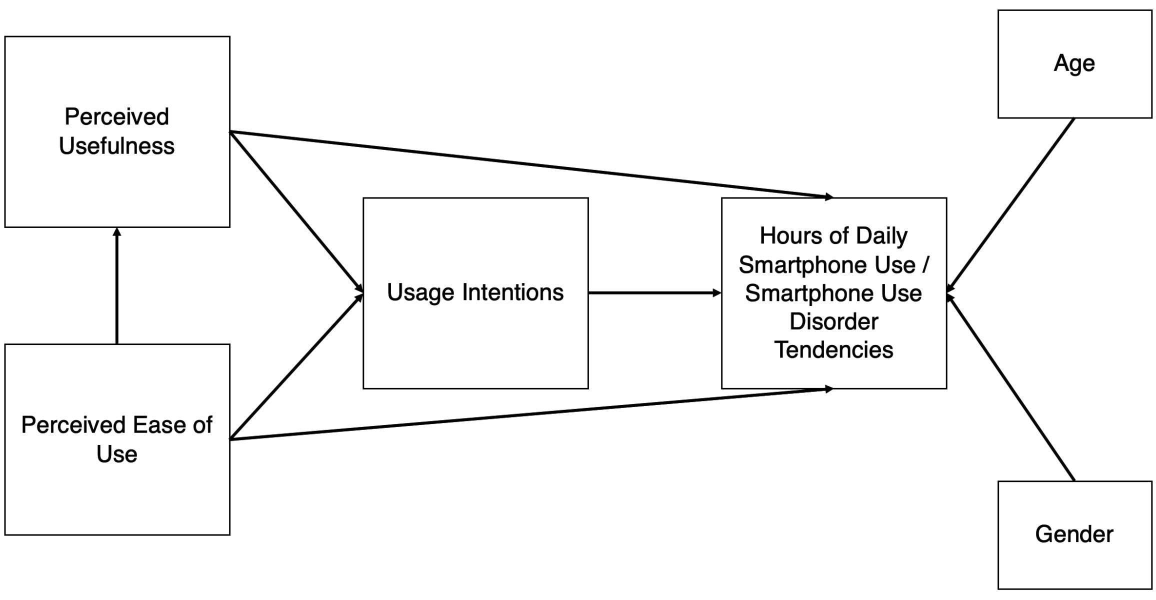

Figure 1. Model tested in the current study. Note that predicted usage was also assessed with the TAM questionnaire, but we chose to investigate hours of daily smartphone use / tendencies towards smartphone use disorder as relevant dependent variables in the main manuscript.

text). Hence, in two of the models, perceived ease of use, perceived usefulness, and usage intentions for business purposes as well as age and gender were specified to predict: i) self-reported hours of daily smartphone use for business purposes; or ii) SAS-SV scores. In the other models, perceived ease of use, perceived usefulness, and usage intentions for personal purposes as well as age and gender predicted: i) self-reported hours of daily smartphone use for personal purposes; or ii) SAS-SV scores. We did not integrate daily use and tendencies towards smartphone use disorder in one single model given the unknown causal association between the two. This allowed us to independently test the cross-sectional predictive effect of TAM variables on technology use and use disorder tendencies.

All variables were entered in the models as manifest variables. The lavaan package was used for these analyses (Rosseel, 2012).

3 Results

3.1 Sample

The sample consisted of n=327 men and n=366 women. The mean age of the sample was 30.61 years (SD=14.98), median age was 26 years, and participant age ranged from 12 to 76 years. Most participants reported a secondary school leaving certificate (n=147), A-level/High school diploma (n=158), or a university (including university of applied sciences) degree (n=280) as their highest educational degree. The remaining participants reported another type of school degree (streamed secondary school for lesser able students or vocational baccalaureate diploma) as highest educational degree (n=79) or no degree (n=29).

3.2 Structural Equation Models

Figures 2 to 5 show standardized estimates for path coefficients in the structural equation models. More detailed information on path coefficients can be found in Supplementary Material 2. Figure 2 shows the model on daily hours of smartphone use for business purposes. As can be seen in the Figure, none of the TAM variables were directly and significantly associated with hours of daily smartphone use for business purposes. Also, none of the indirect or total effects of TAM variables were significant.

Figure 3 presents the model on daily hours of smartphone use for personal purposes. Of TAM variables, only perceived usefulness was significantly and directly associated with hours of daily smartphone use for personal purposes (c1=0.13, p=.004). In line with this, the indirect effect of perceived ease of use via perceived usefulness (standardized estimate = 0.08, p=.005), the total effect of perceived usefulness (standardized estimate = 0.12, p=.004), as well as the total effect of perceived ease of use (standardized estimate = 0.07, p=.048) were significant.

Figure 4 shows the model on SAS-SV scores and perceived ease of use, perceived usefulness, and usage intentions for business purposes. Of the TAM variables, usage intentions (b1=0.23, p<.001) as well as perceived usefulness (c1=0.10, p=.028) were significantly and directly associated with SAS-SV scores. Additionally, all indirect effects as well as total effects were significant: indirect effect of perceived ease of use via perceived usefulness (standardized estimate = 0.06, p=.029); indirect effect of perceived ease of use via perceived usefulness and usage intentions (standardized estimate = 0.05, p<.001); indirect effect of perceived usefulness via usage intentions (standardized estimate = 0.09, p<.001); indirect effect of perceived ease of use via usage

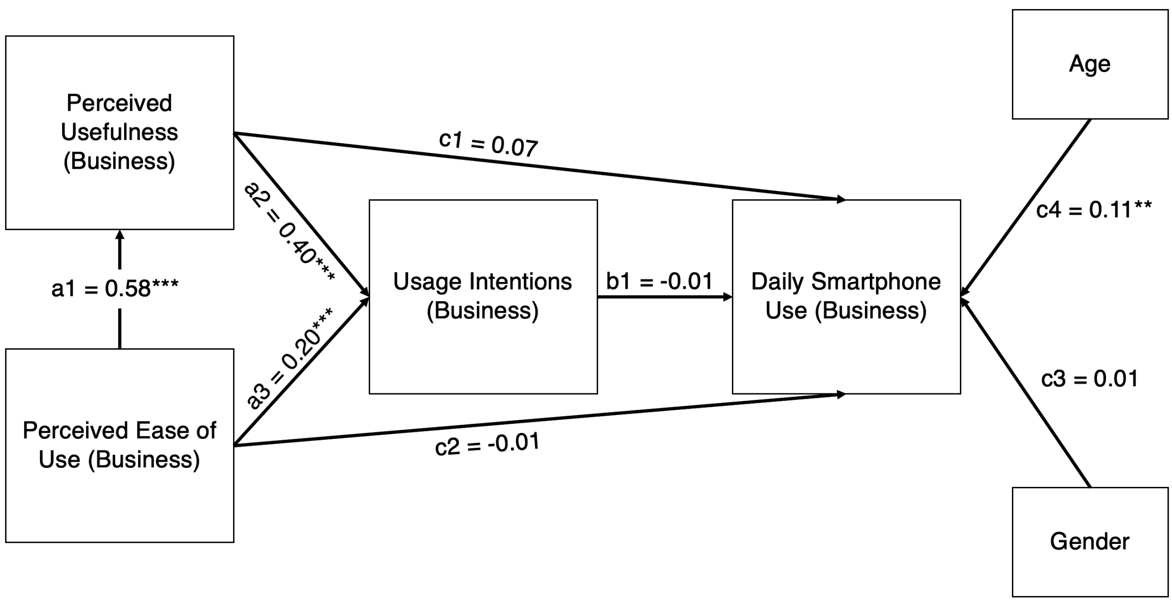

Figure 2. Model to predict daily hours of smartphone use for business purposes by TAM perceived ease of use, perceived usefulness, and usage intentions for business purposes; all estimates of path coefficients are standardized; gender: 0 = men, 1 = women, *p<.05, **p<.01, ***p<.001; Fit indices: Root Mean Square Error of Approximation (RMSEA) = 0.037, Comparative Fit Index (CFI) = 0.993, Tucker-Lewis Index (TLI) = 0.978, Standardized Root Mean Square Residual (SRMR) = 0.017.

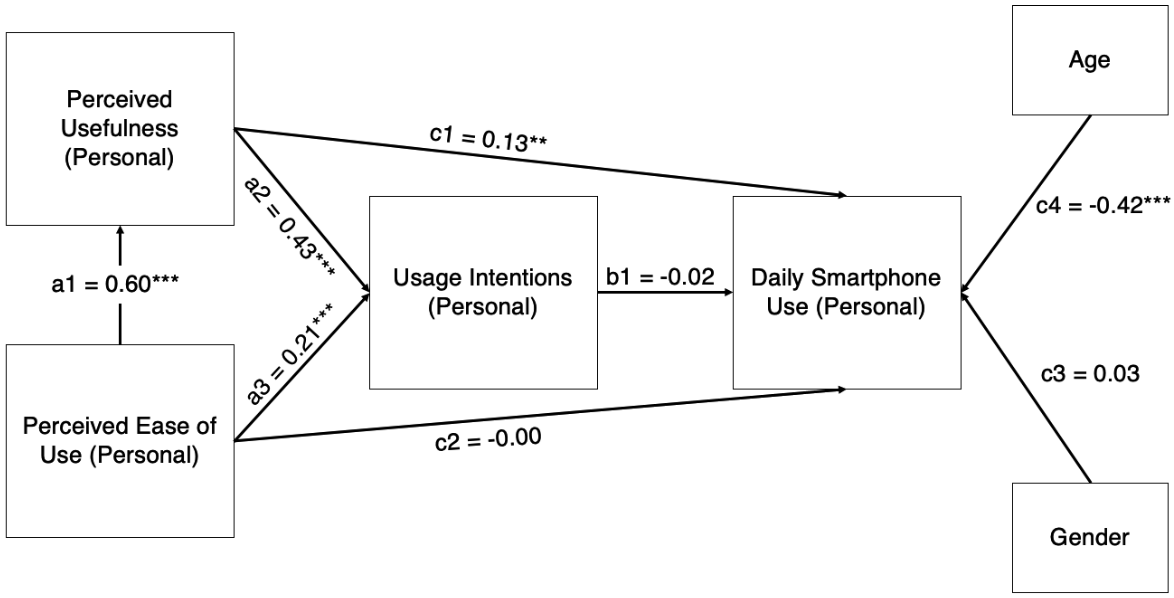

Figure 3. Model to predict daily hours of smartphone use for personal purposes by TAM perceived ease of use, perceived usefulness, and usage intentions for personal purposes; all estimates of path coefficients are standardized; gender: 0 = men, 1 = women, **p*<.05, ***p*<.01, ****p*<.001; Fit indices: Root Mean Square Error of Approximation (RMSEA) = 0.087, Comparative Fit Index (CFI) = 0.973, Tucker-Lewis Index (TLI) = 0.918, Standardized Root Mean Square Residual (SRMR) = 0.032.

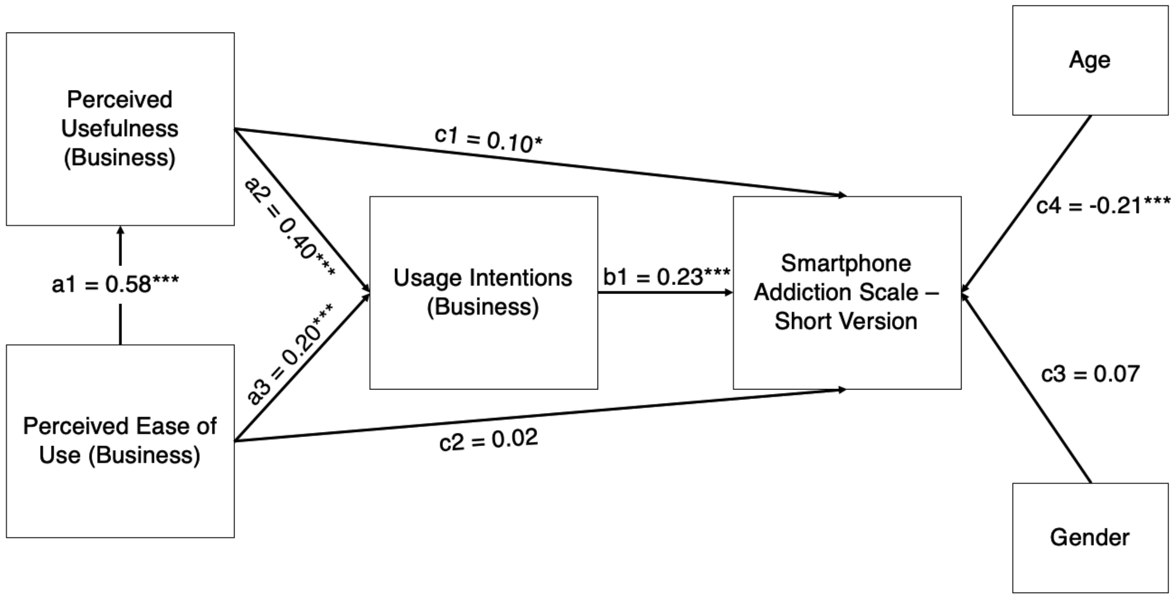

Figure 4. Model to predict Smartphone Addiction Scale – Short Version scores (assessing smartphone use disorder tendencies) by TAM perceived ease of use, perceived usefulness, and usage intentions for business purposes; all estimates of path coefficients are standardized; gender: 0 = men, 1 = women, **p*<.05, ***p*<.01, ****p*<.001; Fit Indices: Root Mean Square Error of Approximation (RMSEA) = 0.037, Comparative Fit Index (CFI) = 0.994, Tucker-Lewis Index (TLI) = 0.982, Standardized Root Mean Square Residual (SRMR) = 0.018.

intentions (standardized estimate = 0.05, *p*<.001); total effect of perceived ease of use (standardized estimate = 0.18, *p*<.001); total effect of perceived usefulness (standardized estimate = 0.19, *p*<.001).

In Figure 5, the associations between perceived ease of use, perceived usefulness, and usage intentions for personal purposes and SAS-SV scores are displayed. Of the TAM variables, usage intentions (b1=0.19, *p*<.001) and perceived usefulness (c1=0.13, *p*=.007) were significantly and directly linked to SAS-SV scores. Moreover, all indirect and total effects were significant: indirect effect of perceived ease of use via perceived usefulness (standardized estimate = 0.08, *p*=.008); indirect effect of perceived ease of use via perceived usefulness and usage intentions (standardized estimate = 0.05, *p*<.001); indirect effect of perceived usefulness via usage intentions (standardized estimate = 0.08, *p*<.001); indirect effect of perceived ease of use via usage

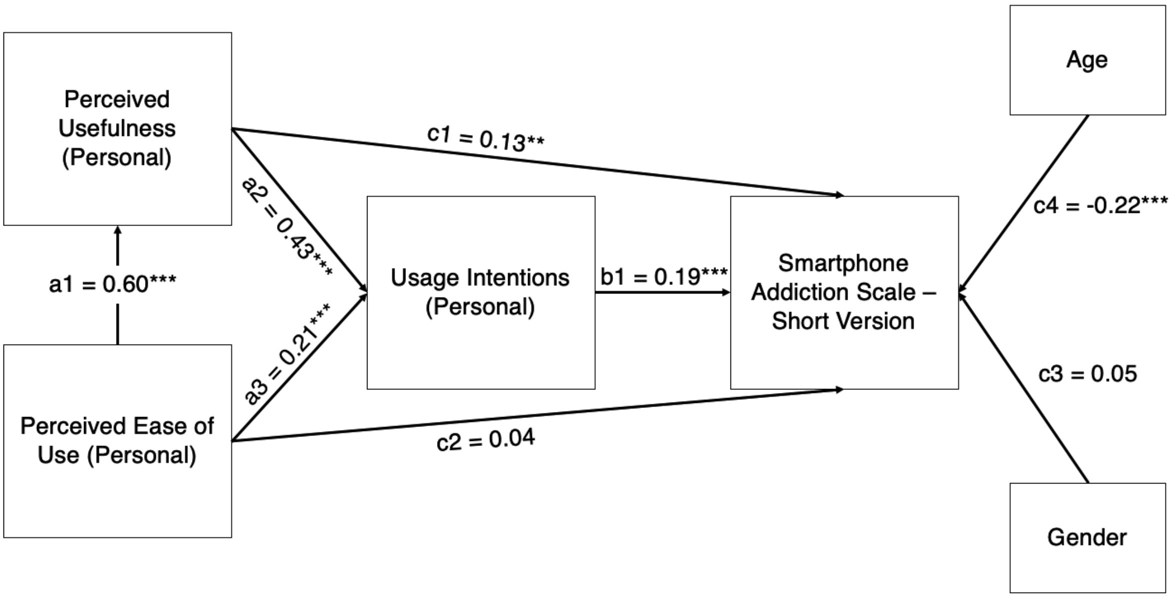

Figure 5. Model to predict Smartphone Addiction Scale – Short Version scores (assessing smartphone use disorder tendencies) by TAM perceived ease of use, perceived usefulness, and usage intentions for personal purposes; all estimates of path coefficients are standardized; gender: 0 = men, 1 = women, *$p<.05$, **$p<.01$, ***$p<.001$; Root Mean Square Error of Approximation (RMSEA) = 0.087, Comparative Fit Index (CFI) = 0.971, Tucker-Lewis Index (TLI) = 0.912, Standardized Root Mean Square Residual (SRMR) = 0.032.

intentions (standardized estimate = 0.04, p=.001); total effect of perceived ease of use (standardized estimate = 0.21, p<.001); total effect of perceived usefulness (standardized estimate = 0.21, p<.001).

Given the few restrictions in the models tested, the fit indices were, unsurprisingly, all quite good (e.g., all Comparative Fit Indices > 0.95 (Hu & Bentler, 1999)).

4 Discussion

The main goal of this work was to develop an understanding of the relationship between major components of TAM (perceived ease of use, perceived usefulness, usage intentions) and use of the smartphone (daily usage hours) and tendencies towards smartphone use disorder. The aim was to attain a greater comprehension of important determinants of smartphone use and tendencies towards its disordered use.

Our results showed that daily use of the smartphone for business purposes was not cross-sectionally predicted by any of the TAM variables. Daily use of the smartphone for personal purposes was directly cross-sectionally predicted by perceived usefulness and some paths including this variable. Regarding tendencies towards smartphone use disorder, we found that nearly all TAM variables – except for the direct effect of perceived ease of use – significantly cross-sectionally predicted SAS-SV scores, in both business and personal use contexts.

Regarding time spent using the smartphone per day, our data indicate that acceptance of the device does not explain its use in the business context. A possible reason is that business use is not dependent only on one's own acceptance of technology, but also on many other (external) factors which may exert influence. As such, regulations of the employer might be of importance. Examples are regulations about which apps to use for communication in the team and when and how long to be available via the smartphone. This is underlined by a study reporting positive associations between smartphone use and expectations of one's supervisor and norms of colleagues (Derks & Bakker, 2014).

Moreover, our data showed that time spent on a smartphone for personal purposes is primarily associated with perceived usefulness, indicating that higher smartphone use is due to a positive attitude towards its usefulness to execute personal tasks (e.g., to contact friends). Interestingly, usage intentions did not significantly affect daily personal use of the smartphone. This might be due to the fact that the smartphone is often not used with a specific and clearly stated intention or purpose, but rather constitutes a habitual behavior integrated in everyday life. Moreover, the lack of influence of usage intentions on daily personal use could also be explained by the fact that social media providers use mechanisms to keep users on the platform or get them back to the platform when they are not online. Such mechanisms comprise, among others, push-notifications, endless scrolling and streaming, and the personalized news feed (Montag, Lachmann, et al., 2019). Since social media use accounts for a substantial portion of time spent on a smartphone (Montag, Błaszkiewicz, Sariyska, et al., 2015), such external mechanisms might further drive smartphone use (especially for personal purposes) without a subjective intention to use it.

Moreover, our data showed that perceived usefulness of a smartphone for both personal and business purposes and perceived ease of smartphone use (see indirect effects and results of correlational analyses presented in Supplementary Material 1), alongside higher usage intentions, are associated with smartphone use disorder tendencies. Putatively, the higher perceived ease of use, perceived usefulness, and usage intentions lead to an increasing focus on the smartphone and ultimately tendencies towards its disordered use and thus smartphone-related negative impacts on one's life. The positive associations found between all TAM variables and tendencies towards smartphone use disorder in comparison to i) no significant predictive effect when investigating time spent on the smartphone for business purposes; and ii) only perceived usefulness as an important direct factor to predict time spent on the smartphone for personal purposes, is remarkable. This finding might indicate that for individuals with higher smartphone use disorder tendencies the smartphone plays a pivotal role. This importance, in turn, seems to be mirrored in a positive attitude and acceptance of various aspects of the smartphone, such as perceived ease of use and perceived usefulness as well as deliberate usage intentions. The mere use of the smartphone, however, does not seem to be reflected in a positive attitude, i.e. high acceptance, with regard to many TAM variables. Finally, positive associations found between TAM and smartphone use disorder tendencies are in line with prior work investigating perceived ease of use and perceived usefulness in association with tendencies towards smartphone use disorder (Park et al., 2013).

When interpreting our results, one should consider the following *limitations*, which deserve attention in future research. Firstly, we did not collect data on objectively measured usage behavior, but instead measured participants' usage intentions and self-reported time spent on the smartphone. Particularly with regard to the latter, studies have shown that these estimations may be biased (Montag, Błaszkiewicz, Lachmann, et al., 2015). Such biased reporting might in part explain why TAM variables rarely explained daily smartphone use. As a starting point for future studies, researchers could draw upon the work by Devaraj et al. (2008), which examined the actual use of a collaborative technology based on activity log files; see also Ryding and Kuss (2020) for a review. Secondly, the data presented in this paper are cross-sectional. What follows is that interpretations of causality patterns must remain speculative and therefore call for future longitudinal studies. Thirdly, another limitation that opens up potential for future research is that major outcome variables, such as depression (Elhai et al., 2019), burnout (Derks & Bakker, 2014), or stress (Vahedi & Saiphoo, 2018) were not included in this study. Moreover, one needs to take into account that smartphone use disorder is not yet an official diagnosis. Therefore, for now there is no consensus on diagnostic criteria and measures to assess the construct or tendencies towards this potential use disorder (i.e., a "gold standard"). Lastly, overall the study sample displayed rather low SAS-SV scores, limiting the generalizability of the results to more severely affected groups with regard to (tendencies towards) smartphone use disorder. However, considering that the rather low SAS-SV scores already showed remarkable associations with TAM variables, it is likely that higher SAS-SV scores would result even in higher correlations with TAM variables. Future empirical research should test this proposition.

In conclusion, this study helps to explain how the prominent TAM and its variables might be linked to smartphone use and smartphone use disorder tendencies. Specifically, tendencies towards smartphone use disorder seem to be especially positively associated with perceived ease of use, perceived usefulness as well as deliberate usage intentions. Based on the existing research, scholars should investigate the exact (causal) relationship between technology acceptance beliefs (e.g., perceived usefulness, perceived ease of use), technology attitude, usage intentions, actual usage patterns, tendencies towards smartphone use disorder, and resulting consequences such as depression, burnout, or stress.

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Declaration of Interest

Outside the scope of the present paper, Dr. Jon Elhai notes that he receives royalties for several books published on posttraumatic stress disorder (PTSD); is a paid, full-time faculty member at University of Toledo; is a paid, visiting scientist at Tianjin Normal University; occasionally serves as a paid, expert witness on PTSD legal cases; and receives grant research funding from the U.S. National Institutes of Health. Dr. Montag mentions that he has received (to Ulm University and earlier University of Bonn) grants from agencies such as the German Research Foundation (DFG). Dr. Montag has performed grant reviews for several agencies; has edited journal sections and articles; has given academic lectures in clinical or scientific venues or companies; and has generated books or book chapters for publishers of mental health texts. For some of these activities he received royalties, but not from the gaming or social media industry. Dr. Montag mentions that he is part of a discussion circle (Digitalität und Verantwortung: https://about.fb.com/de/news/h/gespraechskreis-digitalitaet-und-verantwortung/) debating ethical questions linked to social media, digitalization and society/democracy at Facebook. In this context, he receives no salary for his activities. Finally, he mentions that he currently functions as independent scientist on the scientific advisory board of the Nymphenburg group. This activity is financially compensated.

All authors declare that they do not have any conflicting interests.

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Supplementary Material 1

Smartphone use disorder terminology

The term "smartphone use disorder" is chosen in response to the inclusion of Gaming Disorder in the WHO's ICD-11 (Montag, Schivinski, et al., 2019; Montag, Wegmann, et al., 2021; Pontes et al., 2019; World Health Organization, 2019) and in line with the I-PACE model of specific Internet use disorders by Brand et al. (2016). Moreover, this term is used to strive for unification in the nomenclature in line with our previous works (e.g., Marengo et al., 2020). Note that "problematic smartphone use" or "smartphone addiction" are also terms used in previous publications to describe the same construct (Duke & Montag, 2017; Elhai et al., 2019; Herrero et al., 2017; Mitchell & Hussain, 2018).

Additional information on methods

Data cleaning
Of the N=720 participants, n=4 participants were excluded for being younger than 12 years old or implausibly old (older than 1,000 years). Additionally, n=11 participants were excluded because they reported more than 16 hours of daily smartphone use (personal and business use combined). We chose 16 hours as the criterion because, given an estimated sleeping time of 8 hours, 16 hours of time awake remain per day. Lastly, participants denying smartphone ownership (n=7) as well as individuals reporting the use of the smartphone for 0 hours for both private and business use (n=5) were excluded because we were specifically interested in smartphone use. No missing data were observed.

Finally, it is important to mention that the present sample partly overlaps with samples of other studies investigated in light of other research questions by the authors. More detailed information can be requested from the authors.

Additional analyses and results

Descriptive statistics, gender differences, and associations with age
First, skewness and kurtosis of all variable distributions were checked. Only the distributions of variables on hours of daily smartphone use showed a skewness and kurtosis exceeding +/- 1 (business: skewness=3.36, kurtosis=18.05; personal: skewness=1.39, kurtosis=2.24). According to guidelines by Miles and Shevlin (2001), normality cannot be assumed for these two variables. Therefore, when investigating these two variables, non-parametric statistical analyses were chosen. When investigating the other variables, parametric tests were used.

Descriptive statistics were calculated and associations with gender and age were investigated. Gender differences were tested for significance by means of t-tests (Welch's t-tests were used if necessary) or Mann-Whitney U-tests (for daily smartphone use variables). Associations with age were investigated applying Pearson or Spearman (for daily smartphone use variables) correlations.

Descriptive statistics of TAM and smartphone use (disorder tendency) variables for the total sample and for men and women are presented in Supplementary Table S1. Significant gender differences were found in perceived ease of use (t(691)=2.62, p=.009, Cohen's d=.20), perceived usefulness (t(691)=2.52, p=.012, Cohen's d=.19), and predicted usage (t(691)=2.33, p=.020, Cohen's d=.18) for business use of the smartphone. Men scored higher than women on all of these scales. Additionally, significant differences between men and women, with women scoring higher, were found on hours of daily smartphone use for personal purposes (W=53,800.00, p=.019, r=-.09) and SAS-SV scores (t(691)=-2.11, p=.035, Cohen's d=-.16).

Significant correlations with age were found for perceived ease of use (r=-.09, p=.016) for business use of the smartphone, intentions to use the smartphone for personal purposes (r=.08, p=.028), daily hours of smartphone use for business (ρ=.18, p<.001) and personal purposes (ρ=-.49, p<.001), as well as SAS-SV scores (r=-.22, p<.001). These findings support the decision to include gender and age in the structural equation models.

The partial correlation (corrected for age) between the two daily smartphone use variables (business and personal) was ρ=.06, p=.105. The correlation between daily business use and SAS-SV scores was ρ=.10, p=.006; between daily personal use and SAS-SV scores it was ρ=.46, p<.001.

Table S1. Descriptive statistics

	Total Sample (N=693)			Men (n=327)			Women (n=366)		
	Min	Max	M (SD)	Min	Max	M (SD)	Min	Max	M (SD)
TAM Business									
Perceived Ease of Use	1.22	5.89	4.09 (0.75)	1.44	5.67	4.17 (0.74)	1.22	5.89	4.02 (0.76)
Perceived Usefulness	1.00	5.89	3.51 (0.80)	1.00	5.89	3.59 (0.84)	1.00	5.56	3.43 (0.76)
Usage Intentions	1.00	6.00	4.56 (1.19)	1.00	6.00	4.58 (1.16)	1.00	6.00	4.55 (1.22)
Predicted Usage	1.00	6.00	2.97 (1.15)	1.00	6.00	3.07 (1.16)	1.00	6.00	2.87 (1.14)
TAM Personal									
Perceived Ease of Use	1.56	6.00	4.11 (0.84)	1.56	6.00	4.17 (0.84)	1.56	6.00	4.07 (0.84)
Perceived Usefulness	1.00	6.00	3.50 (0.87)	1.00	6.00	3.53 (0.92)	1.00	6.00	3.47 (0.83)
Usage Intentions	1.00	6.00	4.53 (1.25)	1.00	6.00	4.45 (1.26)	1.00	6.00	4.61 (1.23)
Predicted Usage	1.00	6.00	3.60 (1.26)	1.00	6.00	3.54 (1.21)	1.00	6.00	3.66 (1.30)
Daily Smartphone Use (Business)	0.00	10.00	0.82 (1.16)	0.00	9.00	0.83 (1.13)	0.00	10.00	0.81 (1.19)
Daily Smartphone Use (Personal)	0.00	12.00	3.01 (1.98)	0.00	12.00	2.85 (1.92)	1.00	12.00	3.16 (2.02)
SAS-SV score	10.00	60.00	27.60 (9.48)	10.00	60.00	26.80 (9.51)	10.00	53.00	28.32 (9.42)

Note. The two daily smartphone use variables were assessed in hours. Therefore, 0.82 hours corresponds to around 49 minutes, 3.01 hours corresponds to around 181 minutes (total sample); 0.83 hours correspond to around 50 minutes, 2.85 hours correspond to around 171 minutes (men); 0.81 hours correspond to around 49 minutes, and 3.16 hours correspond to 190 minutes (women). Tendencies towards smartphone use disorder were assessed with the SAS-SV: Smartphone Addiction Scale – Short Version.

Results of correlational analysis

Partial Pearson or Spearman (for the daily smartphone use variables) correlations were calculated (corrected for age) to investigate associations of TAM variables (perceived ease of use, perceived usefulness, usage intention, predicted usage for business and personal use) with daily smartphone use variables (business and personal, respectively) and SAS-SV scores. These correlations were calculated for the total sample as well as separately for men and women (see significant gender differences).

Supplementary Table S2 shows associations of TAM scales for business use of the smartphone with the daily smartphone use variable for business purposes. Supplementary Table S3 shows associations of TAM scales for personal use of the smartphone with the daily smartphone use variable for personal purposes. Supplementary Table S4 shows associations of the TAM scales for both business and personal use of the smartphone with SAS-SV scores. After Bonferroni correction for multiple testing (0.05/16=0.0031; for 16 correlations calculated (in each sample)), not all correlations remain significant.

Table S2. Partial correlations (corrected for age) of the TAM scales for business use with the smartphone use variable for business purposes

	Total Sample (N = 693)	Men (n = 327)	Women (n = 366)
Perceived Ease of Use	ρ=.04, ρ=.356	ρ=.06, ρ=.278	ρ=.03, ρ=.523
Perceived Usefulness	ρ=.10, ρ=.008	ρ=.09, ρ=.117	ρ=.14, ρ=.010
Usage Intention	ρ=.02, ρ=.629	ρ=.01, ρ=.800	ρ=.06, ρ=.285
Predicted Usage	ρ=.16, ρ<.001	ρ=.18, ρ=.001	ρ=.13, ρ=.013

Table S3. Partial correlations (corrected for age) of the TAM scales for personal use with the smartphone use variable for personal purposes

	Total Sample (N = 693)	Men (n = 327)	Women (n = 366)
Perceived Ease of Use	ρ=.11, ρ=.004	ρ=.02, ρ=.759	ρ=.21, ρ<.001
Perceived Usefulness	ρ=.16, ρ<.001	ρ=.10, ρ=.071	ρ=.24, ρ<.001
Usage Intention	ρ=.12, ρ=.002	ρ=.10, ρ=.074	ρ=.13, ρ=.010
Predicted Usage	ρ=.16, ρ<.001	ρ=.08, ρ=.167	ρ=.23, ρ<.001

Table S4. Partial correlations (corrected for age) of the TAM scales for business and personal use with the SAS-SV scores

	Total Sample (N = 693)	Men (n = 327)	Women (n = 366)
TAM Business			
Perceived Ease of Use	r=.17, p<.001	r=.12, p=.034	r=.24, p<.001
Perceived Usefulness	r=.23, p<.001	r=.14, p=.011	r=.33, p<.001
Usage Intention	r=.30, p<.001	r=.32, p<.001	r=.28, p<.001
Predicted Usage	r=.27, p<.001	r=.25, p<.001	r=.31, p<.001
TAM Personal			
Perceived Ease of Use	r=.21, p<.001	r=.15, p=.008	r=.27, p<.001
Perceived Usefulness	r=.26, p<.001	r=.20, p<.001	r=.33, p<.001
Usage Intention	r=.29, p<.001	r=.28, p<.001	r=.30, p<.001
Predicted Usage	r=.32, p<.001	r=.26, p<.001	r=.37, p<.001

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