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Smartphone addiction, daily interruptions and self-reported productivity

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ABSTRACT

The advent of the smartphone has dramatically altered how we communicate, navigate, work and entertain ourselves. While the advantages of this new technology are clear, constant use may also bring negative consequences, such as a loss of productivity due to interruptions in work life. A link between smartphone overuse and loss of productivity has often been hypothesized, but empirical evidence on this question is scarce. The present study addressed this question by collecting self-report data from $N = 262$ participants, assessing private and work-related smartphone use, smartphone addiction and self-rated productivity. Our results indicate a moderate relationship between smartphone addiction and a self-reported decrease in productivity due to spending time on the smartphone during work, as well as with the number of work hours lost to smartphone use. Smartphone addiction was also related to a greater amount of leisure time spent on the smartphone and was strongly related to a negative impact of smartphone use on daily non-work related activities. These data support the idea that tendencies towards smartphone addiction and overt checking of the smartphone could result in less productivity both in the workplace and at home. Results are discussed in relation to productivity and technostress.

Introduction

Ten years since its inception, the smartphone is now ubiquitous in everyday life, with approximately two billion users worldwide (Miller, 2012). Given the diverse range of functions afforded by this pocket-sized gadget – from communication to navigation and entertainment – the popularity of the smartphone seems inevitable. Yet, while 24–7 access to a powerful computer may make certain aspects of our lives easier, increasing concerns exist about the negative effects of smartphone (over)use. Such problems are diverse in nature and include the more general problem of our "digital footprint", i.e. the recording of users' interactions on the Internet through cookies. While we acknowledge that such data can be exploited in a meaningful way (e.g. see review by Montag, Duke & Markowetz, 2016; Montag, Reuter & Markowetz, 2015), the misuse of data recorded in this manner is legion. This has been highlighted by the international mass media many times. For example, in 2016, Time magazine ran a story on how Facebook handles users' data.[1]

On an individual level, more problematic in everyday life may be the habit-forming nature of smartphone use (Oulasvirta, Rattenbury, Ma, & Raita, 2012). Smartphone use has, arguably, the potential to develop into an addictive behaviour, similar to gambling, which can interfere with our everyday life. Though not an official diagnosis, several researchers have demonstrated how classic addiction symptomology may be applicable in the context of smartphone overuse, including loss of control (e.g. distortion of time spent on the phone), preoccupation with the smartphone, withdrawal symptoms and negative effects on our social and work lives (e.g. Kwon et al., 2013; Lanaj, Johnson, & Barnes, 2014; Lin et al., 2015).

The latter problem area is of interest for the current study, as smartphones can distract us to a point where we are unable to achieve a state of flow at work (see Montag & Walla, 2016). Flow describes a state in which we are fully absorbed by an activity, forgetting about space and time, whilst being very productive (Csikszentmihalyi & Csikszentmihalyi, 1992). For example, when in a state of flow, you may write many pages of a document without awareness of the passage of time. To achieve a state of flow two important pre-requisites must be met. First, there must be an even match between a person's ability and

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[1] http://time.com/4695/7-controversial-ways-facebook-has-used-your-data/ (accessed on 21st October 2016)

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the difficulty of a given task. In addition - and this is where smartphone use may play a role – achievement of flow requires several minutes of full, unbroken, concentration (Csikszentmihalyi, 1999; Alton, Trafton & Hambrick, 2014). To remain in this state, one must maintain this concentration of focused attention on the task at hand. Even brief interruptions may undermine an individual's achievement of the flow state. Alton et al. (2014) found that interruptions as brief as 2.8 s disrupted participants' flow of concentration and led to increased errors on a sequence-based cognitive task. Thus, smartphones with their visual and acoustic signals alerting the owner to incoming messages from social networks, etc. act as interrupters (Rennecker & Godwin, 2005), which have the potential to hinder flow experience and may have an associated negative impact on productivity. Furthermore, the intermittent reinforcement received from smartphones may facilitate the development of a “checking habit”, i.e. brief repeated inspections of the phone to scan for new content (Oulasvirta et al., 2012; for a more developed explanation of how conditioning principles may operate to influence unconscious smartphone use, see Duke & Montag, 2017). The degree to which this checking habit could undermine the achievement of flow has been highlighted by the recent observation that participants check their smartphone every 18 min (Markowetz, 2015). Furthermore, it may also be possible to enter a state of flow whilst using the smartphone, which could, in a work environment, further undermine work-related productivity.

Crucially, there exists a spectrum of views among researchers as to the validity of smartphone addiction as a specific sub-type of behavioural addiction (see De-Sola Gutiérrez, de Fonseca, & Rubio, 2016 for a discussion; and Widyanto & Griffiths, 2006 for a related review of the Internet addiction concept). While some work suggests the absolute existence of a specific smartphone addiction, several researchers highlight the role of problematic behaviours (e.g. the checking habit discussed above, Oulasvirta et al., 2012), personality traits (e.g. impulsivity, Cao, Su, Liu, & Gao, 2007; and a lack of inhibitory control, e.g. Chen, Liang, Mai, Zhong, & Chen, 2016) and psychiatric co-morbidities (e.g. ADHD, depression; Sariyska, Reuter, Lachmann, & Montag, 2015) in Internet and smartphone overuse. An important, and as yet unresolved, theoretical point is whether such addiction is related to the smartphone itself or if the smartphone is merely a medium through which an individual accesses other addictions, e.g. through use of applications for chatting with friends, playing games or shopping. The latter idea is supported by recent evidence suggesting social network use and game playing on the smartphone were significant predictors of smartphone addiction (Jeong, Kim, Yum, & Hwang, 2016). Unpublished work by our lab also supports the idea of a common personality type that underlies both Internet and smartphone addiction, with the greatest predictor of addiction being low levels of self-directedness. Given these points, it seems likely that addictions to the smartphone and / or Internet likely arise as a by-product of certain personality and diverse behavioural factors (for a wider discussion, see the I-PACE model by Brand, Young, Laier, Wölfling, & Potenza, 2016), thus it is crucial that we investigate how individuals interact with their smartphones in everyday life.

With the present short report, we aim to illustrate how tendencies towards smartphone addiction, interruptions by the smartphone (and resultant work hours lost due to smartphone use) and self-reported productivity are interrelated. We expect that higher tendencies towards smartphone addiction are associated with higher numbers of daily interruptions by the smartphone and lower reported productivity.

Methods

Participants & recruitment process.

A website was designed to attract participants for our research on smartphone use. This website has been promoted across German media (TV and press) and has also been publicised by the German Government's *Drogenbeauftragte* (office for the regulation of drug use) via www.drogenbeauftragte.de. Between January 2016 and September 2016, 605 participants completed the online questionnaires (248 males and 357 females; mean-age: 29.64, SD = 12.99). Upon completion of the online questionnaires, all users received individualised feedback on their smartphone addiction score compared to a sample of users from the town of Ulm in Germany. This benchmark-sample had been collected previously in a different context and included no data on daily interruptions or self-reported productivity. Of a total of 605 participants, 379 met the criteria for inclusion in the current study, i.e. reported being in employment, over the age of 14 and owning a smartphone. The present study received ethical approval from the local ethics' committee of Ulm University, Ulm, Germany.

Questionnaires.

All participants answered questionnaires on smartphone ownership, private and work-related smartphone use in hours per week, smartphone addiction and productivity.

In order to assess smartphone addiction, we used the short Smartphone Addiction Scale (SAS; Kwon et al., 2013). This ten-item scale is assessed on a six-point Likert scale, with less addictive tendencies corresponding to the lowest score (10) and greatest addictive tendencies corresponding to the highest score (60). We translated this questionnaire into German (and back translated it into English). We also modified the questionnaire slightly to make it more accessible for participants. Namely, we re-worded several items into the first-person format. As an example, where the original item stated, “Missing planned work due to smartphone use”, we changed it to “I miss planned work due to smartphone use”. Internal consistency for the Smartphone Addiction Scale (SAS) was excellent (alpha = 0.87). As we used a 0–5 scale (ranging from strongly disagree (0) to strongly agree (5)), rather than a 1–6 scale, a constant of 10 is added to participants' scores to facilitate comparison with the original Kwon et al. (2013) data (see Table 1).

Productivity at work and in relation to smartphone use was assessed with several questions based on the *Work Productivity and Activity Impairment - General Health* questionnaire (WPAI-GH; see Reilly, Zbrozek, & Dukes, 1993). The original version of the questionnaire comprises six items assessing current employment (yes/no), number of work hours missed due to ill health in the past seven days, hours of work missed for other reasons (e.g. vacation or completing this questionnaire at work) and actual number of hours worked in the past seven days. The remaining two items ask participants to indicate on an 11-point Likert scale (ranging from 0 to 10) to what extent their health problems have affected either productivity at work (item 5) or daily activities excluding work (item 6). The number “0 “indicates that health has had no effect on productivity and “10 “indicates a complete inability to work due to one's ill health. We used the German version provided by Reilly Associates on the website: http://www.reillyassociates.net/WPAI_Translations.html (last accessed 21/05/2016). Items 5 and 6 of the WPAI-GH are designed to assess productivity at work. As such, these items were also administered with the word *smartphone* in place of the word *health* to assess how smartphone use affected productivity (these items are identified by the label “ADAPTED” in the tables below). We also included an additional item to query how many minutes each day a person can work without digital interruptions (we asked for an average estimate in minutes). Finally, we asked about the duration of the longest phase without interruptions (again we asked for an average estimate in minutes, i.e. if a person has three uninterrupted session of 60, 50 and 40 min - resulting in 150 min of uninterrupted work - the longest uninterrupted session from this would have been 60 min). Additional questionnaires on life satisfaction, etc. have been collected for another research project and will not be discussed further in this paper. For the purposes of the current study, we worked with the raw scores from each WPAI-GH item. It is also possible to conceptualise the scale in other ways, e.g. impairment as a percentage (see http://www.reillyassociates.net/WPAI_Scoring.html, accessed on 24th August 2017).

Table 1
Means and standard deviations for all variables.

	Mean	SD
Total SAS scores	13.095 (23.09)*	9.32
WPAI:GH 2 During the past 7 days how many work hours have you missed due to health problems?	1.37 h	5.18 h
WPAI:GH 3 During the past 7 days how many work hours have you missed for any other reason?	3.28 h	7.38 h
WPAI:GH 4 During the past 7 days how many hours have you actually worked?	23.08 h	12.93 h
WPAI:GH 5 During the past 7 days how much did health problems affect your productivity while you were working?	1.64	2.37
WPAI:GH 6 During the past 7 days how much did health problems affect your ability to do regular daily activities, e.g. housework?	2.00	2.50
WPAI:GH 5 (ADAPTED) During the past 7 days how much did your smartphone use affect your productivity while you were working?	1.88	2.11
WPAI:GH 6 (ADAPTED) During the past 7 days how much did your smartphone use affect your ability to do regular daily activities, e.g. housework?	2.33	2.19
Number of work hours lost to smartphone use in the past 7 days	1.76 h	3.35 h
Average weekly minutes worked without interruption from smartphone	123.16 mins	119.90 mins
Longest period (in mins) without interruption	157.55 mins	137.54 mins
Number of hours spent on smartphone for leisure	13.28 h	12.05 h
Number of hours spent on smartphone for work	2.86 h	5.48 h

* Number in brackets is the raw score plus a constant of 10 to facilitate comparison to the original Kwon et al. (2013) scale. As the WPAI:GH 1 comprises a yes / no question on employment status, it is omitted from the above Table.

Statistical analysis.

Data Cleaning: Of a total of 605 participants, 379 met the criteria for inclusion in the current study, i.e. reported being in paid employment, above the age of 14 (i.e. the legal employment age in Germany), and owning a smartphone. After this initial screening, we excluded a further 38 participants due to implausible scores on variables, e.g. spending 800 h of leisure time on the smartphone in the past week or working uninterrupted for 24 h daily. Of the remaining participants, 79 reported working more than a standard 40-h week. The results were not altered by including or excluding these participants; however, we excluded them due to their non-representative work pattern and to minimise artificial inflation of results due to sample size. This left us with a final sample size of $N = 262$ (168 female, mean-age 32.03, SD = 11.08).

Remaining analysis.

Given the non-parametric distribution of the data, the experimental variables of interest were tested using a series of Spearman's rho (r_s) correlations. Gender differences were explored using a Mann-Whitney-*U* test. Partial correlations were carried out on ranked data in accordance with Conover and Iman (1981). A mediation analysis was carried out post-hoc to explore the relationship between SAS scores and self-reported negative effect of smartphone use on work productivity, with daily interruptions (defined as the number of work hours lost to smartphone use) as a mediator. All statistical analyses were carried out using SPSS v. 22 for MAC.

Results

Participant demographics; gender and SAS scores.

Mean SAS scores for females ($M = 13.43$, $SD = 9.18$) were higher than for males ($M = 11$, $SD = 8.07$). This difference was just shy of significance ($U = 13{,}677$, $z = -1.92$, $p = 0.055$). A negative association was observed between age and SAS scores ($r_s = -0.269$, $p < 0.01$). Table 1 shows mean scores and standard deviations for the key variables under study.

SAS and productivity.

Productivity, as assessed by the modified WPAI-GH indicated a moderate positive relationship between hours at work lost due to the smartphone during the last seven days and total SAS scores ($r_s = 0.372$, $p < 0.01$). In-keeping with this observation, a moderate relationship was also observed between the negative effect of smartphone use on productivity (self-reported observation) and total SAS score ($r_s = 0.436$, $p < 0.01$). Similarly, a moderate negative correlation could be seen between total SAS and the number of minutes worked without interruption ($r_s = -0.366$, $p < 0.01$) and weaker correlations with the number of hours actually worked in the past seven days ($r_s = -0.103$, $p = 0.09$). Table 2 shows the correlational relationships for the SAS scores and work-related productivity variables.

Table 2
Correlational relationships between total SAS scores and work productivity variables.

	SAS
Number of work hours lost to smartphone use past 7 days	0.372**
Average weekly minutes worked without interruption from smartphone	− 0.366**
WPAI:GH 4 During the past 7 days how many hours have you actually worked?	− 0.103
WPAI:GH 5 (ADAPTED) During the past 7 days how much did your smartphone use affect your productivity while you were working?	0.436**

** Correlation significant at $p < 0.01$.

SAS and other activities.

SAS scores were also observed to have an impact on other areas of an individual's life. Predictably, SAS scores had a moderate correlation with the number of hours spent on the smartphone for leisure ($r_s = 0.428$, $p < 0.01$). In contrast a very slight relationship was observed between total SAS and hours spent on the smartphone for work ($r_s = 0.130$, $p < 0.05$). A strong relationship emerged for people citing the negative effects of smartphone use on non-work related, everyday activities in their lives, e.g. housework and total SAS scores ($r_s = 0.572$, $p < 0.01$). Table 3 depicts the correlational relationships between SAS scores and everyday life variables.

Table 3
Correlational relationships between total SAS scores and everyday life variables.

	SAS
Number of hours spent on smartphone for leisure	0.428**
Number of hours spent on smartphone for work	0.13*
WPAI:GH 6 (ADAPTED) During the past 7 days how much did your smartphone use affect your ability to do regular daily activities, e.g. housework?	0.572**

* Correlation significant at $p < 0.05$.
** Correlation significant at $p < 0.01$.

SAS scores, work productivity and ill health.

We also assessed the impact of participants' ill health on their work productivity over the past seven days. Participants reported missing on average 1.37 work hours ($SD = 5.18$ h) due to poor health during the week. On average, bad health was thought to affect productivity by 1.64 points ($SD = 2.37$) per week on the eleven-point Likert scale of the WPAI-GH. We subsequently computed partial correlations for the above main variables of interest (SAS and work productivity), this time controlling for the self-reported negative impact of ill health on productivity. The correlation coefficients are reported in Table 4.

Table 4
Partial correlation relationships between SAS scores and work productivity, controlling for the negative impact of ill health on productivity.

	SAS
Number of work hours lost to smartphone use past 7 days	0.301**
Average weekly minutes worked without interruption from smartphone	− 0.412**
WPAI:GH 4 During the past 7 days how many hours have you actually worked?	− 0.050
WPAI:GH 5 (ADAPTED) During the past 7 days how much did your smartphone use affect your productivity while you were working?	0.522**

** Correlation significant at $p < 0.01$.

Post-hoc analyses.

Post-hoc analyses revealed a partial effect of mediation by the variable assessing number of work hours lost to smartphone use in the past seven days (daily interruptions) on the relationship between SAS scores and the negative effect of smartphone use on work productivity (see Fig. 1). SAS scores significantly predicted the number of work hours lost to smartphone use in the past seven days (path a, F (1, 260) $= 25.104$, $p < 0.01$; $R^2 = 0.088$; $b = 0.106$, $t(260) = 5.01$, $p < 0.01$), and daily interruptions significantly predicted the negative impact of smartphone use on work productivity (path b, F (2, 259) $= 84.238$, $p < 0.01$; $R^2 = 0.495$; $b = 0.311$, $t(259) = 9.18$, $p < 0.01$). While SAS scores significantly predicted the self-reported negative impact of smartphone use on work productivity (path c', F (1, 260) $= 97.89$, $p < 0.01$; $R^2 = 0.523$; $b = 0.117$, $t(260) = 9.89$, $p < 0.01$), this effect was greater in the presence of the mediator, daily interruptions (path c, F (2, 259) $= 86.303$, $p < 0.01$; $R^2 = 0.632$; $b = 0.234$, $t(259) = 7.39$, $p < 0.01$). A Sobel test was conducted and indicated a significant effect of mediation ($z = 4.419$, $p < 0.01$), suggesting that the work hours lost to smartphone use goes some way towards explaining the relationship between SAS scores and self-reported negative impact of smartphone use on work productivity.

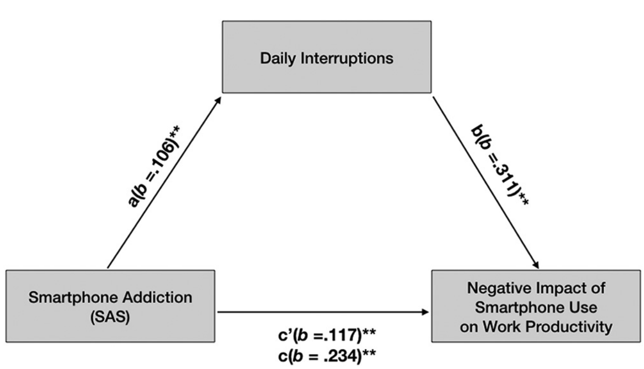

Fig. 1. Mediation analysis with SAS scores as the predictor, daily interruptions (defined as the number of work hours lost to smartphone use) as the mediator, and the self-reported negative impact of smartphone use on work productivity as the dependent variable. a = path a; b = path b; c = total effect, i.e. SAS scores on productivity, mediated by daily interruptions; c' = direct effect of SAS scores on productivity; b = unstandardized regression coefficients.
** $p < 0.01$.

Discussion

This report sought to illustrate the interrelations between smartphone addiction, smartphone interruptions and work-related productivity. We expected that higher tendencies towards smartphone addiction would be associated with a greater level of daily interruptions by the smartphone and with lower reported productivity at work.

In line with these predictions, we observed moderate relationships between smartphone addiction, as measured by SAS scores, and variables associated with the distracting nature of the smartphone. Specifically, a moderate relationship existed between higher SAS scores and participants reporting decreased productivity due to the time spent on the smartphone while at work, as well as people spending fewer minutes working without interruption from the smartphone. Significant relationships were also observed between SAS scores and number of work hours lost due to smartphone usage, as well as a negative relationship between higher SAS scores and the number of hours actually worked in the previous seven days.

Further analysis also indicated significant negative relationships between smartphone use and negative effects on participants' personal lives. Predictably, higher SAS scores were moderately related to a greater amount of leisure time spent on the smartphone. As with time spent on the smartphone during work hours, participants reported a strong relationship between SAS scores and negative effects of smartphone use on daily activities during leisure time.

These data suggest that smartphone use was perceived by participants to have a negative effect on both their work-related and non-work-related productivity. Participants appeared to be spending more time on the smartphone while at work than they felt was optimal, suggesting that despite awareness of the negative effects of smartphone use at work, participants continue to engage in smartphone use behaviours. Post-hoc analyses indicated a significant effect of mediation by the variable assessing the number of hours lost to smartphone use on the relationship between SAS scores and self-reported negative impact of smartphone use on work productivity. This relationship is interesting in light of recent work by Chen et al. (2016), suggesting a deficit in inhibitory control among excessive smartphone users. Such an inhibitory deficit makes sense considering research by Oulasvirta et al. (2012), which suggested that short, frequent "checking" behaviours account for much smartphone use. Indeed, recent work (Markowetz, 2015) indicates that smartphone users exhibit such checking behaviour as often as every 18 min. We have also previously observed that many smartphone users check their phones in the first five minutes after waking and the last five minutes before sleeping (Montag, Kannen et al., 2015). Given the empirical support for such impulsive and frequent smartphone use, we were surprised to note the relatively long period of time (almost 2.5 h) participants in the present study reported spending at work without interruption by the smartphone, especially given participants' perception of the negative effects of phone use on work productivity. We would tentatively suggest that much phone checking behaviour may be automatic and unconscious, leading participants to underestimate the frequency with which they actually interact with their smartphone. Work by Lin et al. (2015) lends some credence to this hypothesis. They examined the relationship between self-reported smartphone use and app-recorded smartphone use among the same group of participants and found that self-reported frequency and duration of smartphone use was significantly underestimated by participants. Previous research from our group also supports the notion that smartphone users seem to have time distortions on these digital devices and problems in assessing their consumption (Montag, Błaszkiewicz, Lachmann et al., 2015). The present study also asked participants how many work hours per week were lost to smartphone use, as well as how much time (in minutes) they spent on the smartphone while at work. These data yielded inconsistent reports, suggesting that participants had either misunderstood the questions or were indeed experiencing time distortion related to their smartphone use; however, as we could not discern whether the participants had in fact understood the items, we did not explore these data further. Further research examining work productivity and smartphone use would be advised to use a more reliable measure of smartphone use, such as tracking the usage by direct recording of the smartphone, a research area which has been dubbed Psychoinformatics (Markowetz et al., 2015; Montag et al., 2016). Such "checking" behaviour poses a clear difficulty in achieving a state of flow at work. Given the substantial correlation observed between SAS scores and the perceived negative influence of the smartphone on work productivity, we suggest that frequent, automatic phone checking behaviours undermine workers' ability to achieve a state of flow in the workplace and, thus, undermines their productivity. We stress that this extrapolation requires further empirical testing.

This relationship between SAS scores and the self-perceived negative influence of smartphone use on productivity also raises questions about users' motivation to engage in smartphone activity during the workday. Several recent studies (e.g. Samaha & Hawi, 2016; Wang, Wang, Gaskin, & Wang, 2015) suggest that smartphone usage may be motivated by perceived stress within academic contexts. It is possible that perceived stress in the workplace may motivate workers to "escape" on to their smartphones. Interestingly, when we controlled for the impact of ill health on work productivity, the correlation between total SAS scores and the perceived negative impact of smartphone use on work productivity increased in size. This suggests to us that participants are not merely engaging in smartphone use when they are feeling unwell or unable to work efficiently, but rather that a more complex motivation is driving their smartphone use, e.g. stress. Additional research is warranted to investigate this theory and to examine exactly what applications users are engaging with while in the workplace, e.g. are they seeking social support from friends on WhatsApp or are they escaping reality with games or videos?

Interestingly, the negative effects of smartphone use on productivity were not limited to work, but also – and more strongly – affected other daily activities outside of work. Participants reported spending an average of approximately 13 h on their smartphone for leisure activities during the week (though, again, this estimate may be subject to time distortion; by directly tracking smartphone use, we previously found that users spend about 160 min per day on their smartphone, suggesting a weekly duration of about 19 h – see Montag, Błaszkiewicz, Sariyska et al., 2015), yet rather than a relaxing leisure pursuit, they perceived that this smartphone use negatively affected other activities in their daily lives. Lee, Chang, Lin & Chen (2014) suggest that smartphone use in and of itself may be a source of stress for users. They describe "technostress", originally conceptualised as the direct or indirect negative influence of technology, including smartphones, computers and the Internet, among others, on one's attitudes, behaviours, thoughts or physiology, including perceptions and emotions pertaining to the increased prevalence of technology in the workplace and society (Fischer & Riedl, 2015; Weil & Rosen, 1997). Earlier work by Thomée et al. (2011; 2010) seems to support the idea of technostress. Their work with young adults indicated that for many young people, the round-the-clock accessibility afforded by mobile phones results in feelings of never being free and guilt at the inability to respond to all calls and messages (Thomée, Dellve, Härenstam, & Hagberg, 2010; for a good overview on technostress see review by Riedl, 2013). Contrary to popular belief, Thomée et al. found no evidence to support a relationship between mobile phone use and increased social support, but rather, that those young adults who reported finding the accessibility promoted by mobile phones to be stressful, were at an increased risk of mental health problems one year later (Thomée et al., 2011). Considering the possible inhibitory control problems among excessive smartphone users (Chen et al., 2016), it is easy to see how this situation could become overwhelming for the user. Again, this is just one possible explanation for the observed results and additional empirical work is required to test these ideas.

The SAS was developed by Kwon et al. (2013), who reported mean scores of 27.89 (females) and 23.75 (males). The observed means for the SAS in the present study were comparable (note: a constant of 10 was added to SAS scores from the present study to enable comparison between the scales). In contrast to the original study, no significant gender difference was observed on SAS scores (although our results approached significance with females scoring higher on the SAS). This result reflects diverging results in the existent literature. For example, Elder, Gardner and Ruth (1987) observed higher levels of technostress among female computer-users compared to their male peers. However, more recent research by Riedl, Kindermann, Auinger, and Javor (2013) revealed contrary results, with males exhibiting higher levels of stress (assessed by galvanic skin response) in reaction to a computer breakdown, compared with their female counterparts. The present study also lends validation to the SAS in the context of an adult (rather than teenaged), German sample. The conflicting results regarding gender differences in SAS scores are also worthy of further research. Previous work by our lab indicates that females are more active on WhatsApp compared with males (Montag, Błaszkiewicz, Sariyska et al., 2015). Future research could investigate whether specific patterns of smartphone use differ between genders and whether different motivations underlie such usage patterns, e.g. females are typically socialised to be more socially responsive, which may foster a more 'social' profile of smartphone use compared with males.

The present study is limited by a number of factors. We have discussed difficulties with the reliability of self-report data elsewhere (see Montag et al., 2016); most relevant for the present study, we wish to emphasize the difficulty with which many individuals recall past events, even over such as short time period as a week. As discussed above, smartphone use estimates are subject to time distortion by users (Lin et al., 2015) and given potential negative implications associated with the term "addiction", participants' responses may be subject to social desirability bias (though, given the comparable responses between our data set and that of Kwon et al., 2013, this seems less likely). We also wish to note that the average self-reported negative impact of smartphone use on work productivity was quite low ($M = 1.88$, $SD = 2.11$). With these limitations in mind, it is important that we do not overemphasise these results, but look to them as a starting point for further, more objective psychoinformatic research. Furthermore, it should be acknowledged that we do not know what applications participants were using on their smartphones during this time period. Given the aforementioned "technostress" associated with the social applications of the smartphone (Lee, Chang, Lin, & Cheng, 2014; Thomée et al., 2011; 2010), future research should seek to objectively quantify how much time is spent on what apps when users are engaged in smartphone use. Finally, it is very difficult to operationalize productivity. We used a well-known and accepted scale for assessing productivity via a self-report. More objective measures related to a specific profession are also of importance and should be considered by future research.

Conclusion

The present study sought to explore the interrelatedness of smartphone addiction, smartphone interruptions and work-related productivity. Moderate correlational relationships illustrated the relationships between these variables, so that smartphone addiction was associated with self-reported negative effects on productivity, both in the work place and in participants' daily lives.

Conflict of interest

None.

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Contributions.

CM designed the present study. CM and ÉD drafted the manuscript. ÉD carried out the statistical analysis.

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