

Preprint: Unhappy and addicted to your phone? – Higher mobile phone use is associated with lower well-being

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### Abstract

With mobile phones becoming central parts of our lives, mobile technology gets criticized for its negative impact on people's well-being. Studies generally report negative associations between mobile phone use (MPU) and well-being. However, few studies contrast the relationship of MPU with different concepts of positive psychology. The aim of this study was to investigate the relationship between MPU and different concepts of positive psychology: life satisfaction, well-being, and mindfulness. Data from 461 German speaking participants answering an online-questionnaire were analyzed. Overall, results suggest that participants who use their mobile phones more often, report lower well-being, life satisfaction, and mindfulness scores. Furthermore, results imply that the relationships between positive psychology concepts and MPU differ between men and women. Results indicate that MPU and its associations with concepts of positive psychology are relevant areas for research and deserve more attention.

### Highlights

- Mobile phone use is negatively correlated with well-being, life satisfaction, and mindfulness
- Well-being and mindfulness are significant predictors of mobile phone use
- For men, well-being is a mediator of the association between mindfulness and mobile phone use
- For women, mindfulness has a direct relationship with mobile phone use

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## 1. Introduction

Mobile phones are part of our everyday life and communication. About 95% of Americans own a mobile phone (Pew Research Center, 2018) and 26% of users report that they are online “almost constantly” (Perrin & Jiang, 2018). While mobile phones are very common, their extensive use is sometimes perceived in a negative light. This is transparent, for example, in language developments. *Phubbing*, derived from the words “phone” and “snubbing”, describes the behavior of using one's mobile phone while others are present. *Smombie*, the German youth word of 2015 derived from the words “smartphone” and “zombie”, refers to people who are too distracted by their smartphones to be aware of their surroundings (Spiegel, 2015). Such terms express the notion that at least some people spend more time on their phone than is good for them.

MPU is defined as problematic when users are unable to regulate their mobile phone usage, which might lead to negative consequences in everyday life (Billieux, 2012). While researchers generally agree that MPU can be problematic, there is less consensus about what problematic MPU actually is (De-Sola Gutiérrez, Rodríguez de Fonseca, & Rubio, 2016). Problematic MPU is a heterogeneous and multifaceted syndrome (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015) and is commonly defined as a behavioral addiction, like pathological gambling. Researchers also compare it to substance abuse or dependency, and compulsive or impulsive behavior (De-Sola Gutiérrez et al., 2016). Thus, it is not yet clear how problematic MPU should be defined.

As a consensus about the definition of a problematic MPU has yet to be found, this has implications for research. One problem of current research on the psychological effects of problematic MPU is that different terms are used for mobile phone (e.g., cell phone, smart phone, etc.) and for the negative effects (e.g. mobile phone dependence, mobile phone addiction, etc.). Furthermore, there are no norm scales developed yet. In some cases, authors developed questionnaires for a problematic MPU without defining at what point of use the behavior becomes problematic or dependent, thus calling any use (more or less) problematic. Likewise, it is not surprising to find negative associations between mobile phone dependency and well-being, as psychological disorders affect people's and/ or society's well-being per definition (American Psychiatric Association, 2013). This study, however, focuses on MPU itself and neither on problematic nor on disordered use.

Though studies' conceptualizations of problematic MPU differ, sociodemographic findings regarding MPU differences for age and gender remain relatively consistent. Two

review articles concluded that younger people show higher levels of MPU and that women use their mobile phones to a greater extent than men (Billieux, 2012; De-Sola Gutiérrez et al., 2016). Furthermore, men and women seem to differ in the way they use their mobile phones. One study found that women use more internet services and indirect communication (such as email), whereas men use more voice phone services (Toda, Monden, Kubo, & Morimoto, 2006). Another study found similar gender differences and argued that the dependence potential of different mobile phone activities varies across gender (Roberts, Yaya, & Manolis, 2014). Thus, it appears that gender differences for MPU exist, however, the way MPU relates to other concepts is not clear but might also be influenced by gender.

### 1.1. Well-being, satisfaction with life, and mindfulness

Since mobile phones are becoming more important for people's lives, it is of interest how MPU relates to psychological constructs, such as a user's well-being, life satisfaction, and mindfulness. Well-being is not merely the absence of psychological problems (Bech, Olsen, Kjoller, & Rasmussen, 2003), but describes optimal functioning and experience (Ryan & Deci, 2001). Well-being can be conceptualized from a hedonic (focusing on happiness) and a eudaimonic (focusing on self-realization) approach (Ryan & Deci, 2001). Commonly, well-being is defined by an individual's cognitive and affective evaluation of his/her life (Diener, 2000). A person's well-being is understood to be relatively stable: well-being changes due to positive and negative experiences, but long-term changes are not common (Diener, Lucas, & Scollon, 2006). Satisfaction with life (SWL) is the cognitive component of subjective well-being (Pavot, Diener, Colvin, & Sandvik, 1991). Thus, SWL is a person's conscious evaluation of his/her life (Pavot & Diener, 1993). Measures of affective well-being and SWL correlate moderately, but have different set-points (Diener, Lucas, & Scollon, 2009), meaning that studying both concepts is not redundant (Pavot & Diener, 1993).

Mindfulness has three main components: a person pays *purposefully* attention to the *present* and *without judgment* (Kabat-Zinn, 2003). A person's level of mindfulness is dispositional (Brown & Ryan, 2003), but can be influenced by practicing mindfulness (Baer et al., 2008). Several studies suggest that higher mindfulness is associated with a better well-being (e.g., Baer et al., 2008; Baer, Lykins, & Peters, 2012; Brown & Ryan, 2003). Hence, a mindfulness training might not only enhance mindfulness but also well-being and SWL (Carmody & Baer, 2008; Harnett et al., 2010).

### 1.2. Relationship of MPU with well-being, satisfaction with life, and mindfulness

To explore the association of MPU with well-being, SWL, and mindfulness, we conducted a systematic literature search. We searched databases (Web of Science, PsycINFO, PsycARTICLES) for the keywords smartphone OR phone AND life satisfaction OR well-being OR happiness OR mindfulness. This search led to 432 results. Abstracts were then screened for relevance. Studies were excluded when the focus did not lie on the relationship between MPU and well-being, SWL, or mindfulness, e.g., studies that evaluated mental health apps or medical support. After checking exclusion criteria and duplicates, 35 studies remained. The remaining articles were then checked in more detail. Studies not published in English in peer-reviewed journals were excluded. As the aim of the present study was to focus on an individual's MPU and well-being, life satisfaction, and mindfulness, studies that focused on MPU and for instance relationship well-being or conversation satisfaction were also excluded. Furthermore, studies that drew conclusions about well-being without assessing well-being (e.g., measuring depression instead) were excluded. This resulted in 15 relevant studies, see Table 1.

Table 1

*Overview of studies investigating the relationship between mobile phone use with well-being, satisfaction with life, and mindfulness.*

Reference	Design	Sample			Central measures	Observations concerning MPU
		Size	Features	Location		
Bauer, Loy, Masur, and Schneider (2017)	Questionnaires on 5 consecutive days	211	<i>M</i> <sub>age</sub> = 23 years; 54% female; high level of education	Germany	Instant messaging-related positive affect, stress, mindfulness	<ul style="list-style-type: none"> <li>- Mindful use of instant messaging was positively related to positive affect and negatively related to stress</li> <li>- MPU itself was not assessed</li> </ul>
Chan (2015)	Cross-sectional	514	<i>M</i> <sub>age</sub> = unclear; 52% female; Hong Kong residents aged between 18 and 70	Hong Kong	Social capital, well-being, mobile phone use	<ul style="list-style-type: none"> <li>- both voice and online communication with the mobile phone is positively related to various indicators of subjective well-being</li> <li>- non-communicative use was inversely related to well-being</li> <li>- social capital mediated the relationship between mobile phone use and well-being</li> </ul>
Chan (2018)	Cross-sectional	926	<i>M</i> <sub>age</sub> = between 45-49 years (no number); 52% female; Hong Kong residents from the age of 18	Hong Kong	Well-being, affect, relationship quality, communication	<ul style="list-style-type: none"> <li>- number of WhatsApp groups an individual belonged to was related to well-being for subjects aged 35-54 years</li> <li>- subjects aged 55+ years did not exhibit any negative consequences from mobile mediated communications</li> <li>- smartphones complement face-to-face communications in increasing friendship satisfaction, social support, and well-being</li> </ul>
Cheng and Hong (2017)	Cross-sectional	332	Age: mostly between 18 and 22 years; 35% female; university	Taiwan	daily life stress, smart mobile phone addiction, life satisfaction	<ul style="list-style-type: none"> <li>- No correlation between smart mobile phone addiction scales and life satisfaction were found</li> <li>- Time management problems due to smart mobile phone addiction was a significant positive predictor of life satisfaction</li> </ul>

			students in northern Taiwan			
Elhai, Levine, O'Brien, and Armour (2018)	Repeated- measures web- survey (T2 one month after T1)	261	$M_{age} = 20$ years; 77% female; college students	USA	Smartphone addiction, smartphone use frequency, mindfulness, anxiety sensitivity, distress tolerance	<ul style="list-style-type: none"> <li>- Mindfulness was inversely associated with levels of problematic smartphone use</li> <li>- Mindfulness mediated relations between both depression and anxiety sensitivity with problematic smartphone use severity</li> </ul>
Kang and Jung (2014)	Cross-sectional	US: 565 Korea: 376	USA: $M_{age} = 27$ years; 58% female; university students Korea: $M_{age} =$ 23 years; 56% female; university students	USA & Korea	Basic needs, smartphone use, SWL	<ul style="list-style-type: none"> <li>- Smartphone use was positively associated with SWL in both samples</li> <li>- Both samples believed that the smartphone fulfills the needs of safety and self-actualization that predict smartphone use and life satisfaction</li> </ul>
Lachmann et al. (2018)	Cross-sectional	China: 612 Germany: 304	China: $M_{age} = 22$ years; 26% female; university students Germany: $M_{age}$ $= 24$ years; 68% female; university students	China & Germany	Smartphone addiction, internet addiction, SWL	<ul style="list-style-type: none"> <li>- Negative associations between smartphone use disorder and life satisfaction were found only in the Chinese sample</li> </ul>

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Lepp, Barkley, and Karpinski (2014)	Cross-sectional	536	<i>Age</i> = 21 years; ca. 63% female; undergraduate students	USA	Cell phone use, texting, academic performance, anxiety, SWL	<ul style="list-style-type: none"> <li>- Cell phone use/ texting were negatively related to academic performance and positively related to anxiety</li> <li>- Academic performance was positively related to SWL</li> <li>- Anxiety was negatively related to SWL</li> </ul>
Li, Lepp, and Barkley (2015)	Cross-sectional	516	<i>Age</i> = 20 years; 80% female; undergraduate students	USA	Locus of control, SWL, sleep quality, cell phone use, cell phone use habits, academic performance	<ul style="list-style-type: none"> <li>- Individuals with greater external locus of control, in comparison to subjects with greater internal locus of control, have less control over their cell phone use</li> <li>- Individuals with greater external locus of control report lower SWL</li> </ul>
Liu et al. (2018)	Cross-sectional	899	<i>Age</i> = 17 years; 54% female; 10 <sup>th</sup> – 12 <sup>th</sup> graders in a senior high school	China	Perceived stress, mobile phone addiction, self-control, mindfulness	<ul style="list-style-type: none"> <li>- Self-control partially mediated the association between perceived stress and mobile phone addiction.</li> <li>- The direct association between perceived stress and mobile phone addiction and the indirect effect of self-control were moderated by mindfulness: the relations were stronger for individuals with low mindfulness than for those with high mindfulness</li> </ul>
Pearson, Mack, and Namanya (2017)	Cross-sectional	92 households	No mean age and gender distribution reported; 35% of households owned phones; 47% of households relied on land	Uganda	Well-being, mobile phone ownership	<ul style="list-style-type: none"> <li>- Mobile phone ownership was associated with increased well-being for persons <i>without</i> family nearby</li> <li>- Mobile phone ownership was not significantly associated with increased mental well-being for persons with family nearby.</li> </ul>

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			cultivation for primary livelihood			
Roser, Schoeni, Foerster, and Rööslı (2016)	Cross-sectional	412	<i>Age</i> = 14 years; 61% females; 7 <sup>th</sup> – 9 <sup>th</sup> graders in secondary schools in Central Switzerland	Switzerland	Problematic MPU, well-being, health and behavioral problems	- Problematic MPU was inversely associated with well-being
Rotondi, Stanca, and Tomasuolo (2017)	Cross-sectional	148,088	<i>Age</i> = not reported; 51% female; representative sample of Italians from the age of 16 - 75	Italy	Smartphone use, SWL, time spend with friends	- Smartphone use was positively associated with SWL - The interaction of smartphone use and time spent with friends is negatively associated with SWL
Samaha and Hawi (2016)	Cross-sectional	249	<i>Age</i> = 21 years; 46% female; university students	Lebanon	Risk of smartphone addiction, perceived stress, SWL, academic performance	- Risk of smartphone addiction was not directly associated with SWL - Perceived stress and academic performance mediated the relationship between risk of smartphone addiction and SWL
Twenge, Martin, and Campbell (2018)	Cohort study	1.1 million	Mean age and gender distribution not reported, 8 <sup>th</sup> – 12 <sup>th</sup> graders	USA	Well-being, activities (e.g., new media, TV, homework, exercise)	- Adolescents who spent more time on information technology and less time on non-screen activities reported lower well-being (highly significant, but small relations) - Adolescents who spent a small amount of time on electronic communication were the happiest



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*Note.* SWL = satisfaction with life. MPU = mobile phone use.

The literature review yielded mixed results regarding the association between MPU and concepts of positive psychology. Regarding well-being, some studies report clear negative associations with media activity (Roser et al., 2016; Twenge et al., 2018). Other studies create a more nuanced view. For example, in one study, owning a mobile phone was associated with better well-being in subjects without nearby family members (Pearson et al., 2017). However, this finding might not be transferable to the Western culture, as the study was conducted in a developing country. Two other studies suggest that MPU is positively associated with well-being (Chan, 2015, 2018). Thus, there are hints that MPU and well-being show a positive association, but also contrary results. In general, however, the relationship appears negative.

Regarding SWL, two studies found a positive association with MPU (Kang & Jung, 2014; Rotondi et al., 2017). However, one of these studies also suggested that the interaction between smartphone use and time spent with friends is inversely associated with SWL (Rotondi et al., 2017). One study found a negative direct association between SWL and MPU in one of their samples (Lachmann et al., 2018). Other studies reported no direct relationship between SWL and MPU, but mediated associations by academic performance, stress, and anxiety (Lepp et al., 2014; Samaha & Hawi, 2016). In these cases, higher MPU was related to more stress and anxiety as well as lower academic performance. In turn, more stress and anxiety, as well as lower academic performance, were associated with less SWL. In one more case, the direct relationship between SWL and MPU was not significant, but the authors found a relationship between the subject's locus of control and MPU (Li et al., 2015). In this study, subjects with greater external locus of control (LC) had less control over their MPU than participants with greater internal LC. Consequently, participants with greater external LC used their mobile phones more at night and during class, which in turn was associated with worse sleep quality and academic performance. These measures were then associated with students' SWL. Considering these studies, the relationship between MPU and SWL is less clear. Overall, research suggests that MPU is negatively associated with SWL.

Regarding mindfulness, only a few studies have investigated the association with MPU. To the best of our knowledge, only one prior study investigated the relationship between MPU and mindfulness directly and found a negative association between mindfulness and mobile phone use frequency (Elhai et al., 2018), meaning that the more mindful a person is, the less often he/she uses his/her mobile phone. The same study reported a negative relation between mindfulness and participants' mobile phone addiction score. This is in line with prior research on mindfulness and other addiction research (Arslan, 2017;

Karyadi, Vanderveen, & Cyders, 2014). One study found a negative relation between mindfulness and mobile phone addiction (Liu et al., 2018). This study also showed that mindfulness moderated the relationship between perceived stress and mobile phone addiction; the association between stress and MPU was stronger for people with lower mindfulness. Another study investigated the relationship of mindful use of instant messaging with well-being and found a positive association (Bauer et al., 2017). This finding is in line with general research on mindfulness and well-being that shows that higher mindfulness is related to an increased well-being (Baer et al., 2012). Thus, there is evidence that suggests that mindfulness is inversely associated with MPU and that a mindful use of mobile phones is related to well-being.

The present study aims to test previously found associations between MPU and well-being, SWL, and mindfulness. This is a necessary step, as found associations in the previous research described above are not always consistent. Hence, an investigation of these relationships is valuable. Another objective lies in the exploration of the associations between well-being, mindfulness, and MPU. The above presented empirical findings suggest that a person's mindfulness influences well-being. Well-being, in turn, appears to be associated with MPU. Therefore, we assume that well-being is a mediator of the association between mindfulness and MPU. To the best of our knowledge, no study has yet investigated this proposed potential pathway. This proposed mediation model is somewhat different from other studies investigating positive psychology concepts and their relationship with MPU (e.g., Lepp et al., 2014; Samaha & Hawi, 2016) that propose that MPU affects SWL. We propose mindfulness as the independent variable, well-being as the mediating variable, and MPU as the dependent variable, since well-being is a dispositional construct (Diener et al., 2006) and since this study focuses on dispositional mindfulness. In conclusion, based on previous empirical and theoretical work, this study aims to investigate the proposed mediation effect by well-being on the relationship between mindfulness and MPU.

Additionally, as MPU appears to differ between genders, it might be the case that the relations of MPU with well-being and mindfulness are different for men and women. As described above, previous studies did find gender differences for MPU. However, these differences have not yet been considered in studies investigating associations between MPU and positive psychology concepts. Thus, this study also investigates whether the proposed mediation model differs between genders.

### 1.3.Current Study

Given the literature sketched above, the present study investigates the association between well-being, SWL, mindfulness, and MPU. We expect to find that MPU is negatively correlated with well-being (H1), life satisfaction (H2), and mindfulness (H3). Furthermore, the following three research questions regarding the association between the variables of interest were raised:

RQ1: To what extent do well-being, SWL, and mindfulness explain differences in MPU?

RQ2: Does gender influence the relation between MPU and well-being, SWL, and mindfulness?

RQ3: Is well-being a mediator for the association between mindfulness and MPU?

## 2. Methods

### 2.1. Participants and Design

As psychological MPU research is still at the beginning there are not many research paradigms yet. The biggest problem in this context is that most participants are not willing to participate in a longitudinal experimental study, where MPU could be manipulated and its causal impact investigated. Because this would mean that participants would have to refrain from using their mobile phones for a certain time. Therefore, data for the present study were obtained via a cross sectional online survey where participants gave self-reports by answering a questionnaire. In total, 491 respondents participated in the survey. Exclusion criteria were (a) not completing the survey, (b) not owning a mobile phone, (c) not answering the questions earnestly (assessed via an item “Did you answer the questionnaire earnestly?” at the end of the questionnaire), (d) being younger than 15, and (e) answers that suggest that the survey was not taken seriously (screened via the free text entries) (f) outlier detection (regression analysis with the independent variables well-being, SWL, and mindfulness and the dependent variable mobile phone use: participants with leverage values above critical values and cook’s distances above 1 were excluded). This resulted in 461 included participants. Most participants were female (71.4%) and university students (52.9%) or employees (27.3%). Their age ranged from 15 to 77 years, with  $M_{\text{age}} = 30.00$ ,  $SD_{\text{age}} = 11.97$ .

### 2.2. Material and procedure

The survey consisted of five parts (demographic information, WHO-Five well-being index, Satisfaction With Life Scale, Freiburg Mindfulness Inventory, and Test of Mobile

Phone Dependence. To measure participants' well-being, the German version of the *WHO-Five well-being index* (WHO-5) was used (Brähler, Mühlhan, Albani, & Schmidt, 2007). The WHO-5 assesses well-being with five items which refer to the past two weeks (e.g., "Have you been a happy person?"; Brähler et al., 2007). Items are rated on a 6-point Likert scale (ranging from 1 = *at no time* to 6 = *all of the time*). Higher scores indicate higher well-being in the past two weeks. For the present study, the German translation by Brähler and colleagues (2007) was used. The internal consistency for the WHO-5 in the present study was acceptable,  $\alpha = .80$ .

To assess participants' SWL, the German version of the *Satisfaction with Life Scale* (SWLS) developed by Diener, Emmons, Larsen, and Griffin (1985) was used (Glaesmer, Grande, Braehler, & Roth, 2011). The SWLS assesses SWL in five global statements (e.g., "In most ways my life is close to my ideal") that are rated on a 7-point Likert scale (ranging from 1 = *strongly disagree* to 7 = *strongly agree*). High scores on the SWLS indicate a higher SWL. In the present study, the SWLS had an internal consistency of  $\alpha = .86$ .

To measure mindfulness the German version of the short version of the *Freiburg Mindfulness Inventory* (FMI; Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006) by Heidenreich, Ströhle, and Michalak (2006) was used. The FMI short version assesses mindfulness using 14 items (e.g., "I see my mistakes and difficulties without judging them") that are rated on a 4-point Likert scale (ranging from 1 = *rarely* to 4 = *almost always*). Higher scores on the FMI indicate higher mindfulness levels. The FMI had an internal consistency of  $\alpha = .84$ .

To assess participants' MPU behavior a German translation of the brief version of the *Test of Mobile Phone Dependence* (TMDbrief; Chóliz, 2012) was used<sup>1</sup>. The TMDbrief consists of 12 items (e.g. "I have gone to bed later and slept less because I was using my mobile phone") that are rated on a 5-point Likert scale (ranging from 1 = *completely disagree* to 5 = *completely agree*) and assesses the three main features of mobile phone dependence: a) abstinence syndrome, b) lack of control, c) tolerance development, interference with other activities (Chóliz et al., 2016). Higher scores on the TMDbrief indicate higher mobile phone use. The internal consistency for our German version of the TMDbrief was  $\alpha = .87$ .

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<sup>1</sup> Two people with good command of German and English separately translated the TMDbrief into German.

The online survey was conducted from April 2017 through June 2017. Participants were recruited through flyers at a Bavarian University and at the vocational school of Freising, an invitation to the subscribers of the information service of the University, an advertisement for participation on the website of the magazine “Psychologie Heute”, an article about the topic with a link to the survey on the website Geist und Gegenwart (Volkmer, 2017) and a notice about the survey on a blog. Participants were recruited at a Bavarian University and at the vocational school of Freising, as there was access to data pools at these locations. Students from the Bavarian University received course credits for participation.

To analyze the data SPSS 24.0 for Windows was used. For the mediator analysis the SPSS Macro PROCESS, Version 2.16, by Andrew Hayes (Hayes, 2017) was used and the theoretical framework of a simple mediation as described in Hayes (2013) was considered. The main difference of this framework to the classical framework by Baron and Kenny (1986) is that a simple relationship between the independent variable X and the dependent variable Y is not a precondition of the mediation analysis. In this study, PROCESS model 4 was used with well-being as the mediator variable (M), mindfulness as the independent variable (X), and MPU as the outcome variable (Y). Bootstrap samples were set to 5000 with the bias-corrected confidence interval method.

### 3. Results

#### 3.1. TMDbrief evaluation

Before the actual analysis, we replicated the principal component analysis for the TMDbrief as conducted by Chóliz and colleagues (2016). We were not able to reproduce the four-component structure Chóliz and colleagues (2016) obtained. Data of the present study showed a 2-component solution: *abstinence* (in line with Chóliz and colleagues (2016)) and a second component consisting of all remaining items. Thus, only the sum score was considered,  $\alpha = .86$ . However, one item was removed from the analysis (“Since I got my mobile phone, I have increased the number of SMSs I send”), because participants commonly misunderstood the item. Therefore, a summation of the remaining eleven items was used in the further analysis (TMD-11),  $\alpha = .87$ .

#### 3.2. Descriptive statistics

The descriptive statistics for well-being, SWL, mindfulness, and MPU are presented in Table 2. Previous studies suggest that gender differences for MPU exist, showing that women

are more frequently dependent on their mobile phones than men (Billieux, 2012). Thus, gender differences for the present sample were checked before further analysis. The difference between female and male participants was significant for MPU,  $t(457) = 2.07, p = .039, d = 0.44$ , and SWL,  $t(457) = 1.98, p = .049, d = 0.20$ . Previous research suggests that there are no general gender differences for SWL (Pavot & Diener, 1993). In this study, the results bordered on non-significant.

Table 2

*Descriptive statistics for study variables*

	<i>M</i>	<i>SD</i>	Range	
			Potential	Observed
Well-being	13.81	4.36	0 – 25	2 – 24
SWL <sub>all</sub>	24.13	5.82	5 – 35	7 – 35
SWL <sub>F</sub>	24.50	5.68		7 – 35
SWL <sub>M</sub>	23.32	5.98		9 – 35
Mindfulness	37.99	6.04	14 – 56	23 – 53
MPU <sub>all</sub>	16.29	8.69	0 – 44	0 – 42
MPU <sub>F</sub>	18.84	8.93		0 – 42
MPU <sub>M</sub>	14.98	7.94		0 – 37

*Note.* SWL = satisfaction with life. MPU = mobile phone use. Potential Range = range of the questionnaire. Observed range = range observed in this studies' sample. F = female, M = male.

### 3.3. Association between MPU, well-being, SWL, and mindfulness

In order to explore Hypotheses 1-3 (MPU correlates negatively with well-being, H1; satisfaction with life, H2; mindfulness, H3) Pearson correlations were conducted. Table 3 shows that well-being, SWL, and mindfulness are all negatively associated with MPU. However, the correlation between SWL and MPU is not significant for female participants. Hence, Hypotheses 1 and 3 are accepted, Hypothesis 2 is only accepted for the male subsample.

Table 3

*Zero-order correlations among study variables for the whole sample as well as the female and male subsamples*

Whole sample correlations	2	3	4
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1. Well-being	.58**	.53**	-.23**
2. SWL	-	.46**	-.12**
3. Mindfulness		-	-.22**
4. MPU			-
Female sample correlations	2	3	4
1. Well-being	.55**	.48**	-.18**
2. SWL	-	.41**	-.11
3. Mindfulness		-	-.22**
4. MPU			-
Male sample correlations	2	3	4
1. Well-being	.64**	.62**	-.35**
2. SWL	-	.58**	-.23*
3. Mindfulness		-	-.25**
4. MPU			-

*Note.* SWL = satisfaction with life. MPU = mobile phone use.

### 3.4.RQ1: Explaining MPU with well-being, SWL, and mindfulness and RQ2: Gender influences

To explore Research Question 1, asking how much of MPU variance can be explained by well-being, SWL, and mindfulness, a hierarchical, block-wise regression analysis was conducted. Well-being was added in the first step, as previous research as reported earlier suggests a relationship between MPU and well-being (e.g., Chan, 2015; Roser, Schoeni, Foerster, & Röösl, 2016; Twenge, Martin, & Campbell, 2018). In the second step, SWL was added as it was also a significant predictor in previous research (e.g., Kang & Jung, 2014; Lachmann et al., 2018). Mindfulness was added in a third step. To answer Research Question 2, the regression analysis was not only performed for the whole sample, but also for the male and female subsamples.

Regarding the whole sample, regression results revealed, as the correlational results above suggest, that well-being is a significant predictor of MPU (see Table 4). This finding is in line with previous studies (Roser et al., 2016; Twenge et al., 2018), suggesting an association between well-being and MPU. In this study, MPU decreased when well-being increased. However, for the female sample well-being did not significantly explain MPU



variance when mindfulness was added to the regression analysis. In the present study, SWL did neither for the whole sample nor for one of the subsamples provide information on top of well-being. Including mindfulness as a predictor increased explained variance significantly for the female, but not for the male subsample. For the female subsample, well-being, SWL, and mindfulness explained 6% of the variation in MPU. For the male subsample, well-being explained 13% of the variation in MPU, without SWL and mindfulness adding significantly to the explained variance.

Table 4

*Regression analysis for the whole sample and subsamples*

Whole sample	<i>b</i>	<i>SE b</i>	B	<i>p</i>
Step 1: $R = 0.23$ , $R^2 = 0.05$ , $F(1, 459) = 25.25$ , $p < .001$				
Constant	22.57	1.31		< .001
Well-being	-.46	0.09	-.23	< .001
Step 2: $R = 0.23$ , $R^2 = 0.05$ , change in $F$ : $F(1, 458) = 0.11$ , $p = .747$				
Constant	22.21	1.72		< .001
Well-being	-.48	0.11	-.24	< .001
SWL	.03	0.08	.02	.747
Step 3: $R = 0.26$ , $R^2 = 0.07$ , change in $F$ : $F(1, 457) = 7.96$ , $p = .005$				
Constant	27.67	2.59		< .001
Well-being	-.36	0.12	-.18	.003
SWL	.08	0.08	.05	.351
Mindfulness	-.221	0.08	-.15	.005
<hr/>				
Female subsample	<i>b</i>	<i>SE b</i>	B	<i>p</i>
Step 1: $R = 0.18$ , $R^2 = 0.03$ , $F(1, 327) = 11.06$ , $p = .001$				
Constant	22.11	1.66		< .001
Well-being	-.38	2.22	-.18	= .001
Step 2: $R = 0.18$ , $R^2 = 0.03$ , change in $F$ : $F(1, 326) = 0.03$ , $p = .864$				
Constant	22.36	2.22		< .001
Well-being	-.37	0.14	-.18	.008
SWL	-.02	0.10	-0.01	.864
Step 3: $R = 0.24$ , $R^2 = 0.06$ , change in $F$ : $F(1, 325) = 8.05$ , $p = .005$				
Constant	29.09	3.23		< .001
Well-being	-.23	0.15	-.11	.106

SWL	.04	0.10	.03	.682
Mindfulness	-.27	.09	-.18	.005
Male subsample	<i>b</i>	<i>SE b</i>	<i>B</i>	<i>p</i>
Step 1: $R = 0.35$ , $R^2 = 0.13$ , $F(1, 128) = 18.37$ , $p = .001$				
Constant	23.27	2.04		< .001
Well-being	-.59	0.14	-.35	< .001
Step 2: $R = 0.36$ , $R^2 = 0.13$ , change in $F$ : $F(1, 127) = 0.04$ , $p = .853$				
Constant	22.95	2.67		< .001
Well-being	-.62	0.19	-.37	.001
SWL	.03	0.15	.02	.853
Step 3: $R = 0.36$ , $R^2 = 0.13$ , change in $F$ : $F(1, 126) = 0.06$ , $p = .806$				
Constant	23.80	4.38		< .001
Well-being	-.60	0.21	-.36	.004
SWL	.04	0.15	.03	.807
Mindfulness	-.04	0.15	-.03	.806

Note. SWL = satisfaction with life.

### 3.5.RQ3: Mediation Analysis

To investigate Research Question 3, asking whether well-being is a mediator for the association between mindfulness (independent variable) and MPU (dependent variable), a mediation analysis was conducted. Well-being was assumed to serve as a mediator since prior research suggests that an increase in mindfulness leads to an improvement in well-being (Baer et al., 2008; Brown & Ryan, 2003). To investigate the gender influence, the mediation analysis was also conducted separately for women and men.

As correlational results in Table 3 above suggest, mindfulness is a significant predictor of well-being. Mindfulness explained 28% of the variance in well-being for the whole sample, 23% for the female, and 39% for the male subsample. Mindfulness (without well-being) explained 6% of the variance in MPU in the whole sample, 5% in the female, and 6% in the male subsample. For the whole sample, the indirect effect of mindfulness on MPU was significant,  $b = -.25$ , 95%-CI = [-.40; -.10]. For women, the indirect effect of mindfulness on MPU was not significant,  $b = -.07$ , 95%-CI = [-.17; .02]. For men, the indirect effect was significant,  $b = -.25$ , 95%-CI = [-.41; -.10]. Thus, results indicate that the mediation effect is

not significant for the female subsample, but for the male. In the whole sample, the mediation effect is significant. The mediation model can be found in Figure 1 for the female subsample and in Figure 2 for the male subsample.

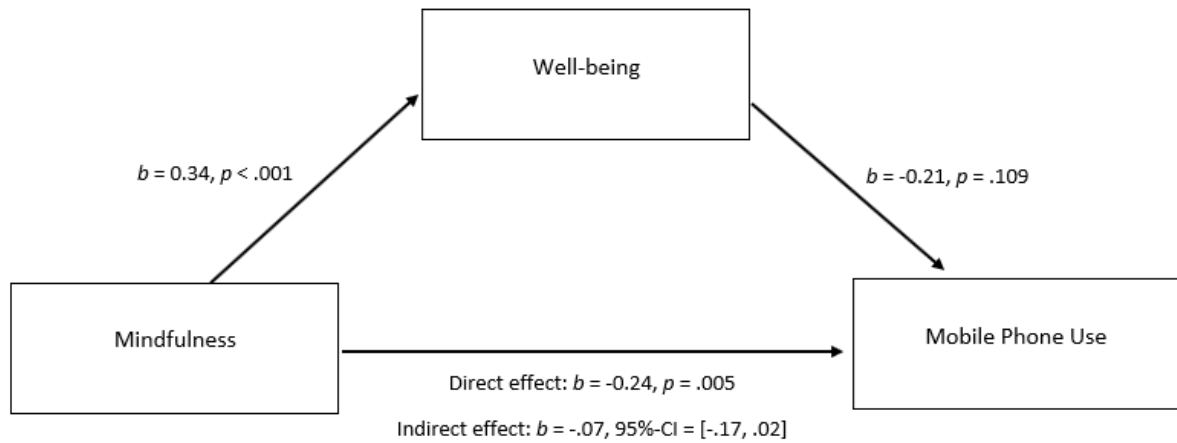


Figure 1. Mediation effect of well-being on the relationship between mindfulness and mobile phone use for the female subsample.

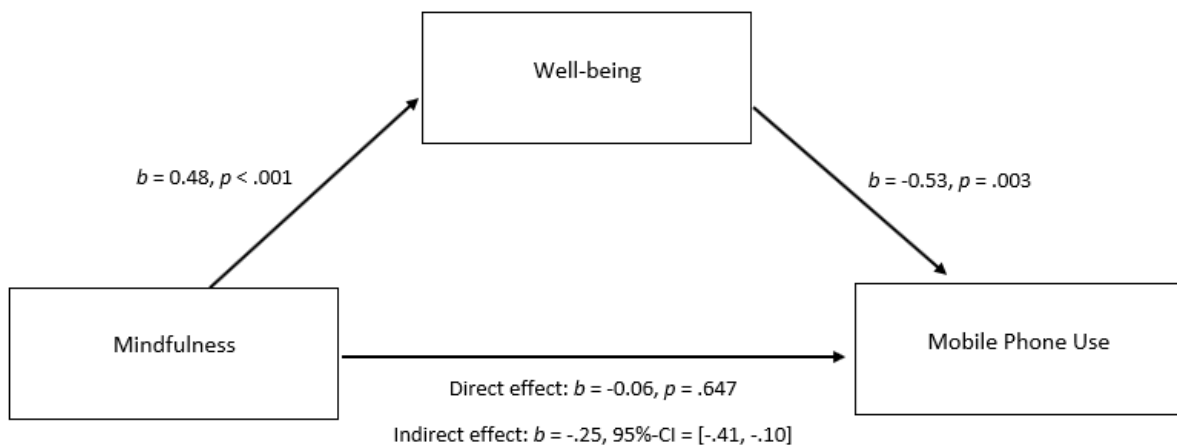


Figure 2. Mediation effect of well-being on the relationship between mindfulness and mobile phone use for the male subsample.

#### 4. Discussion

This study investigated the relationship between MPU and positive psychology concepts, namely well-being, SWL, and mindfulness. The present findings suggest that people who use their mobile phone to a greater extent, experience lower well-being, SWL, and mindfulness. The present study is the first investigating the relationships of all three of these concepts with MPU. Five major findings emerge from this study: 1) MPU is negatively correlated with well-being and mindfulness; 2) MPU is negatively correlated with SWL in

men; 3) women's MPU can be explained by well-being and mindfulness; 4) men's MPU can be explained by well-being; 5) the relation between mindfulness and MPU is mediated by well-being in men.

Previous studies' findings, screened via a systematic literature review, led to the assumption that well-being is negatively associated with MPU (Roser et al., 2016; Twenge et al., 2018). Further, previous research showed that mindfulness is positively associated with well-being (Baer et al., 2012) and negatively with MPU (Elhai et al., 2018). These findings led to our mediation model that proposed well-being as the mediator for the relationship between mindfulness and MPU. This model differs from other studies on MPU and positive psychology constructs that declare MPU as the independent and well-being as the dependent variable. The intuitive interpretation that more extensive MPU negatively influences well-being has a theoretical challenge: while we assume that a person's well-being set-point can be changed (Diener et al., 2006), well-being, SWL, and mindfulness are understood to be relatively stable constructs (Brown & Ryan, 2003; Diener et al., 2006; Pavot & Diener, 1993). Thus, it seems unlikely that an acute increase in information technology use has a direct, substantial impact on a person's well-being, SWL, or mindfulness. Generally, the results of this study corroborate previous research, but with the present study a different theoretical framework is proposed. To understand the relationship between positive psychology constructs and MPU better, future studies should also investigate potential causal effects. Therefore, experimental manipulations of MPU are needed.

Previous findings regarding the association between MPU and SWL yielded different results (Kang & Jung, 2014; Rotondi et al., 2017; Samaha & Hawi, 2016). In this study, SWL was only related to MPU in the male subsample. While gender differences in MPU have been reported previously (Billieux, 2012; De-Sola Gutiérrez et al., 2016), the present study is the first to discover different relations for positive psychology constructs and MPU between genders: results showed that the relationships between well-being, SWL, and mindfulness with MPU differ between men and women. Perhaps sample characteristics could explain different findings in previous studies. Indeed, over half of the participants in the study by Kang and Jung (2014) were female and results showed a positive association between MPU and SWL. In contrast, Lachmann and colleagues (2018) found a negative association between SWL and MPU in their Chinese, predominantly male, sample. Based on the findings of this study and sample differences in previous research, we suggest that future studies should investigate gender differences in their data.

This study has some limitations. Even though the sample did not exclusively consist of psychology students as many psychological studies do (Grohol, 2010), the majority of the participants had higher education. A long-term cohort study by Yang (2008) indicates that a university degree increases the likelihood of feeling happy. Further, evidence exists that a person's socioeconomic background influences his/her MPU (De-Sola Gutiérrez et al., 2016). Therefore, we suggest that more heterogeneous studies that include socioeconomic variables in their analyses should be conducted in the future. One further critical issue of this study concerns the questionnaire used for assessing MPU. We were not able to replicate the component structure of the TMDbrief proposed by Chóliz and colleagues (2016) and several participants had trouble understanding one item.

Potential implications of these results can be drawn for preventive projects. Since problematic MPU is assumed to be more common among adolescents (De-Sola Gutiérrez et al., 2016), mindfulness training at school might be a way to improve adolescents' well-being as well as lead to a more conscious use of information technology.

## 5. Conclusion

With mobile phones being a central part of daily life, it is important to understand whether there is a relation to well-being. While mobile phones can make life easier, they are also seen as a source of stress. This study suggests that more extensive MPU is associated with lower well-being, SWL, and mindfulness. Well-being appears to be a mediator of the relationship between mindfulness and MPU for men. For women, mindfulness and well-being appear to have more direct effects on MPU. Future studies should analyze gender differences in more detail and manipulate participants' mobile phone use experimentally in order to gain knowledge about cause and effect relationships.

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