Mind-Wandering and Mindfulness as Mediators of the Relation Between Online Vigilance and Well-Being

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Abstract

As mobile technology allows users to be online anywhere and at all times, a growing number of users report feeling constantly alert and preoccupied with online streams of online information and communication—a phenomenon that has recently been termed online vigilance. Despite its growing prevalence, the consequences of this constant orientation towards online streams of information and communication for users' well-being are largely unclear. In the present study, we investigated whether being constantly vigilant is related to cognitive consequences in the form of increased mind-wandering and decreased mindfulness, and examined the resulting implications for well-being. To test our assumptions, we estimated a path model based on survey data ($N = 371$). The model supported the majority of our preregistered hypotheses: Online vigilance was indeed related to mind-wandering and mindfulness, but only mindfulness mediated the relation with decreased well-being. Thus, those mentally preoccupied with online communication were overall less satisfied with their lives and reported less affective well-being when they also experienced reduced mindfulness.

Keywords: smartphones, vigilance, mind-wandering, mindfulness, well-being, distraction

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Vigilance and Well-Being

Mobile technology, especially smartphones, have become a central part of people's lives (Cumiskey & Ling, 2015) and afford users to be constantly connected to online streams of communication and interaction (Bayer, Campbell, & Ling, 2015; Mascheroni & Vincent, 2016). In other words, users are "permanently connected and permanently online" (Vorderer & Kohring, 2013). Interestingly, many users complain about the challenges of being in a constant *mindset* of connectivity (Johannes, Veling, Verwijmeren, & Buijzen, in press; Mihailidis, 2014; Näsi & Koivusilta, 2013). This mindset has recently been defined as *online vigilance*, a state of constant awareness of ongoing threads of online communication and interaction (Klimmt, Hefner, Reinecke, Rieger, & Vorderer, 2018). However, there is little research on the possible consequences of this new mindset for well-being. As absentmindedness has shown to decrease well-being (Friese & Hofmann, 2016; Killingsworth & Gilbert, 2010), a constant division of attention between the present situation and past, ongoing, or future online interactions may result in the same effect. More specifically, this constant division could come at the cost of decreased attentional focus (Thomson, Besner, & Smilek, 2015), which in turn decreases well-being. With the current study, we therefore test whether online vigilance is negatively related to well-being through increased mind-wandering and decreased mindfulness.

Online Vigilance and Well-Being

Online vigilance refers to a mindset of constant awareness of online communication and comprises three dimensions (Klimmt et al., 2018). First, *salience* refers to thoughts about past, present, or future online interactions, that is, the intensity and permanence of a mental preoccupation with online streams of information. Second, *reactibility* refers to how responsive a user is to incoming smartphone stimuli, that is, the sensitivity to notifications and speed with

which they are checked. Third, *monitoring* refers to how frequently a user checks her or his mobile device, that is, the continuous observation of ongoing threads of online interaction, unprompted by incoming notifications. Online vigilance is markedly nonpathological; whereas problematic smartphone or Internet use are, by definition, maladaptive (Marino, Gini, Vieno, & Spada, 2018), online vigilance describes an acquired mindset that can be both adaptive and maladaptive.

In particular, as Reinecke (2018) lays out, online vigilance bears the potential to foster but also hamper well-being. That is, there are different mechanisms that can account for adaptive, but also maladaptive effects of online vigilance. On the one hand, online vigilance can take the form of awareness of one's social network and social support. In addition, constant access to pleasant content, distractions from unpleasant experiences, and gratification of social needs can be beneficial (Karapanos, Teixeira, & Gouveia, 2016; Mascheroni & Vincent, 2016; van Koningsbruggen, Hartmann, Eden, & Veling, 2017). Therefore, online vigilance might positively contribute to well-being. On the other hand, constantly monitoring and checking online streams of information can induce absentmindedness and possibly distract from a pleasant moment (Shin & Shin, 2016), resulting in decreased well-being. Thus, the link between online vigilance and well-being likely follows different mechanisms, allowing for both positive and negative effects (Reinecke & Hofmann, 2016; Valkenburg & Peter, 2013). Consequently, rather than assuming a direct relationship, we examined, and preregistered, one possible mediating mechanism, proposing that online vigilance is related to decreased well-being through increased absentmindedness.

Mind-Wandering and Mindfulness

In order to investigate the notion that online vigilance would be related to absentmindedness, we selected two traits that have been well-researched and present excellent

measures to approach the phenomenon of absentmindedness: mind-wandering and mindfulness. Whereas mind-wandering in the form of task-unrelated thoughts can be understood as a general form of absentmindedness (Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015), mindfulness is considered the ability to focus attention fully on the present moment without letting attention wander off, while simultaneously taking a nonjudgmental stance toward thoughts about the present moment (Brown & Ryan, 2003; Sauer et al., 2013). Moreover, both concepts have been linked such that mind-wandering occurs when mindfulness decreases (Mrazek, Smallwood, & Schooler, 2012).

Therefore, when thoughts of past, present, and forthcoming online interactions occur during a task, online vigilance may result in increased mind-wandering. Although to date there is little direct evidence for such vigilance-induced mind-wandering, Stothart, Mitchum, and Yehnert (2015) argued that smartphone notifications elicited mind-wandering in participants which was responsible for an impairment in sustained attention. However, they did not measure mind-wandering. In a similar vein, other work suggests mobile technology constantly reminds people of how easily they can communicate with others and that these task-irrelevant thoughts lead to a disruption in task performance (Thornton, Faires, Robbins, & Rollins, 2014; Ward, Duke, Gneezy, & Bos, 2017). This reasoning can also explain why heavy smartphone users experience higher levels of rumination (Elhai & Contractor, 2018). Last, a moderate amount of mind-wandering episodes have shown to be explicitly about online content and applications (Hollis & Was, 2016). Taken together, we predict that online vigilance is positively related to mind-wandering (H_{1a}).

On the flip side, those high in vigilance should also experience less mindfulness. For instance, individuals with higher levels of excessive social media use are often preoccupied with thoughts about the online world and report lower mindfulness (Sriwilai & Charoensukmongkol,

2016). Similarly, automatic texting behavior, a concept related to the monitoring dimension of online vigilance, negatively predicted facets of mindfulness (Bayer, Dal Cin, Campbell, & Panek, 2016). Thus, it appears those who have a strong mental preoccupation with past, ongoing, or forthcoming online interactions also experience difficulties to focus their attention on the present moment. Consequently, we predict that online vigilance is negatively related to mindfulness (H_{1b}).

Increased mind-wandering and decreased mindfulness present plausible mechanisms that may connect online vigilance to decreased levels of well-being. Whereas mind-wandering has repeatedly shown to be negatively associated with well-being outcomes (Killingsworth & Gilbert, 2010; Smallwood, O'Connor, Sudbery, & Obonsawin, 2007), mindful individuals, in general, display greater well-being (Friese & Hofmann, 2016; Gu, Strauss, Bond, & Cavanagh, 2015; Keng, Smoski, & Robins, 2011). Other recent work suggests that a mindful use of instant messaging positively relates to well-being (Bauer, Loy, Masur, & Schneider, 2017). Furthermore, mindfulness mediated the relationship between problematic smartphone use and well-being outcomes (Elhai, Levine, O'Brien, & Armour, 2018). Based on this research and our theoretical assumptions leading to H_{1a} and H_{1b}, we propose that mind-wandering as well as mindfulness act as mediators between online vigilance and psychological well-being.

Thus, we predict direct, negative relationships between mind-wandering and both satisfaction with life (H_{2a}) and affective well-being (H_{2b}), and direct, positive relationships between mindfulness and these well-being indicators (H_{3a}, H_{3b}). Furthermore, we expect an indirect relation between online vigilance and well-being: We predict online vigilance relates negatively to both satisfaction with life and affective well-being via higher mind-wandering (H_{4a} and H_{4b}) and via lower mindfulness (H_{5a} and H_{5b}).

Method

Given the recent call to improve the replicability of scientific studies, and in order to reduce false positives (Nosek, Ebersole, DeHaven, & Mellor, 2018), we preregistered the hypotheses outlined above, as well as sample size justification, analyses plan, and exclusion criteria before data collection. Readers can find the preregistration, data, analysis script, and study materials on the Open Science Framework (https://osf.io/ufyq4/).

Participants and Procedure

In total, 497 respondents participated in our online survey hosted by Qualtrics. Participants were students from Radboud University who participated for course credit; in addition, we also employed snowball sampling, that is, posted the survey on Facebook and disseminated it within our personal networks. Participants were invited to participate in a survey about media use and personality. In light of the generally small effect sizes in media effects research (Rains, Levine, & Weber, 2018), we aimed to detect a smallest effect size of interest of $|p| = .15$ (Lakens & Evers, 2014). Thus, for a two-tailed correlation with $\alpha = .05$ to achieve 80% power, we required a sample of 343 participants.

In line with our a priori exclusion criteria, we first removed 112 participants because they did not finish the survey. Second, we followed recommendations on how to obtain high-quality data by excluding participants who did not take the survey seriously, as indicated by an extremely long or short survey time or clicking the same option for each item ("straightlining"). To account for the former, we relied on the Relative Speed Index (RSI), developed by Leiner (2013), which gives an indication of how quickly a participant went through a survey in relation to all other participants. To account for straightlining, we examined variables with a variance of zero. Accordingly, we excluded 14 participants because they had an RSI > 1.75. Thus, our final sample

consisted of 371 participants (70% females) with a mean age of 21.47 (SD = 5.65), of whom almost everyone owned a smartphone (369).

Measures

      Online Vigilance. To assess online vigilance, we employed the Online Vigilance Scale, developed and validated by Reinecke et al. (2017). The scale consists of three dimensions (salience, monitoring, reactivity) with four items each. Respondents answered items such as "My thoughts often drift to online content" on Likert-scales, ranging from 1 (*Does not apply at all*) to 5 (*Fully applies*). As suggested by Reinecke et al., the three subscales were aggregated to form an overall indicator of online vigilance. In line with the scale validation of Reinecke et al., the scale displayed high internal consistency (M = 2.54, SD = .72, α = .89).

      Mind-Wandering. To measure trait mind-wandering, we employed the commonly used Daydreaming Frequency Scale (Giambra, 1993). The scale consists of twelve items that assess the frequency of absentmindedness in everyday situations and has five different answer options depending on the items, increasing from little to a lot of mind-wandering. For instance, respondents rated items such as "Instead of noticing people and events in the world around me, I will spend approximately…" on a scale from 1 (*0% of my time lost in thought*) to 5 (*50% of my time lost in thought*). The scale displayed excellent internal consistency (M = 3.08, SD = .75, α = .92).

      Mindfulness. To measure mindfulness, we employed the FFMQ-SF (Bohlmeijer, ten Klooster, Fledderus, Veehof, & Baer, 2011). The scale measures five facets of mindfulness (observe, describe, act aware, nonjudge, nonreact) and consists of 24 items. Respondents rated statement such as "I find it difficult to stay focused on what's happening in the present moment" on Likert-style ratings ranging from 1 (*never or rarely true*) to 5 (*very often or always true*). The aggregated scale displayed high internal consistency (M = 3.26, SD = .48, α = .84).

Satisfaction with Life. We measured the cognitive component of subjective well-being with the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985). The scale consists of five items, such as "I am satisfied with my life", that respondents rate on Likert-style scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale showed high internal consistency ($M = 4.87$, $SD = 1.17$, $\alpha = .86$).

Affective Well-Being. We measured the affective component of subjective well-being with the Scale of Positive and Negative Experience (Diener et al., 2010). The scale assesses both positive ($M = 22.69$, $SD = 3.53$, $\alpha = .88$) and negative affect ($M = 15.75$, $SD = 4.18$, $\alpha = .83$) with six items each. Respondents reported how much they experienced affect such as "positive" or "negative" in the past four weeks, and rate those on a Likert-type scale from 1 (*very rarely or never*) to 5 (*very often or always*). By subtracting negative affect from positive affect, we obtained an overall balance measure, with higher scores indicating more positive affect ($M = 6.94$, $SD = 6.99$).

Results

Confirmatory Analyses

To test our hypotheses, we estimated a path model with maximum likelihood estimation using the lavaan package (Rosseel, 2012) in R (R Core Team, 2018). We controlled for age and gender in the model. Mardia's test, Henze-Zirkler's test and the E-statistic all indicated that our data were not multivariate normal (all $p < .001$). Thus, to deal with the nonnormal distribution, we employed 10.000 bootstrap samples for our models. In addition, all results presented below remained unchanged when we used a robust estimator, namely maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic. By employing bootstrapping, we also followed recommendations of Shrout and Bolger (2002) who advise to use bootstrapping to obtain more reliable results for indirect effects. Therefore, we obtained indirect

effects by bootstrapping the combined direct effects. To give an example of the combined direct

effects, the indirect effect of online vigilance on satisfaction with life via mindfulness was

obtained by multiplying the direct effect of online vigilance on mindfulness with the direct effect

of mindfulness on satisfaction with life. We determined the criteria for model fit before-hand (for

details see our preregistration).

Table 1

Means, standard deviations, and correlations with confidence intervals

Variable	*M*	*SD*	1	2	3	4
1. VIG	2.54	0.72				
2. MW	3.08	0.75	.17** [.07, .27]			
3. MF	3.26	0.48	-.31** [-.40, -.22]	-.38** [-.46, -.29]		
4. LS	4.87	1.17	-.07 [-.17, .03]	-.22** [-.31, -.12]	.47** [.38, .54]	
5. SPANE	6.94	6.99	-.14** [-.24, -.04]	-.30** [-.39, -.20]	.56** [.48, .63]	.66** [.60, .72]

Note. *** indicates *p* < .001; ** indicates *p* < .01. Values in square brackets indicate the 95%

confidence interval for each correlation. VIG = Vigilance. MW = Mind-Wandering. MF =

Mindfulness. LS = Satisfaction with Life. SPANE = Affective Well-Being.

Zero-order correlations are displayed in Table 1. Our original model with all specified

paths and no error covariances did not fit the data well, $\chi^2(3) = 48.83$, $p < .001$, CFI = .90,

RMSEA = .20, 90%CI[.16, .26], SRMR = .08. Following the steps in our preregistration, we

added a covariance between mind-wandering and mindfulness, based on theoretical accounts

which predict a moderate relation between the two (Mrazek et al., 2012). This resulted in a good

model fit, $\chi^2(2) = 4.01$, $p = .13$, CFI = .99, RMSEA = .05, 90%CI[.00, .13], SRMR = .02. The

final model is displayed in Figure 1.

Supporting H_{1a}, online vigilance was significantly and positively related to mind-

wandering ($\beta = .17$, $p = .002$).). Mind-wandering, in turn, did not significantly predict

satisfaction with life ($\beta = -.05$, $p = .336$), rendering no support for H_{2a}, but was significantly and

negatively related to affective well-being ($\beta = -.10$, $p = .040$), supporting H_{2b}.

Supporting H_{1b}, online vigilance was significantly and negatively related to mindfulness

($\beta = -.31$, $p < .001$). In support of H_{3a}, mindfulness was significantly and positively related to

satisfaction with life ($\beta = .46$, $p < .001$); likewise, supporting H_{3b}, mindfulness was significantly

and positively related to affective well-being ($\beta = .53$, $p < .001$).

Finally, we expected indirect relationships between online vigilance and the two well-

being indicators via mind-wandering and mindfulness, respectively. The data did not show a

significant indirect relationship of online vigilance and satisfaction with life via mind-wandering

(H_{4a}; $\beta = -.01$, $p = .354$), nor with affective well-being (H_{4b}; $\beta = -.02$, $p = .081$). In contrast, there

was a significant negative indirect relationship of online vigilance via mindfulness with life

satisfaction (H_{5a}; $\beta = -.14$, $p < .001$) and with affective well-being (H_{5b}; $\beta = -.16$, $p < .001$).
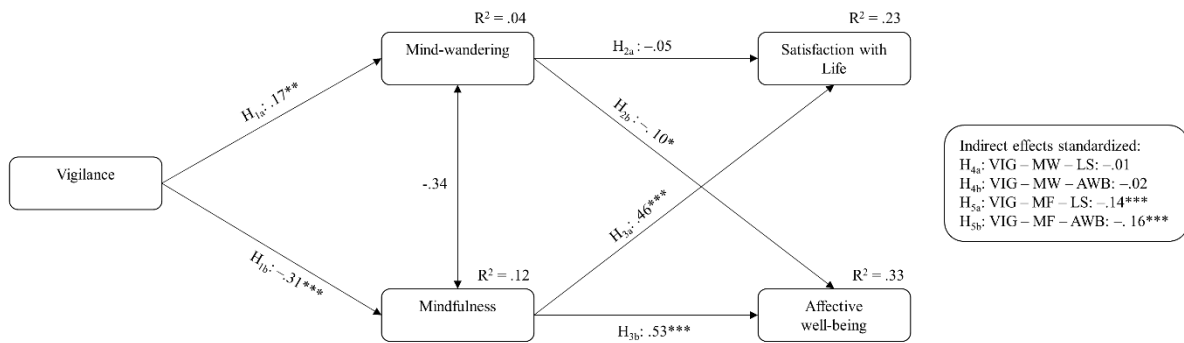
Figure 1. Final path model after adding an error covariance between mind-wandering and mindfulness. All coefficients standardized. * $p < .05$; ** $p < .01$; *** $p < .001$. $\chi^2(2) = 4.01$, $p = .13$, CFI = .99, RMSEA = .05, 90%CI[.00, .13], SRMR = .02.

Exploratory Analyses

To further examine the nature of online vigilance, we explored how each dimension contributed to the proposed mechanism. Consequently, we estimated the same model as above, but split online vigilance into its three dimensions as predictors. The model had mediocre fit, $\chi^2(12) = 37.47$, $p < .001$, CFI = .97, RMSEA = .08, 90%CI[.05, .10], SRMR = .04. Interestingly, salience appeared to be the most crucial component of online vigilance, as only salience was directly related to mind-wandering ($\beta = .16$, $p = .007$) and mindfulness ($\beta = -.24$, $p < .001$), and indirectly via mindfulness to satisfaction with life ($\beta = -.11$, $p < .001$) and affective well-being ($\beta = -.13$, $p < .001$). All other paths were nonsignificant. However, given that these results are exploratory and obtained post-hoc, p-values are not meaningful and the results should be treated as preliminary until independently replicated (De Groot, 2014; Nosek et al., 2018; Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012). The exploratory model can be found on the OSF.

Discussion

With this study, we address a phenomenon that is becoming increasingly prevalent in society: Technology users report to be in a state of constant alertness, which we refer to as online vigilance. We asked how users experience this online vigilance and investigated whether it relates to decreased well-being due to increased mind-wandering and decreased mindfulness.

Indeed, the results of our study show that those high in online vigilance experienced more mind-wandering and less mindfulness. In the case of mind-wandering, our findings support the notion that a constant preoccupation with online streams of information and communication coincides with more frequent task-unrelated thoughts during the day. Specifically, the correlation is consistent with the assumption of previous experimental work that smartphones may elicit mind-wandering (Stothart et al., 2015; Thornton et al., 2014). In such a view, smartphones represent an omnipresent communication channel to friends and family, which prompts thoughts about what is happening within one's social circle. Therefore, our study shows that being concerned with streams of online information is related to more task-unrelated thoughts, which lends external validity to the assumptions of previous experimental work.

Furthermore, our study demonstrates that those high in vigilance experienced less mindfulness to a considerable degree. Apparently, people constantly devoting attention to past, ongoing, or forthcoming online interactions experience problems to focus on the present moment. Our findings are in line with previous work on phone use and mindfulness. For example, automatic texting behavior does not require an observation of current thoughts and feelings and was thus related to lower mindfulness (Bayer et al., 2016). In particular, automated checking behavior in the form of monitoring and a more or less automatic response to online stimuli in the form of reactivity are in stark contrast to mindfulness, which is reflected in the moderate to large effect size of the negative correlation between online vigilance and mindfulness.

In addition to finding a link between online vigilance and mind-wandering and mindfulness, our study mostly replicated the links between these constructs and well-being established in previous work. Particularly mindfulness was strongly related to both satisfaction with life and affective well-being, providing further support for the benefits of mindfulness (Friese & Hofmann, 2016; Gu et al., 2015; Keng et al., 2011). However, contrary to previous findings on the state-level (Killingsworth & Gilbert, 2010; Smallwood et al., 2007), mind-wandering was only weakly related to both well-being outcomes on the trait-level. In addition, given that we investigated this relationship within the path model while controlling for mindfulness, our findings provide support for a recent account claiming that mindfulness mediates the relationship between mind-wandering and well-being (Stawarczyk, Majerus, der Linden, & D'Argembeau, 2012).

More important, the study shows partial support for our prediction that online vigilance relates to well-being through increased mind-wandering and decreased mindfulness. In particular, our results show that mindfulness appears to be the key factor in this mechanism: Online vigilance was indirectly related to both well-being outcomes via lower levels of mindfulness. Although the size of this indirect relationship was rather small, it did explain a significant amount of variance in both well-being outcomes. Moreover, for exploratory reasons we also ran a model that included direct paths from online vigilance to the well-being indicators (available on the OSF). The paths were not significant and model fit was poor. Thus, the total correlation between online vigilance and satisfaction with life was masked by the mediation and not significant in itself. First, this underlines the need to consider mediating mechanisms when investigating the relations between media-related concepts and well-being outcomes. Second, given the direct relation between pathological media use (e.g., problematic Facebook use) and well-being (Marino et al., 2018), our findings are in line with the idea that online vigilance is

nonpathological. Mind-wandering, however, did not function as a mediator. Therefore, the role of mind-wandering in the relationship between online vigilance and well-being appears less important as soon as mindfulness is considered simultaneously.

One important limitation of our design is that it only allowed us to investigate these links at a person-level; thus, it did not explicitly test a situational link between smartphone notifications, online vigilance, and the other measures. In addition, some of the effect sizes we observed were relatively small. For instance, online vigilance can only account for a small amount of variance in mind-wandering. This may point to a clear conceptual difference between online vigilance and mind-wandering. More important, there is a need for future work to examine the exact contributions of the specific components of online vigilance to the components of mind-wandering, especially given recent theorizing about the different forms mind-wandering can take (Seli et al., 2018). Likewise, we call for more research on the relation between online vigilance and mindfulness. Our exploratory analyses indicate that salience might be the most potent, and possibly the only predictor of well-being through decreased mindfulness. However, this fine-grained analysis is post-hoc (Nosek et al., 2018; Wagenmakers et al., 2012), and we call for independent, preregistered replications of this finding.

Taken together, our study examined a potential mechanism of how being constantly vigilant about one's online communication relates to well-being: Those mentally preoccupied with online communication were overall less satisfied with their lives and reported less affective well-being when they also experienced reduced mindfulness. However, this mechanism does not mean that online vigilance has negative consequences per se. On the contrary, online vigilance has the potential to increase well-being by making access to social support, enjoyable content, and social gratifications cognitively salient and available (Karapanos et al., 2016; van Koningsbruggen et al., 2017). Our results imply that potential positive effects on well-being may

be contingent on whether it reduces mindfulness. While our findings should be interpreted as preliminary due to the cross-sectional nature of our design, they give a first indication of the importance to advance research on the topic of online vigilance.

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