

# Mind-Wandering and Mindfulness as Mediators of the Relationship 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, consequences of this constant orientation toward 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 relationship 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

## Introduction

Mobile technology, especially smartphones, has become a central part of people's lives<sup>1</sup> and allows users to be constantly connected to online streams of communication and interaction.<sup>2-4</sup> In other words, users are permanently connected and permanently online.<sup>4</sup> Interestingly, many users complain about the challenges of being in a constant *mindset* of connectivity.<sup>5-7</sup> This mindset has recently been defined as *online vigilance*, a state of constant awareness of ongoing threads of online communication and interaction.<sup>8</sup> However, there is little research on possible consequences of this new mindset for well-being. As absentmindedness has shown to decrease well-being,<sup>9,10</sup> 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,<sup>11</sup> 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.<sup>8</sup> First, *salience* refers to thoughts about past, present, or future online interactions, that is, the intensity and permanence of mental preoccupation with online streams of information. Second, *reactivity* 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 is, by definition, maladaptive<sup>12</sup>, online vigilance describes an acquired mindset that can be both adaptive and maladaptive.

In particular, as Reinecke<sup>13</sup> lays out, online vigilance bears the potential to not only foster but also hamper well-being. That is, there are different mechanisms that can account for adaptive but also maladaptive effects of online

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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.<sup>3,14,15</sup> 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,<sup>16</sup> 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.<sup>17,18</sup> 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*

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,<sup>19,20</sup> 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.<sup>21,22</sup> Moreover, both concepts have been linked such that mind-wandering occurs when mindfulness decreases.<sup>23</sup>

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 et al.<sup>24</sup> 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 that 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.<sup>25,26</sup> This reasoning can also explain why heavy smartphone users experience higher levels of rumination.<sup>27</sup> Last, a moderate amount of mind-wandering episodes have shown to be explicitly about online content and applications.<sup>28</sup> 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.<sup>29</sup> Similarly, automatic texting behavior, a concept related to the monitoring dimension of online vigilance, negatively predicted facets of mindfulness.<sup>30</sup> Thus, it appears that those who have a strong mental preoccupation with past, ongoing, or forthcoming online interactions also experience difficulties in focusing 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 been shown to be negatively associated with well-being outcomes,<sup>10,31</sup> mindful individuals, in general, display greater well-being.<sup>9,32,33</sup> Other recent work suggests that mindful use of instant messaging positively relates to well-being.<sup>34</sup> Furthermore, mindfulness mediated the relationship between problematic smartphone use and well-being outcomes.<sup>35</sup> Based on this research and our theoretical assumptions leading to  $H_{1a}$  and  $H_{1b}$ , we propose that mind-wandering and 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 relationship between online vigilance and well-being: we predict that online vigilance relates negatively to both satisfaction with life and affective well-being through higher mind-wandering ( $H_{4a}$  and  $H_{4b}$ ) and through lower mindfulness ( $H_{5a}$  and  $H_{5b}$ ).

### **Method**

Given the recent call to improve replicability of scientific studies and to reduce false positives,<sup>36</sup> we preregistered the hypotheses outlined above as well as sample size justification, analysis plan, and exclusion criteria before data collection. Readers can find the preregistration, data, analysis script, and study materials on the Open Science Framework (OSF).\*

### *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,<sup>37</sup> we aimed to detect a smallest effect size of interest of  $|p| = 0.15$ .<sup>38</sup> Thus, for a two-tailed correlation with  $\alpha = 0.05$  to achieve 80 percent 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,<sup>39</sup> 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 percent females) with a mean age of 21.47 ( $SD = 5.65$ ), of whom almost everyone owned a smartphone (369).

\*<https://osf.io/ufyq4>

### Measures

**Online vigilance.** To assess online vigilance, we employed the Online Vigilance Scale, developed and validated by Reinecke et al.<sup>40</sup> The scale consists of three dimensions (salience, monitoring, and 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 by Reinecke et al., the scale displayed high internal consistency ( $M=2.54$ ,  $SD=0.72$ ,  $\alpha=0.89$ ).

**Mind-wandering.** To measure the trait mind-wandering, we employed the commonly used Daydreaming Frequency Scale.<sup>41</sup> The scale consists of 12 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 percent of my time lost in thought*) to 5 (*50 percent of my time lost in thought*). The scale displayed excellent internal consistency ( $M=3.08$ ,  $SD=0.75$ ,  $\alpha=0.92$ ).

**Mindfulness.** To measure mindfulness, we employed the FFMQ-SF.<sup>42</sup> The scale measures five facets of mindfulness (observe, describe, act aware, nonjudge, and nonreact) and consists of 24 items. Respondents rated statements such as “I find it difficult to stay focused on what’s happening in the present moment” using Likert-style ratings ranging from 1 (*never or rarely true*) to 5 (*very often or always true*). The aggregated scale displayed high internal consistency ( $M=3.26$ ,  $SD=0.48$ ,  $\alpha=0.84$ ).

**Satisfaction with life.** We measured the cognitive component of subjective well-being with the Satisfaction with Life Scale.<sup>43</sup> The scale consists of five items such as “I am satisfied with my life,” which respondents rate on Likert-style scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale showed high internal consistency ( $M=4.87$ ,  $SD=1.17$ ,  $\alpha=0.86$ ).

**Affective well-being.** We measured the affective component of subjective well-being with the Scale of Positive and Negative Experiences.<sup>44</sup> The scale assesses both positive ( $M=22.69$ ,  $SD=3.53$ ,  $\alpha=0.88$ ) and negative affect ( $M=15.75$ ,  $SD=4.18$ ,  $\alpha=0.83$ ) with six items each. Respondents reported how much they experienced affect such as positive or negative in the past four weeks and rated 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<sup>45</sup>

in R.<sup>46</sup> We controlled for age and gender in the model. Mardia’s test, Henze-Zirkler’s test, and the E-statistic indicated that our data were not multivariate normal (all  $p<0.001$ ). Thus, to deal with non-normal 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<sup>47</sup> who advise the use of 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 through 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 beforehand (for details, see our pre-registration).

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,  $\chi^2(3)=48.83$ ,  $p<0.001$ , comparative fit index (CFI)=0.90, root-mean-squared error of approximation (RMSEA)=0.20, 90% confidence interval (CI) [0.16–0.26], and standardized root mean of the residual (SRMR)=0.08. Following the steps in our preregistration, we added a covariance between mind-wandering and mindfulness based on theoretical accounts that predict a moderate relationship between the two.<sup>23</sup> This resulted in a good model fit,  $\chi^2(2)=4.01$ ,  $p=0.13$ , CFI=0.99, RMSEA=0.05, 90% CI [0.00–0.13], and SRMR=0.02. The final model is displayed in Figure 1.

Supporting H<sub>1a</sub>, online vigilance was significantly and positively related to mind-wandering ( $\beta=0.17$ ,  $p=0.002$ ). Mind-wandering, in turn, did not significantly predict satisfaction with life ( $\beta=-0.05$ ,  $p=0.336$ ), rendering no support for H<sub>2a</sub>, but was significantly and negatively related to affective well-being ( $\beta=-0.10$ ,  $p=0.040$ ), supporting H<sub>2b</sub>.

Supporting H<sub>1b</sub>, online vigilance was significantly and negatively related to mindfulness ( $\beta=-0.31$ ,  $p<0.001$ ). In support of H<sub>3a</sub>, mindfulness was significantly and positively related to satisfaction with life ( $\beta=0.46$ ,  $p<0.001$ ); likewise, supporting H<sub>3b</sub>, mindfulness was significantly and positively related to affective well-being ( $\beta=0.53$ ,  $p<0.001$ ).

Finally, we expected indirect relationships between online vigilance and the two well-being indicators through mind-wandering and mindfulness, respectively. The data did not show a significant indirect relationship of online vigilance and satisfaction with life through mind-wandering (H<sub>4a</sub>;  $\beta=-0.01$ ,  $p=0.354$ ), nor with affective well-being (H<sub>4b</sub>;  $\beta=-0.02$ ,  $p=0.081$ ). In contrast, there was a significant negative indirect relationship of online vigilance through mindfulness with life satisfaction (H<sub>5a</sub>;  $\beta=-0.14$ ,  $p<0.001$ ) and with affective well-being (H<sub>5b</sub>;  $\beta=-0.16$ ,  $p<0.001$ ).

### 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

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	0.17** [0.07–0.27]			
3. MF	3.26	0.48	-0.31** [-0.40 to -0.22]	-0.38** [-0.46 to -0.29]		
4. LS	4.87	1.17	-0.07 [-0.17 to 0.03]	-0.22** [-0.31 to -0.12]	0.47** [0.38–0.54]	
5. SPANE	6.94	6.99	-0.14** [-0.24 to -0.04]	-0.30** [-0.39 to -0.20]	0.56** [0.48–0.63]	0.66** [0.60–0.72]

Note: \*\*\*Indicate  $p < 0.001$ ; \*\*indicate  $p < 0.01$ . Values in square brackets indicate the 95% confidence interval for each correlation. LS, satisfaction with life; M, mean; MF, mindfulness; MW, mind-wandering; SD, standard deviation; SPANE, affective well-being; VIG, vigilance.

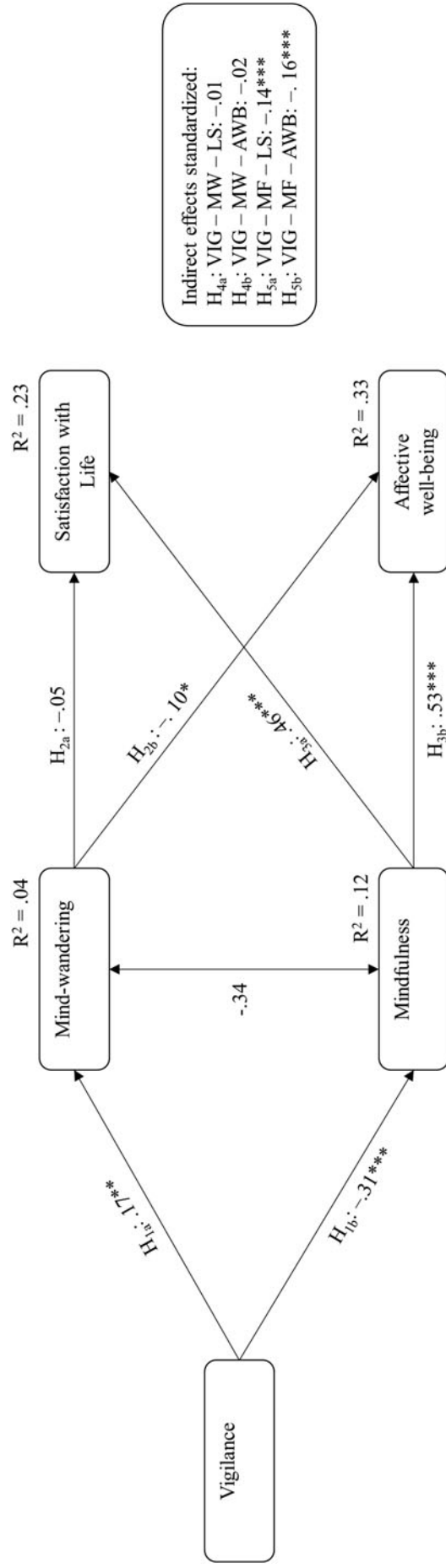


FIG. 1. Final path model after adding an error covariance between mind-wandering and mindfulness. All coefficients are standardized. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .  $\chi^2(2) = 4.01$ ,  $p = 0.13$ , CFI = 0.99, RMSEA = 0.05, 90% CI [0.00–0.13], and SRMR = 0.02. CFI, comparative fit index; CI, confidence interval; RMSEA, root-mean-squared error of approximation; SRMR, standardized root mean of the residual.

above, but split online vigilance into its three dimensions as predictors. The model had mediocre fit,  $\chi^2(12)=37.47$ ,  $p<0.001$ , CFI=0.97, RMSEA=0.08, 90% CI [0.05–0.10], and SRMR=0.04. Interestingly, salience appeared to be the most crucial component of online vigilance as only salience was directly related to mind-wandering ( $\beta=0.16$ ,  $p=0.007$ ) and mindfulness ( $\beta=-0.24$ ,  $p<0.001$ ) and indirectly through mindfulness to satisfaction with life ( $\beta=-0.11$ ,  $p<0.001$ ) and affective well-being ( $\beta=-0.13$ ,  $p<0.001$ ). 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.<sup>36,48,49</sup> 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 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.<sup>24,25</sup> 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 in focusing 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.<sup>30</sup> 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.<sup>9,32,33</sup> However, contrary to previous findings on the state level,<sup>10,31</sup> mind-wandering was only weakly related to both well-being out-

comes 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.<sup>50</sup>

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 through 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 mediation and not significant in itself. First, this underlines the need to consider mediating mechanisms when investigating relationships between media-related concepts and well-being outcomes. Second, given the direct relationship between pathological media use (e.g., problematic Facebook use) and well-being,<sup>12</sup> 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 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 specific components of online vigilance to the components of mind-wandering, especially given recent theorizing about the different forms that mind-wandering can take.<sup>51</sup> Likewise, we call for more research on the relationship 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*,<sup>36,48</sup> 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.<sup>14,15</sup> 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.

### Acknowledgment

The authors would like to thank Joris, Kirsten, Max, and Renate for their help with data collection.

### Author Disclosure Statement

No competing financial interests exist.

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