Privacy Concerns Can Stress You Out: Investigating the Reciprocal Relationship Between

Mobile Social Media Privacy Concerns and Perceived Stress

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Abstract

Mobile social media have become a widespread means to participate in everyday social and professional life. These platforms stimulate the disclosure and exchange of personal information, which implies certain privacy risks. While past scholarship has extracted various predictors and consequences of online privacy concerns, there is to date no empirical investigation of its relationship with perceived stress. Using a longitudinal panel study, we examined the reciprocal relationship between mobile social media privacy concerns and perceived stress. Results supported the hypothesis that mobile social media privacy concerns at T1 are associated with higher perceived stress at T2. However, we found no evidence for the reverse association, i.e., perceived stress at T1 was not related to mobile social media privacy concerns at T2. The findings are discussed against the background of the Antecedents Privacy Concerns Outcome Model as well as the Privacy Calculus Model.

Keywords: mobile social media, privacy concerns, perceived stress, panel study, reciprocal relationship

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Disclosing personal information on social networking sites (SNSs) has become a common part of our social and professional lives. In that sense, large amounts of personal information are shared and stored online. Revealing personal information can lead to concerns about privacy. In fact, 67% of respondents in the Eurobarometer survey (2015) expressed concerns about losing control over online information. They indicated concerns about online activities being tracked via mobile phones. In a survey conducted among 1000 Germans in 2018, 75% indicated that they felt rather unsafe or completely unsafe regarding their personal data online (Koptyug, 2019). Mobile internet users account for 69% in Germany, which is the context of the present research (The German Association for the Digital Economy, 2018). This information calls for an examination of specific mobile privacy concerns.

Privacy concerns are defined as the perceived loss of control and the lack of protection of personal information (e.g., Dienlin, 2014). Concerns about the uncontrollable use of personal information mainly include the fear of data and identity thefts, financial frauds, or gathering information for advertising purposes, cyberbullying, or sexual harassment (e.g., Dienlin & Trepte, 2015; Mesch, 2009; Milne, Rohm, & Bahl, 2009). Specifically, privacy concerns refer to the lack of knowledge about how another person or company may use one's personal information (Joinson & Paine, 2007).

In that context, privacy concerns are meaningful stressors (Dhir & Midha, 2014; Nimrod, 2017; Suh & Lee, 2017) which lead to negative affect such as frustration (Mamonov & Koufaris, 2014). As Lim and Choi (2017) explained, privacy is related to stress because of self-exposure, which is the main feature of mobile social media channels. The omnipresent and salient nature of mobile SNS use underlines the importance of elaborating on the relationship between privacy concerns and stress. Despite crucial ramifications of mobile

social media privacy concerns for individuals' well-being, pressing research gaps remain in this field.

First, existing research lacks a thorough investigation of privacy concerns as a predictor of stress, and of stress as a predictor of privacy concerns. The relationship could be of reciprocal nature and tighten over time. This could potentially explain the stress that is increasingly associated with SNSs (Hou et al., 2017). None of the studies we are aware of has investigated the reciprocal relationship of privacy concerns and stress. Instead, literature on factors associated with privacy concerns often divides them into predictors and consequences, limiting the discussion on potential circularity. Additionally, consequences of privacy concerns are oftentimes discussed rather in terms of privacy protecting behaviors than in terms of well-being (e.g., Weinberger, Bouhnik, & Zhitomirsky-Geffet, 2017; Youn & Hall, 2008). Yet, investigating the reciprocal relationship of privacy concerns and stress is of crucial importance because stress is an important predictor of individuals' overall well-being (Cassel, 2017; Kendler, Karkowski, & Prescott, 1999).

Second, most of the studies investigating both privacy concerns and stress are cross-sectional (e.g., Nimrod, 2017). While the results suggest that privacy concerns and stress are associated, it is not possible to determine the direction of the relationship in correlational studies. Thus, longitudinal panel designs are warranted.

Drawing from the Antecedents Privacy Concerns Outcomes (APCO) model, the present study extends the current body of literature by investigating the reciprocal relationship of privacy concerns about mobile social media use and perceived stress in a two-wave panel study.

Mobile Social Media Privacy Concerns

Information privacy is defined as "the claim of the individual to determine for themselves when, how, and to what extent information about them is communicated to others" (Westin, 1970, p. 7). Privacy concerns can thus be treated as a state of not perceiving

oneself in control of the communication flow around one's personal information, resulting in

worry. Moreover, individuals often do not have sufficient knowledge and control over who

uses their personal information online and for what purpose (Joinson & Paine, 2007). This is

especially relevant because data shared on SNS is embedded in various highly complex

contexts and privacy depends not only on individual decisions but also on the decisions of

those included in the SNS network (e.g., Marwick & Boyd, 2011).

We focus on mobile social media privacy concerns (MSMPC) because social media

companies or service providers oftentimes collect sensitive data from mobile devices.

Smartphones allow for real-time and location-based applications (e.g., Keith, Thompson,

Hale, Lowry, & Greer, 2013) that capture large amounts of personal information. Due to the

increased mobility of devices, there is a constant opportunity to share and store personal

information (e.g., Wei, 2013). The widespread use of location-based applications might result

in permanent concerns about the dispersion of personal information or even in quitting SNS

(e.g., Humphreys, 2013). Thus, it is relevant to understand how users perceive privacy

concerns when using mobile SNS.

Previous research on privacy concerns has mostly been grounded in the Antecedents

Privacy Concerns Outcome Model (APCO; Smith, Dinev, & Xu, 2011), a framework that

summarizes the processes which lead to and result from privacy concerns. This macro

framework was based on a meta-review of empirical studies on information privacy concerns.

It comprises of concepts regarding users' privacy concerns and related behaviors and

classifies the variables used in previous studies as predictors or outcomes of privacy concerns

(Benamati et al., 2017; Heravi et al., 2018). The authors noted that "only limited attention has

been paid to factors that serve as antecedents to privacy" (Smith et al., 2011, p. 1005) and

argue that "outcomes should be interpreted as actual changes of state or behavior" not just

intentions (p. 1007). In the present study, for the first time, we have included a reciprocal

effect between perceived stress and mobile-specific privacy concerns, which means that we

examine perceived stress both as an antecedent and as an outcome of mobile social media privacy concerns.

The most commonly investigated antecedents are personality traits, demographic variables, and previous privacy experiences. Research applying this framework has yielded insightful findings on the predictors of privacy concerns. Groups with relatively high privacy concerns are women (Cho, Rivera-Sanchez, & Lim, 2009; Gosh & Singh, 2018; Youn & Hall, 2008), comparably educated (Cecere, Le Guel, & Soulié, 2015; Hwang, Han, Kuo, & Liu, 2012) and less trusting individuals (Bergström, 2015), as well as individuals from individualistic cultures (Cho et al., 2009). Relatively low privacy concerns are reported by heavy SNS users (Dinev et al., 2006), which might be explained by higher perceived rewards from SNSs (Bellman, Johnson, Kobrin, & Lohse, 2004; Debatin, Lovejoy, Horn, & Hughes, 2009; Gosh & Singh, 2018) as well as higher privacy self-efficacy (Dinev & Hart, 2004; Xu, Teo, Tan, & Agarwal, 2012), which predicts fewer privacy concerns.

As outcomes, researchers frequently examined users' privacy protection behavior or intention to disclose information (e.g., Sun, Fang, & Hwang, 2019). However, a systematic review concluded that users often do not behave in line with their privacy attitudes (Barth & de Jong, 2017). Findings generated from the APCO framework suggest that privacy concerns alone cannot account for privacy protecting behaviors (Heravi, Mubarak, & Choo, 2018; Norberg, Horne, & Horne, 2007). When users experience only moderate privacy concerns or when their privacy self-efficacy is low, their privacy attitudes often do not correspond to their behaviors (Weinberger et al., 2017). Barnes (2006) has named this mismatch the "privacy paradox". This paradox is especially hard to resolve when an all-or-nothing-policy is employed, i.e., either the user agrees to all privacy invasions or they cannot use the application (Shklovski, Mainwaring, Skúladóttir, & Borgthorsson, 2014).

Due to the logic of mobile SNS regarding participation and the disclosure of private information, the Privacy Calculus Model (PCM) has also been found to be a suitable basis to

investigate the interplay between risks, benefits and self-disclosure on SNS (Dienlin &

Metzger, 2016; Dinev & Hart, 2004; Krasnova, Veltri, & Günther, 2012; Wang, Duong, &

Chen, 2016). The PCM suggests that before disclosing personal information online,

individuals weigh the perceived risks and benefits and base their decision upon this

calculation (Dinev & Hart, 2004; Keith, Babb, Furner, & Abdullat, 2010). Previous research

suggests that the evaluation of risks and benefits within the desire to share personal

information can be more complicated in a SNS context compared to offline situations

(Krämer & Schäwel, 2020). One possible explanation for this might be according to Krämer

and Schäwel (2020) that SNS users perceive it as difficult to engage in rational decision-

making processes in order to decide between the positive and negative effects of online self-

disclosure. These risk-benefit evaluations may therefore lead to different outcomes. On the

one hand, it was found that privacy concerns positively predicted withdrawal from SNS

(Dienlin & Metzger, 2016). On the other hand, it was shown that the perceived benefits of a

SNS application influenced the intention to reveal personal information more strongly than

the perceived risks (Wang et al., 2016). People seem to sacrifice their privacy in order to be

able to use a certain SNS application, which means that users' privacy concerns do not

automatically lead to privacy protective behaviors especially when there remain tempting

benefits. Due to technological and social obstacles and the increasing mobility of SNS, users

might find it difficult to control self-disclosure (Hargittai & Marwick, 2016). As a

consequence, this can render the evaluation between risks of using mobile SNS and benefits

of disclosing personal information even more challenging to users, leaving privacy concerns

unsolved while harming privacy for the benefit of using a certain SNS application. In the long

term, such behavior has the potential to increase levels of stress and could even result in so-

called privacy fatigue phenomena (Choi, Park, & Jung, 2018).

   Finally, important for the study at hand, existing research suggests a close relation

between privacy concerns and psychological states such as protective behaviors and perceived

dissatisfaction or insecurity (e.g., Benamati, Ozdemir, & Smith, 2017; Bulgurcu, Cavusoglu, & Benbasat, 2010). However, to date, perceived stress both as an antecedent and as an outcome of privacy concerns has not been investigated.

Stress as a Predictor of Mobile Social Media Privacy Concerns

Perceived stress refers to an individual's subjective stress level (Cohen, Kamarck, & Mermelstein, 1983). In the present study, we focused on perceived stress as a state, which is reflected in our measurement of perceived stress based on the frequency of stress experiences during the past month. Considering perceived stress as a predictor of privacy concerns might account for the finding that some individuals are more susceptible to privacy concerns than others (Stieger, Burger, Bohn, & Voracek, 2013). Specifically, stressful experiences might elevate privacy concerns, especially when taking the mobile social media context into account. As previous research suggested, with the ongoing expansion of mobile Internet, users are increasingly disclosing their personal information sometimes even without knowing that their data is being collected by companies or service providers (Zhou & Li, 2014).

In this context, researchers have observed a phenomenon called "social media burnout" (Han, 2018), which has been found to result from stress associated with new information technologies (e.g., Lim & Choi, 2017). This stressful state has been shown to impact the intention to exert more privacy protection behavior and to discontinue SNS use (Dhir & Midha, 2014; Stieger et al., 2013). Perceived stress can decrease the "illusion of control" over an unmanageable outcome, which can be explained by decreased reward responsiveness in a state of stress (Bogdan, Pringle, Goetz, & Pizzagalli, 2012). Thus, in a state of stress, lower perceived rewards from SNS use may lead to a decreased illusion of control over one's online privacy (Bogdan et al., 2012). Rephrased, in a state of stress, perceived control over privacy on SNSs may be lower than in a state of relaxation, which results in higher privacy concerns.

In line with these theoretical assumptions, previous research has shown that individuals' perceived vulnerability predicts privacy concerns (Dinev & Hart, 2004; Mohamed & Ahmad, 2012). Moreover, computer anxiety has been shown to increase SNS privacy concerns (Osatuyi, 2015). Additionally, loneliness—which correlates with stress symptoms (Deberard & Kleinknecht, 1995) —predicted privacy concerns in the context of a mobile dating application (Lutz & Ranzini, 2017). These findings suggest that a state of perceived stress might be a solid ground for enhancing concerns about personal information on social media. Therefore, we hypothesized:

H1: Perceived stress will increase mobile social media privacy concerns over time.

Mobile Social Media Privacy Concerns as a Predictor of Perceived Stress

Drawing from the APCO model, our aim was to investigate whether stress is not only an antecedent, but also an outcome of MSMPC. The association between privacy concerns and stress is well-established in real-life situations. Early research has shown that the gap between individuals' attitudes and behavior related to privacy concerns may cause stress (Webb, 1978). Giving value to privacy but not engaging in corresponding privacy protecting behavior (i.e., privacy paradox, Weinberger et al., 2017), can result in a state of cognitive dissonance. Cognitive dissonance is an emotionally stressful state as it interferes with our need for cognitive consistency (Ding & Liu, 2019; Festinger, 1957). Being latently concerned about one's privacy, but sacrificing it in order to be able to use SNSs can therefore cause cognitive dissonance and result in a state of stress in the long term.

Moreover, the concept of control is crucial for experiencing stress (e.g., Folkman, 1984; Schönfeld, Brailovskaia, Bieda, Zhang, & Margraf, 2016). Online sharing of personal information, pictures, and opinions with a broad community automatically means a loss of real control over personal data. The perceived uncontrollability over one's own circumstances have coined the term *learned helplessness* (Seligman & Maier, 1967). This perceived powerlessness over the outcome of one's actions is applicable to mobile social media privacy

regulations. Both the perceived uncontrollability of one's data shared online and the peer pressure not to resign from SNSs when concerned about privacy are presumed to be meaningful stressors.

There is first empirical evidence for the assumption that privacy concerns and the associated diminished trust and control predict an increase in stress. Existing research suggests that privacy concerns closely relate to psychological states such as perceived dissatisfaction or insecurity (e.g., Benamati, Ozdemir, & Smith, 2017; Bulgurcu, Cavusoglu, & Benbasat, 2010). However, to date, perceived stress as a consequence of privacy concerns has mostly been neglected. Previous studies showed a strong positive association between fear of disclosure and stress (Cruddas, Gilbert, & McEwan, 2012). Researchers have shown a positive relationship between privacy concerns and social media fatigue (Bright, Bardi, & Landreth, 2015), which in turn elevates anxiety and depression (Dhir, Yossatorn, Kaur, & Chen, 2018). Based on these theoretical assumptions and the related empirical evidence, it is conceivable that MSMPC increase stress. Therefore, we hypothesized that:

H2: Mobile social media privacy concerns will increase perceived stress over time.

Method

Sample and Procedure

As part of a larger project on the impact of mobile SNS use on psychological well-being, we tested our hypotheses using a two-wave panel survey. We employed a quota sampling method based on the distribution of age, gender, and educational level in Germany. Additional selection criteria were the possession of a smartphone and prior use of at least one SNS on the phone. The study was conducted in cooperation with a GfK research institute. A total of 833 participants (54.1% women, $M_{age} = 45.44$, $SD_{age} = 14.83$) took part in the first panel-wave (T1) in March/April 2018. The second wave (T2), was conducted four months later and included 461 participants (53% women, $M_{age} = 48.65$, $SD_{age} = 13.02$).

The attrition rate was 45%. Participants who dropped out at T2 were significantly younger, $F(1,831) = 42.64$, $p < .001$, and indicated higher levels of stress, $F(1,824) = 16.76$, $p < .001$, than those who stayed in the panel. The latter has to be kept in mind when interpreting the results. No differences were found with regard to gender $F(1,831) < 0.01$, $p = .934$, occupation $F(1,831) < 0.01$, $p = .967$, education $F(1,831) = 2.28$, $p = .131$, and privacy concerns $F(1,831) = 0.01$, $p = .906$.

Measures

Mobile social media privacy concerns. Online Appendix A displays all items. We selected the items based on the *privacy concerns* subscale by Hsu and Lin (2016) as well as Mani and Chouk (2017) and adapted them to our topic of mobile social media use (e.g., "The use of social media platforms on the mobile phone carries a considerable data protection risk", $M = 3.69$; $SD = 0.96$; $\alpha = 0.89$ at T1, $M = 3.55$; $SD = 1.04$; $\alpha = 0.90$ at T2).

Perceived stress. We used four items to measure perceived stress ($M = 2.57$; $SD = 1.14$; $\alpha = 0.88$ at T1; $M = 2.38$; $SD = 1.14$; $\alpha = 0.89$ at T2). We initially included seven items from the Brief Inventory of Perceived Stress (BIPS) scale by Lehman, Burns, Gagen, & Mohr (2012). However, we based our theoretical model on the two dimensions and adapted two items from the subscales *conflict and imposition,* and *lack of control*, respectively (e.g., "In the last month how often did you feel like you had to do things, even though you did not want to do them"). We selected these four items due to their highest CFA factor loadings in the BIPS scale study which was relevant for good model fit of confirmatory factor analysis. First, a principal component analysis indicated a one-dimensional scale for the four items at T1 (eigenvalue = 2.94; accounting for 73.42% of the variance; factor loadings of all four items above .81) and at T2 (eigenvalue = 3.04; accounting for 76.02% of the variance; factor loadings of all four items above .85). Second, a CFA with latent variables for perceived stress at T1 and T2 resulted in a good model fit: $\chi^2/df = 5.17$, CFI = .98, TLI = .96, RMSEA = .07, 90 % CI [.06; .09].

Control variables. We controlled for various smartphone activities, specifically for communicative (i.e., active) and non-communicative (i.e., passive) uses. We adapted the items by Chan (2015). For communicative use, we asked participants on a 6-point scale (1= *never,* 6 = *several times a day*) how often they communicate with others using social media (e.g. WhatsApp, Facebook, Snapchat), talk on the mobile phone with family and with friends, read or send e-mails, and post or send photos or videos on social media ($M = 3.58$, $SD = 0.99$). For non-communicative (i.e., passive) use, we asked participants on the same scale how often do they use smartphones to: read online news, search for information e.g., on Wikipedia, Google and blogs, view profiles of friends and family on social media platforms (e.g., Facebook), listen to radio/podcasts/music, watch television, movies or video clips (e.g., YouTube, Netflix), play games, and take photos or videos ($M = 3.04$, $SD = 1.14$).

Socio-demographic variables. We assessed age, gender, educational level (34.3% possessing a high school degree), and occupation (38.1% employed full-time) as control variables.

Data Analysis

We used the *lavaan* (Rosseel, 2012) package in *R* for conducting Structural Equation Modeling (SEM) with the Full Information Maximum Likelihood (FIML) procedure. We controlled for participants' communicative and non-communicative smartphone use, gender, age, education, and occupation as well as autoregressive effects (e.g., stress at T1 predicting stress at T2).

Results

Table 1 shows the zero-order correlations between the main variables. Figure 1 displays the hypothesized model and the results.

Measurement Invariance

To ensure that identical constructs with the same structure were measured over time (Schoot, Lugtig, & Hox, 2012), we tested longitudinal measurement invariance by

constraining all factor loadings of the same constructs across two times of measurement for metric invariance (Vandenberg & Lance, 2000). Furthermore, we constrained all intercepts of the same constructs across two times of measurement for scalar invariance (Vandenberg & Lance, 2000). The procedure yielded a good fit for the constrained model: CFI = .998; TLI = .998, χ/df = 76.66; $p < .001$; RMSEA = .01, 90% CI [.00; .02]. No significant difference was found between MSMPC at T1 and T2 ($p = .56$) and between perceived stress at T1 and T2 ($p = .24$), which confirms metric and scalar invariance for MSMPC and perceived stress. Therefore, for both constructs full metric invariance could be established.

Structural Equation Model

Table 2 displays the results. Figure 1 show the longitudinal and reciprocal associations between MSMPC and perceived stress. The hypothesized model suggested a good model fit, CFI = .96; TLI = .95; χ^2/df = 2.92; $p < .001$; RMSEA = .05, 90% CI [.04; .05].

Regarding our first hypothesis, findings showed that stress at T1 did not significantly predict MSMPC at T2, $b = .04$, $SE = .03$, $\beta = .06$, $p = .230$. Thus, H1 was not supported.

In our second hypothesis, we assumed that MSMPC would increase perceived stress over time. Supporting H2, our findings revealed that MSMPC at T1 significantly predicted stress at T2, $b = .12$, $SE = .05$, $\beta = .10$, $p = .026$.

In terms of covariates, we found that more educated people reported more MSMPC at T2, $b = .14$, $SE = .07$, $\beta = .09$, $p = .028$. In addition, our findings revealed that women perceived significantly more stress than men at T2, $b = -.18$, $SE = .08$, $\beta = -.09$, $p = .027$. Moreover, communicative smartphone use had no significant effect on MSMPC, $b = .02$, $SE = .04$, $\beta = .02$, $p = .658$ or on perceived stress over time, $b = -.05$, $SE = .06$, $\beta = -.04$, $p = .417$. Non-communicative smartphone use had no significant effect on MSMPC, $b = .01$, $SE = .04$, $\beta = .02$, $p = .772$, but the relationship with perceived stress was close-to-significant, $b = .11$, $SE = .06$, $\beta = .12$, $p = .052$.

Discussion

Concerns about mobile privacy deprivation seem to be rising in an overly connected age. Large amounts of personal information can be shared via smartphones anytime and anywhere. Linking privacy concerns with stress is a relevant indicator of how concerns about social media information immerse with offline psychological states. Our aim was to investigate the reciprocal relationship of MSMPC and perceived stress by means of a longitudinal two-wave study. For the first time, we examined the reciprocal relationship of MSMPC and perceived stress following the APCO framework. Although we could not confirm the reciprocal relationship, our findings suggest a longitudinal link between the two.

First, our results revealed that perceived stress does not positively predict MSMPC. This non-significant finding could mean that stress is not a predictor and does not increase MSMPC over time. This is at odds with the finding that loneliness – which correlates with stress symptoms (Deberard & Kleinknecht, 1995) – predicted SNS privacy concerns (Lutz & Ranzini, 2017). Following Bogdan et al. (2012), we had hypothesized that stress would decrease one's perception of control over mobile social media and therefore result in higher privacy concerns, but found no support for this assumption.

Several explanations for this null finding are possible. First, the T2 sample consisted of people with significantly lower stress levels than the T1 sample. Low stress levels may not lead to MSMPC, while the expected effect of stress on MSMPC may be present in people with relatively high stress levels. Second, there might be an indirect effect via a variable we did not capture, e.g., the type of stress individuals experience. Previous research has shown that SNS related stress increases emotional exhaustion and depression because individuals experience information overload (e.g., Lim & Choi, 2017). SNS related stress refers to the experiences and activities conducted online and not necessarily to stressful situations in real-life. Because individuals might already be worried about many other aspects of their lives, they might simply diminish the relevance of this online aspect.

Second, our findings showed that MSMPC positively predicted perceived stress over time. This result is in line with previous findings showing that feelings of insufficient privacy are directly associated with psychological stress (Webb, 1978). For instance, Osatuyi (2015, p. 330) suggests that "ambiguity in the privacy policies has been noted as a source of stress and frustration for social media users". Indeed, this perceived uncertainty about individual rights and management of privacy settings might be one of the main reasons why MSMPC result in stress. Our result can further be explained with previous finding that online vigilance, i.e., "users' permanent cognitive orientation towards online content and communication", increases perceived stress levels on a daily basis (Reinecke et al., 2018, p. 1). In other words, being overly attentive and occupied with social media as well as monitoring social media activities results in stress.

MSMPC positively predict perceived stress over time even when controlling for communicative and non-communicative uses of smartphones. There are several reasons for this result from a mobile social media perspective. Social media platforms require sharing personal information when users join the platform. In that way a great deal of personal information is stored on social media platforms and can be used by social media companies or even third parties. Personal information is not controlled or owned individually, but other individuals can post information or photographs of other users. Therefore, privacy management is interpersonal and respective agreements should be made (De Wolf, 2020). Moreover, social media platforms oftentimes use location-based services that are built in their applications which collect users' personal information. In that way users' locations are being tracked because a great deal of private information is provided by the mobile device (Zhou & Li, 2014). These technological possibilities can aggravate privacy concerns. Our result suggests that due to the concerns about shared private information on mobile social media individuals may feel a lack of control and helplessness.

The idea of not knowing what will happen to personal information shared online already implies a certain vulnerability. Previous research has shown that perceived vulnerability increases privacy concerns (Dinev & Hart, 2004; Mohamed & Ahmad, 2012). The finding that privacy attitudes lead to stress over time also suggests that when people do not behave in line with their privacy attitudes (privacy paradox), they experience stressful cognitive dissonance (Ding & Liu, 2019; Festinger, 1957).

Although previous studies found that privacy concerns positively predict protection behavior on SNSs (Mohamed & Ahmad, 2012), our finding regarding mobile SNSs point to a different direction. Instead of actively engaging in protection of personal information, individuals seem to feel imposition and lack of control over their personal information, i.e., they experience higher stress levels due to MSMPC. Perceived stress might lead to either data protection behavior or, on the contrary, discontinuance of using mobile SNSs (Zhou & Li, 2014). Mobile SNS users experiencing privacy concerns may think that they do not have sufficient time resources to actually learn how to protect their privacy online. The resulting feeling of helplessness may increase perceived stress levels in response to privacy concerns.

Furthermore, it is important to note that perceived stress as a state, as measured over time in this study, can be an indicator of general well-being. Against this background, our findings are particularly interesting because they extend the well-established APCO model by showing the broader consequences of privacy concerns on individuals' psychological states.

In terms of covariates, it was not surprising that level of education positively predicted privacy concerns. Previous research has established a positive association between the two variables (e.g., Cecere et al., 2015; Hwang et al., 2012). Likewise, we were not surprised to find gender to be a significant predictor of stress. There are several potential explanations of why gender influences MSMPC. As shown in previous research, women are more concerned about the effects of online information gathering on their personal privacy (Sheehan, 1999) and have significantly higher concerns about information privacy compared to men (Benamati

et al., 2017). This correlation could be attributed to different, gender-specific socialization

processes in terms of emotional self-disclosure (e.g., Stokes, Fuehrer, & Childs, 1980) and

can be more vulnerable to information leaks. Youn and Hall (2008) found that girls perceive

more online privacy risks than boys. Therefore, the gender effect could be present because of

the socialization toward stressful experiences. Girls oftentimes perceive more stress which

points out their higher awareness and sense of responsibility. Our finding contributes to the

current body of research in so far as other studies have focused on higher privacy concerns of

women, rather than on stress per se (Cho et al., 2009; Gosh & Singh, 2018). However, we

have not focused on the gender aspect in detail and based on our data we cannot make further

inferences. Future research should dive into this aspect more specifically. Nevertheless, we

can conclude that it is necessary to control for education and gender when investigating

privacy concerns and stress.

Regarding smartphone use, we did not find any direct effects of communicative and

non-communicative uses on MSMPC and perceived stress over time. This was expected,

because direct linear effects are not sufficient to describe the complex relationship between

MSMPC and perceived stress. Further moderators and mediators, such as previously

experienced privacy violations or risky behaviors are needed to explain these associations.

Limitations and Suggestions for Future Research

Some methodological limitations should be noted. Most importantly, the present panel

study employed only two waves of data collection which are sufficient to detect a linear

relationship. Yet, in order to investigate a potential downward spiral effect, as proposed by

Wadhwa and Salkever (2018), more measurements would be necessary. With three or more

waves, one could test such a reinforcing loop between MSMPC and perceived stress.

Frequent measurements would additionally account for the dynamic nature of stress.

We measured stress using retrospective self-reports (e.g., "In the last month how often did

you feel like..."). Such reports of stress could be distorted by memory bias (Segerstrom &

O'Connor, 2012; Scharkow, 2019). As a more valid measurement, Trull and Ebner-Priemer (2013) introduced ambulatory assessment. This assessment method allows for frequent near real-time measurements and has proven useful in the study of stress (Rodrigues, Paiva, Dias, & Cunha, 2018; see Naab, Karnowksi & Schlütz, 2019). In future studies, participants could report their immediate stress levels on their smartphones every time they experience MSMPC (mobile experience sampling) which would account for robust measurement of stress as a state.

On a conceptual level, this study is based on two variables across two-time points. Additional variables would further strengthen the results and the contribution of this study. For example, including several dimensions of perceived stress and variables related to it such as anxiety as a trait might be relevant. Assessing personality traits could further explain different susceptibility to perceived stress due to MSMPC. We did not distinguish between different dimensions of privacy concerns, e.g., social and institutional as suggested by previous research (e.g., Lutz & Ranzini, 2017;). Because SNS use implies a social dimension in terms of sharing personal information with other people it would be meaningful to include this dimension in future research.

Future research could further investigate potential underlying mechanisms between MSMPC and perceived stress. For instance, perceived control, need for control, trust in SNS, SNS related stress, or rewards gained from SNSs could account for further explanation of the processes. However, because privacy settings are logically a subject of concern, when they are adapted accordingly they might even reduce perceived stress (Dhir & Midha, 2014). This situation implies possible positive outcomes of privacy concerns, which can mean changes in privacy protection. In terms of positive outcomes, studies could also test if privacy concerns (and resulting stress) are reduced when social media applications with high data encryption standards are used.

Implications

Our results also have important implications regarding the Privacy Calculus Model (PCM; Culnan, 1993; Culnan & Armstrong, 1999; Dienlin & Metzger; Dinev & Hart, 2004; Krasnova, Spiekermann, Koroleva, & Hildebrand, 2010). This model proposes that when the estimated benefits of SNS use are higher than the perceived risks, individuals are more likely to disclose personal information (e.g., Dienlin & Metzger, 2016). Our findings reveal an additional risk by showing that MSMPC result in higher levels of perceived stress, which might decrease the intention to disclose personal information in the long term.

There are also several practical implications regarding the SNS context and the mobility of devices. Collectors of personal information, individuals or companies, invade people's privacy, whenever and wherever due to mobile smartphones and can cause stress. At the very least, more transparency about it should be warranted to users. Policy makers and SNS users should recognize privacy concerns as a source of stress and tackle them by adapting privacy settings, disengaging from social media, or by assuring stricter policies of the social networks management. In that sense, privacy concerns and associated distress may advance privacy policy and implementation. Social media executives must understand that if they do not handle personal information confidentially, they risk discontent of their users who may become less active or even stop using their service entirely.

Securing transparent information about the use and the distribution of individual's personal information might be a necessary condition to tackle the negative outcome of privacy concerns. Factors like the communication of fair procedures while collecting individuals' personal information might also decrease privacy concerns and corresponding stress. Transparency and fair use make people more secure when sharing personal information than privacy related scandals (Culnan & Armstrong, 1999). In the future, individuals' privacy concerns might become even more important, as more and more information is shared online. Therefore, more transparent data protection policies on SNSs are necessary to ensure that individuals feel comfortable using SNSs in the long term.

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Table 1.

Correlations

		1	2	3	4	5	6	7	8	9	10
1	Age (T1)	1									
2	Gender (T1)	.17***	1								
3	Education (T1)	-.20***	-.01	1							
4	Occupation (T1)	.31***	-.02	-.11***	1						
5	Communicative use (T1)	-.25***	.01	.10*	-.14***	1					
6	Non-communicative use (T1)	-.47***	-.03	.13***	-.17***	.72***	1				
7	Perceived Stress (T1)	-.32***	-.10**	.04	-.05	.19***	.29***	1			
8	Perceived Stress (T2)	-.21***	-.13**	-.01	.05	.13**	.20***	.62***	1		
9	Mobile Social Media Privacy Concerns (T1)	.10**	.01	.05	.02	-.01	-.05	.10*	.14***	1	
10	Mobile Social Media Privacy Concerns (T2)	-.02	-.02	.13**	.00	.04	.03	.11*	.15***	.60***	1

Note. $N_{T1}=$ 833, $N_{T2}=$ 461, T1 = Time 1, T2 = Time 2; $^*p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

Table 2.

Results of the structural equation model

Predictor	Mobile Social Media Privacy Concerns (T2)			Perceived stress (T2)		
	b	*SE*	*β*	*b*	*SE*	*β*
Age (T1)	-0.00	0.00	-0.05	-0.01	0.00	-0.08
Gender (T1)	-0.00	0.06	-0.00	-0.18*	0.08	-0.09
Education (T1)	0.14*	0.07	0.09	-0.04	0.09	-0.02
Occupation (T1)	0.02	0.02	0.04	0.03	0.02	0.06
Communicative use (T1)	0.02	0.04	0.02	-0.05	0.06	-0.04
Non-communicative use (T1)	0.01	0.04	0.02	0.11	0.06	0.12
Perceived Stress (T1)	0.04	0.03	0.05	0.65***	0.05	0.65
Mobile Social Media Privacy Concerns (T1)	0.62***	0.05	0.64	0.12*	0.05	0.09
R^2		0.43			0.46	

Note. $N_{T1} = 833$, $N_{T2} = 461$, T1 = Time 1, T2 = Time 2; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$
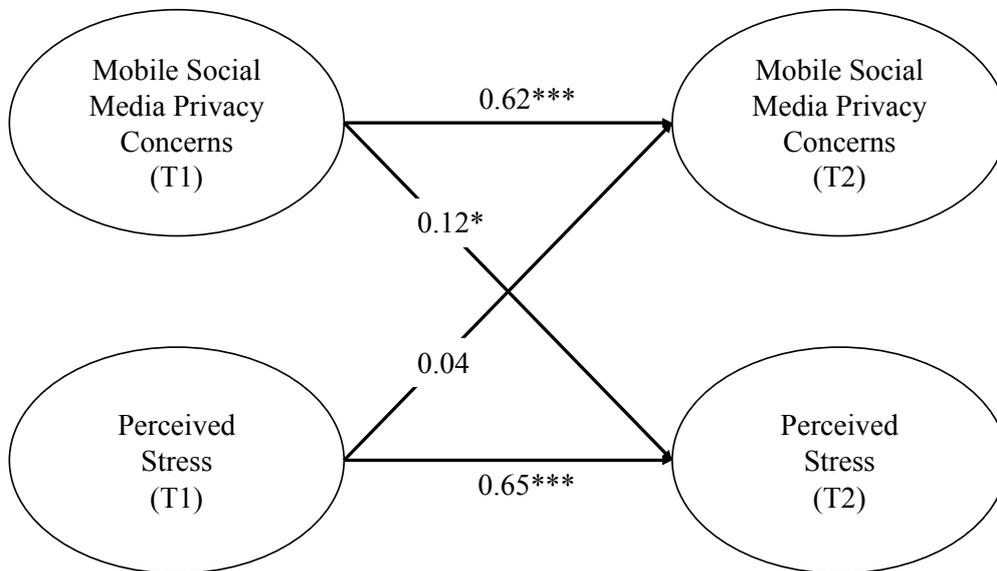
Figure 1. The final model examining the longitudinal, auto-regressive, and reciprocal associations between Mobile Social Media Privacy Concerns and Perceived Stress suggests a good model fit, CFI = .96; TLI = .95; χ^2/df = 2.920; $p < .001$; RMSEA = .05, 90% CI [.04; .05]. Ovals present latent variables. The control variables are omitted due to clarity of presentation. We controlled for age, gender, education, occupation, communicative and non-communicative uses of smartphones.

Note. $N_{T1} = 833$, $N_{T2} = 461$, T1 = Time 1, T2 = Time 2; $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Online Appendix A

Mobile social media privacy concerns. Respondents were asked to indicate their

agreement with three items on a 5-point Likert scale (1 = *do not agree at all*, 5 = *agree*

completely): "The use of social media platforms on the mobile phone carries a considerable

data protection risk"; "I worry about my privacy when I use social media platforms on the

phone"; "I am concerned that data from social media platforms on my phone has been

collected without my consent" ($M = 3.69$; $SD = 0.96$; $\alpha = 0.89$ at T1, $M = 3.55$; $SD = 1.04$; $\alpha =$

0.90 at T2).

Perceived stress. We asked participants to indicate the frequency of particular stress

symptoms on a 6-point Likert-scale (1 = *never*, 6 = *several times a day*): "In the last month

how often did you feel like you had to do things, even though you did not want to do them";

"did you feel criticized or judged"; "did you feel as if there were so much trouble that you

could not overcome it"; "did you have too many worries?" ($M = 2.57$; $SD = 1.14$; $\alpha = 0.88$ at

T1; $M = 2.38$; $SD = 1.14$; $\alpha = 0.89$ at T2).