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Smartphone uses and emotional and psychological well-being in China: the attenuating role of perceived information overload

Xueqing Li [a] and Michael Chan [b]

[a]School of Media and Communication, Shanghai Jiao Tong University, Shanghai, People's Republic of China; [b]School of Journalism and Communication, The Chinese University of Hong Kong, Shatin, Hong Kong

ABSTRACT

Smartphone ownership is growing rapidly in China. Using a national sample of smartphone users, this study examined how different uses of the smartphone were related to emotional and psychological well-being, while examining the mediating role of perceived information overload. Results showed that social use, informational use, and entertainment use of the smartphone were positively associated with various indicators of well-being, while social use of the smartphone was also related to perceived information overload. Moreover, perceived information overload mediated the relationship between social use and psychological well-being. The findings point to the important role of perceived information overload in attenuating the potential positive effects of social uses of the smartphone on well-being.

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Smartphone uses; social use of the smartphone; information overload; emotional well-being; psychological well-being

1. Introduction

The smartphone has experienced unprecedented growth in China. More than 700 million people own a smartphone as mobile Internet users have increased from 39.5% to 98.6% of the total Internet users within a decade (CNNIC 2019; Statista 2019b). As a device that integrates the functions of the mobile phone and personal computer, the smartphone affords users always-on connectivity with friends and acquaintances, access to burgeoning information, and various entertainment options. There is little doubt that such wide diffusion of the smartphone in the everyday activities of people's lives will have important psychological and behavioural consequences. One of them is users' general well-being.

Indeed, the Chinese government has extoled the importance of personal well-being among citizens as a goal that is as important as the country's economic development (Xinhua News 2017). To meet the societal need, academic scholarship has focused on subjective well-being so as to facilitate policy-making that can benefit citizens. Uses of digital technologies can affect well-being in different ways (Liu et al. 2019). For example, mobile voice or mobile messaging improves psychological well-being by alleviating feelings of loneliness and isolation (Kiat and Chen 2015; Wei and Lo 2006). However, the smartphone is not only a device that engenders well-being, it also places heavy demands on people's cognitive resources. A typical smartphone user in China has 56 apps installed on his or her phone (Cao 2019). While this facilitates anytime anywhere access to information as well as convenience to accomplish many tasks, the myriad of vibrations, notifications, ringtones, and other constant interruptions demands users' attention and cognitive resources. Multitasking and task-switching have thus become the norm, and the associated information overload may cause acute stressful responses, such as anxiety and attention deficit disorder (Kaufman-Scarborough and Cohen 2004). Recognising this danger to well-being, the Chinese government has promoted media literacy programs to reduce the risk of information overload (Xinhua News 2015), and the tech giant Tencent has also launched the 'Tech for Social Good' project to encourage innovative solutions to information overload (Tencent Research Institute 2018).

This study thus contributes to the literature by examining the role of perceived information overload in the relationship between smartphone use and subjective well-being. It builds on previous studies that have focused mainly on (1) problematic uses and modalities of smartphone communications (e.g. Chan and Li, 2020), and (2) relationships between gratifications of smartphone use and perceived information overload and well-being (e.g. Horwood and Anglim, 2020). This study focuses on the actual uses of smartphones and argues that although smartphone uses grounded in

CONTACT Xueqing Li lixueqingivory@sjtu.edu.cn School of Media and Communication, Shanghai Jiao Tong University, 800 Dongchuan Rd, Shanghai 200240, People's Republic of China

user gratifications seem to be autonomous self-choices, some uses would reduce subjective well-being. Moreover, in contrast to previous studies that conceptualised subjective well-being as a unitary concept that does not distinguish between emotional states or psychological well-being (Chen and Li 2017), this study applies a multi-faceted concept of subjective well-being by integrating both *emotional* and *cognitive* dimensions. Third, while the effects of smartphone on well-being appear to be small to negligible (Kushlev and Leitao 2020), the mechanism that people use and perceive media effects would be important to understand their well-being outcomes. Based on the temporal stage model of subjective well-being (Diener, Scollon, and Lucas 2009), this study examines the psychological mechanism through which personal appraisals and emotional reactions mediate the effects of smartphones on well-being. In particular, perceived information overload is proposed to be a personal appraisal resulting from smartphone uses, which then channels the effects of smartphone uses to emotions and cognitive well-being. Overall, this study proposes a framework that can explain the conditions in which smartphone use can positively or negatively affect psychological and emotional well-being.

2. Literature review

2.1 Smartphone uses and perceived information overload

Perceived information overload refers to a psychological experience of 'feeling burdened by large amounts of information' [Misra and Stokols (2012), p.739]. It is a perception of being overwhelmed by incoming information that exceeds people's cognitive capacity. Based on information processing models, Lang (2000) developed the limited capacity model of motivated mediated information processing (LC4MP) to examine how people can be overloaded by mediated information. A central argument is that media messages may not be thoroughly processed because individuals have limited cognitive capacity to process the information (Lang 2000, 2017).

A rich body of research has explored the sources of information overload, among which information characteristics and processing parameters are two of the most significant factors, such as the quantity of information (Hiltz and Turoff 1985) and the complexity of information processing (Bawden 2001). This study draws on two mechanisms to understand the role of the smartphone in informational overload. First, the increased amount of information can cause overload because the incoming information brought by media may exceed cognitive processing capacity (Misra and Stokols 2012). The always on and always available aspect of the smartphone have already expanded the volume of information, boosted diffusion efficiency, and increased information access.

The second reason is that the subprocesses of information processing consist of encoding, storage, and retrieval. According to LC4MP, the activation of the subprocesses affects the level of cognitive load. For instance, allocating cognitive resources to knowledge learning could be higher than the relaxing use of smartphone because the former needs more allocated resources to encode the media stimuli, store it in memory and retrieve it to interpret social issues (Lang 2000). The perception of information overload is thus dependent on the level of cognitive resources demanded by smartphone uses. Furthermore, the feeling of overload is likely to increase when new information interrupts the subprocesses and induces a loss of control.

Social use of smartphone refers to socialisation with others on social media through the smartphone. Extant research supports the positive relationship between social uses and perceived information overload. For example, two-thirds of Twitter users felt they are overloaded by too many posts (Bontcheva et al. 2013). Although some people try to limit their own online posts, most users do not limit the inflow information on social media and end up being exhausted by too much information (Gao et al. 2018; Rodriguez, Gummadi, and Schoelkopf 2014). In addition, the overall information flow is getting faster due to the diffusion of the fourth and fifth generation of cellular networks (i.e. 4G and 5G), which further delivers information at a rate higher than people's cognitive capacity to process the information.

Social use of smartphones also demands a higher level of information processing because social interaction requires people to constantly encode messages and retrieve the stored information to manage subsequent interactions. Smartphone-enabled social connections normalise the expectation for perpetual connection (Katz and Aakhus 2002) and create the 'always-on' culture that requires people to be always available and respond instantaneously to others (Turkle 2011). The temporally demanding messages tax users' cognitive resources and social media fatigue can be an outcome (Bright, Kleiser, and Grau 2015). Moreover, social use necessitates the need for multitasking and task-switching because the flow of information diverts people's attention from their primary tasks to other tasks (Przybylski and Weinstein 2013). These patterns run through the subprocesses of information processing

and lead to a positive relationship between the social use of smartphones and perceived information overload.

The association between informational use of smartphones and perceived information overload is ambivalent. On the one hand, the amount of information about social affairs has increased exponentially. Most mobile users in China have 56 applications installed on their smartphone (Cao 2019) and thereby leading to more notifications and messages that divide personal attention, distract routines, and increase cognitive overload (Kuznekoff and Titsworth 2013). On the other hand, information use is more self-directed than that of social use because users can control the pace of information encoding, storage, and retrieval to restrain information within their own cognitive capacity. In this way, the information can be used to engender faster decision-making and increased productivity (Demerouti et al. 2014).

Entertainment use of smartphones is unlikely to induce information overload because the cognitive demands for storing and retrieving the relevant information are less (Lang 2000). Entertainment use is also self-directed and entails more relaxing experiences instead of cognitive stretching (Holton and Chyi 2012). Although people may be addicted to large volumes of entertainment information (Bian and Leung 2015), they may feel more positive stimulation than negative concerns because the instant gratifications are less likely to make people anxious about the loss of self-control (Choi and Kim 2004). Based on the evidence, this study proposes the following hypotheses and research questions:

H1: Social uses of the smartphone is positively related to perceived information overload.

RQ1: How do other smartphone uses relate to perceived information overload?

2.2 Smartphone uses and subjective well-being

Subjective well-being is the personal evaluations of one's life quality and it is comprised of two dimensions: emotional well-being and cognitive well-being (Diener, Scollon, and Lucas 2009). Emotional well-being refers to an ongoing assessment of life conditions based on positive and negative affect, and cognitive or psychological well-being is a global judgment of life satisfaction (Diener, Scollon, and Lucas 2009). An overview of the literature suggests that the smartphone can have both a positive and a negative impact on subjective well-being. The complementary perspective (Ruppel and Burke 2015) suggests smartphone uses have positive impacts on emotional and psychological well-being because smartphone complements other communication channels and fulfils the need to belong for social beings (Baumeister and Leary 1995). Specifically, social use of smartphones improves psychological well-being because it reduces loneliness (Wei and Lo 2006), satisfies the need for affection (Chen and Katz 2009), and facilitates social integration (Campbell and Kwak 2010).

Informational use of smartphones enables people to stay informed about up-to-date news and provides them resources to regulate affective states and psychological well-being (Hoffner and Lee 2015). For instance, informational use of smartphone can promote health knowledge to the elders and helps them maintain a healthy lifestyle (Boontarig et al. 2012). The entertainment use of smartphone shields users from stressful or challenging situations and give them chances to relax and pass time. Listening to music is a coping strategy to release anxiety and maintain mental health (Skånland, 2013). Mobile gaming decreases loneliness and increases physical and psychological wellness (Yang and Liu 2017). Such uses of smartphones can be a respite from problems and bring in psychological benefits.

In contrast to the complementary perspective, the displacement hypothesis proposes that smartphone uses reduce face-to-face interaction that is important for satisfactory social relationships (Newell 2007). The absence of smartphone in dyadic interactions increases the feeling of connectedness and empathetic concerns (Misra et al. 2016) while the presence of a smartphone reduces the quality of time with friends and attenuates the positive effects of face-to-face interaction on subjective well-being (Rotondi, Stanca, and Tomasuolo 2017). Due to its always-on nature, social use of smartphones provokes anxiety, creates the feeling of entrapment, and reduces relationship satisfaction (Hall and Baym 2012). The continuous information flow enabled by smartphones generates various kinds of interruptions and leads to habitual checking as well as compulsive use of smartphones (Van Deursen et al. 2015). In addition, entertainment use may provide too many incitements that raise anxiety and stress to hamper psychological well-being (Lee et al. 2014).

To summarise, the seminal studies drawing on different theoretical perspectives conclude that smartphone uses have both positive and negative effects on subjective well-being. More recent research applied the relational dialectic theory to examine the dual role of the smartphone and showed that smartphone uses have dialectic impacts on social interaction (Chan 2018). Based on these perspectives, this study contends that smartphone uses do have influences on subjective well-

being. However, it is not sufficient to propose specific hypotheses because the extant literature is mainly focused on smartphone modalities rather than uses. Moreover, research examining smartphone usages tends to isolate different smartphone uses and limit the substantial conclusions about the integrated smartphone influences. As such, our study asks the following research question:

RQ2: How are the smartphone uses (social use, informational use, and entertainment use) related to subjective well-being?

2.3 The mediating roles of perceived information overload and emotions

The temporal stage model of subjective well-being explains how the influence of external events on well-being is channelled by personal appraisals and emotional reactions. In particular, external events such as media stimuli trigger personal appraisals and translate the influences to emotional reactions and then lead to a global judgment of cognitive well-being (Diener, Scollon, and Lucas 2009). In our study, perceived information overload is a personal appraisal resulted from media stimuli, and channels the effects on emotions and psychological well-being (Figure 1).

Specifically, perceived information overload is coupled with negative emotions because overload is defined as a lack of capacity to process information or a loss of control over the flow of information (Bawden, Holtham, and Courtney 1999). This can create psychological uneasiness such as overwhelming and distress (Wilson 2001). According to LC4MP, information overload is a typical negative stimulus that activates the aversive system, which projects negative emotions to protect people from potential threats (Lang 2000). Some empirical findings have supported the positive associations between perceived information overload and negative emotions. For instance, too much information on the Internet makes people feel stressed and depressed (Misra and Stokols 2012) and users overloaded by social media messages suffer exhaustion and fatigue (Lee, Son, and Kim 2016).

Furthermore, information overload negatively affects psychological well-being through emotions because overload will not be conceived until the volume of information amplifies the harmful properties like negative emotions to the level of exacerbated personal well-being (Himma 2007). Even if users could limit their smartphone use, the burgeoning information creates new anxieties such as 'fear of missing out' (FOMO) and results in decreased psychological well-being (Alt 2015).

In addition, there has been little attention to the relationships between the two components of subjective well-being – emotional and cognitive well-being. According to the temporal stage model of subjective well-being, emotional well-being is the foundation to assess cognitive well-being because emotion is a source of information utilised by individuals to evaluate psychological well-being (Diener, Scollon, and Lucas 2009). Those who have positive emotions are likely to judge their life as satisfactory while those in a negative mood hold a pessimistic view about life (Mahmoud et al. 2012). As such, this research further asks:

H2: Perceived information overload is positively related to negative emotions.

H3: Perceived information overload and negative emotions will mediate the relationship between social use of smartphones and psychological well-being.

RQ3: Would positive emotions and negative emotions mediate the relationships between other smartphone uses (informational use and entertainment use) and psychological well-being?

RQ4: Would perceived information overload mediate the relationships among other smartphone uses, emotional well-being, and psychological well-being?

3. Method

3.1 Sampling

This study recruited smartphone users through Wenjuanxing (http://www.sojump.com/), one of the biggest online survey companies with more than 260 million registered users from 34 cities in China. Wenjuanxing verifies respondents' information through their email addresses and mobile phone numbers and screens invalid data by response time and IP addresses. Academic research typically employs Wenjuanxing samples to collect data on Chinese populations (e.g. Zhan et al., 2016). To be more representative, this study employed quota sampling based on the report from Statista (2019a) revealing the percentages of smartphone owners of different ages. This research retrieved 909 valid responses, with 115 respondents aged below 18 (12.65%), 398 respondents aged from 18 to 34 (43.78%), and 396 respondents aged from 35 to 54 (43.26%), which are consistent with the distribution of smartphone users in China by age group from Statista (2019a). An exception was smartphone users aged above 55 were not sampled due to the fact that online pools in China have difficulties in reaching this group of people. Besides, an initial filter question 'Do you have a smartphone?' was used to ensure that all participants were smartphone users.

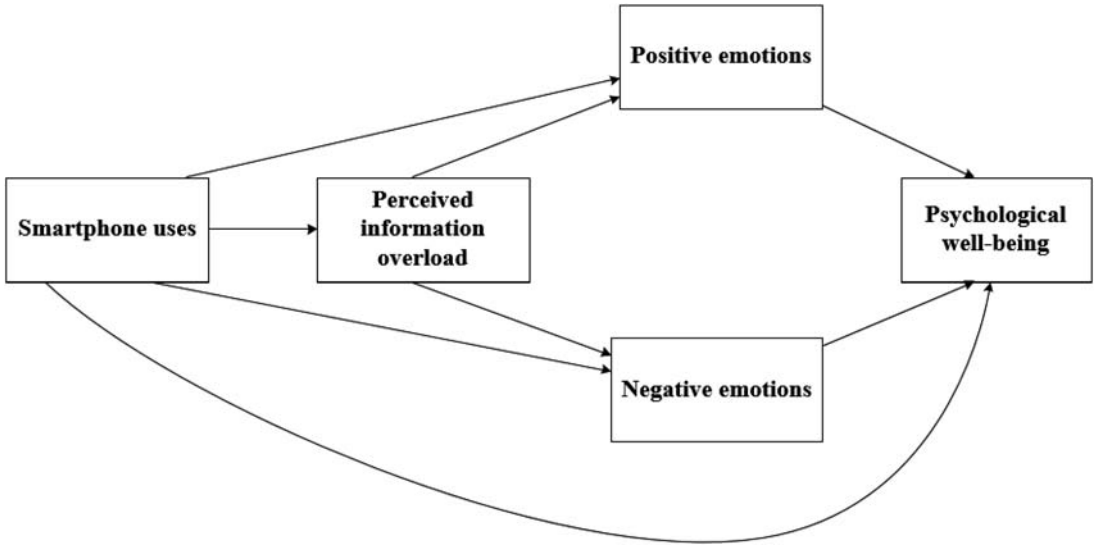

Figure 1. The proposed theoretical framework of the study.

3.2 Measures

3.2.1 Social use of smartphones

Following previous literature on smartphone use (e.g. Park and Lee 2012), items were adapted to measure social use of smartphones. Respondents were asked on a 5-point scale from 1 = never to 5 = always how often they engage in the following activities: (1) use mobile social networking applications, (2) update social media contents such as feeds and geotags, (3) send messages to friends by mobile social media, and (4) share interesting things I found to friends on mobile social media, such as photos and videos. The four items were averaged to form the scale (M = 3.51, SD = .80, *Cronbach alpha* = .75).

3.2.2 Information use of smartphones

Respondents were asked to indicate the frequency (from 1 = never to 5 = always) of using smartphones to attend the information-seeking activities adapted from Wei and Lo (2006), such as (1) search information I want to know, (2) update on news, (3) learn something in which I am interested. The seven items were averaged to form a measure of information use of smartphone (M = 3.59, SD = .54, *Cronbach alpha* = .62).

3.2.3 Entertainment use of smartphones

Conceptualised as passing time activities by smartphone, the scale was adapted from Chan (2015). Respondents were asked to indicate the frequency (from 1 = never to 5 = always) of using smartphones to attend the relaxing activities such as (1) take photos and/or videos, (2) listen to music, (3) watch videos or movies. The six items were averaged to create a measure of entertainment use of smartphone (M = 3.34, SD = .68, *Cronbach alpha* = .63).

3.2.4 Perceived information overload

The reflective self-reports of perceived information overload have been validated and adopted by previous studies (e.g. Matthes et al. 2020). The measure was adapted from Misra and Stokols (2012). It asked respondents to indicate the extent to which they agree with the following statements from 1 = strongly disagree to 5 = strongly agree: (1) I often feel overwhelmed with the number of messages I receive on my smartphone, (2) It takes too much effort to manage the contact lists and groups on my smartphone, (3) Sorting all the information on my smartphone takes up too much of my time, and (4) I have too many apps on my smartphone. The scores were averaged to form the scale (M = 3.02, SD = .78, alpha = .75).

3.2.5 Positive and negative emotions (SPANE-P and SPANE-N)

Respondents indicated how often (from 1 = never to 5 = a lot) they experienced different emotions based on the Scale of Positive and Negative Experience (SPANE) (Diener, Scollon, and Lucas 2009): (1) Positive, (2) Happy, (3) Good, (4) Joyful, (5) Contented, (6) Afraid, (7) Angry, (8) Bad, (9) Negative, and (10) Sad. SPANE-P was computed by adding the scores of the five positive emotions (M = 18.65, SD = 3.20, Min = 8, Max = 25, alpha = .82), and SPANE-N was computed by adding the scores of negative emotions (M = 12.66, SD = 3.41, Min = 5, Max = 24, alpha = .81).

3.2.6 Psychological well-being (PWB)

The Psychological Well-Being Scale (PWB) (Diener, Scollon, and Lucas 2009) was employed to ask respondents to rate how strongly they agree with the eight items (from 1 = strongly disagree to 5 = strongly agree) such as 'I lead a purposeful and meaningful life,' 'My social relationships are supportive and rewarding,' and 'I am optimistic about my future.' The scores were added to form the measure ($M = 30.70$, SD = 4.40, Min = 13, Max = 40, alpha = .80).

3.2.7. Demographics

Demographic data included age ($M = 4.83$, SD = 2.16; 4 = 25–29, 5 = 30–34; increments of 5 years), gender (46.9% male), education ($M = 4.75$, SD = .73; 4 = senior high school, 5 = bachelor degree), monthly income ($M = 2.52$, SD = 1.01; 2 = 2001–5000 RMB, 3 = 5001–10,000 RMB) and smartphone ownership ($M = 3.7$, SD = 1.42; 3 = 4-5 years, 4 = 6–7 years).

4. Results

Structural equation modelling was employed to examine the research hypotheses and questions. At first, a partial correlation matrix was created to encompass all the variables while controlling for the demographics. The result shows that the three types of smartphone use were moderately related. Perceived information overload was positively associated with all the types of smartphone use, though the relationships were relatively weak. Regarding the dimensions of subjective well-being, SPANE-P and PWB were positively related to all the smartphone uses, and SPANE-N was positively related to perceived information overload.

According to the criteria suggested by Hu and Bentler (1999), our structural equation modelling based on the partial correlation matrix indicated an accepted model fit: χ^2 (1) = 4.26, $p = .04$; CFI = 1.00; TLI = .93; RMSEA = .06; SRMR = .01. The standardised coefficients were summarised in Figure 2. The data showed that social use of smartphone positively predicted perceived information overload ($\beta = .12$, $p < .01$), while informational use ($\beta = .02$, $p > .05$) and entertainment use ($\beta = .04$, $p > .05$) were not related to perceived information overload. H1 was supported. Moreover, H2 asked about the impacts of perceived information overload on SPANE-P. The result suggested perceived information overload positively predicted SPNAE-N ($\beta = .21$, $p < .001$). H2 was supported.

Regarding RQ2 about the relationships between smartphone uses and subjective well-being, the results showed that SPANE-P was positively predicted by informational use ($\beta = .16$, $p < .001$) and entertainment use ($\beta = .10$, $p < .01$), while SPANE-N was not significantly related to all the smartphone uses (social use: $\beta = .04$, $p > .05$; informational use: $\beta = -.07$, $p > .05$; entertainment use: $\beta = -.02$, $p > .05$). Meanwhile, PWB was positively predicted by social use ($\beta = .06$, $p < .05$) and entertainment use of smartphone ($\beta = .07$, $p < .05$).

RQ3 asked about the mediating roles of SPANE-P and SPANE-N in the relationships between smartphone uses and PWB, while H3 and RQ4 were about the serial mediations from smartphone uses to PWB through perceived information overload and emotional well-being. Data analyses revealed that the influences of informational use ($\beta = .081$, $p < .001$) and entertainment use ($\beta = .052$, $p < .01$) on PWB were significantly mediated by SPANE-P. Moreover, only the impact of social use on PWB was mediated by perceived information overload and SPANE-N in a serial way ($\beta = -.004$, $p < .05$).

A more parsimonious model can be retrieved by removing the insignificant relationships, which generated a better model fit with χ^2 (7) = 11.64, $p = .11$; CFI = 1.00; TLI = .99; RMSEA = .03; SRMR = .02. However, this study retained the first model because it was theory-based. In addition, the substantive findings in the two models were consistent to test the research questions and hypotheses.

5. Discussion

In a media-saturated world, people rely on smartphones and other media to stay informed about society and maintain their personal well-being. Situated in China, this study explicated the types of smartphone use and their influences on subjective well-being. More importantly, based on the temporal stage model of subjective well-being and LC4MP, this study explores the role of perceived information overload as an outcome of smartphone uses, as well as a mediator in the relationships between smartphone uses and psychological well-being. The result suggests that smartphone uses have an overall positive effect on subjective well-being. Meanwhile, perceived information overload and positive emotions are important mediating mechanisms that engender the relationships.

Our research echoes the concept of intermediality that explicates the combined functions of media affordances and their integrated influences on psychological outcomes (Helles 2013). That is, instead of being attentive to a specific media use or a singular media modality, researchers need to hold a holistic view to examine the integrated media effects derived from the configuration of various smartphone uses and affordances. This is because the individual effect and the integrated effect

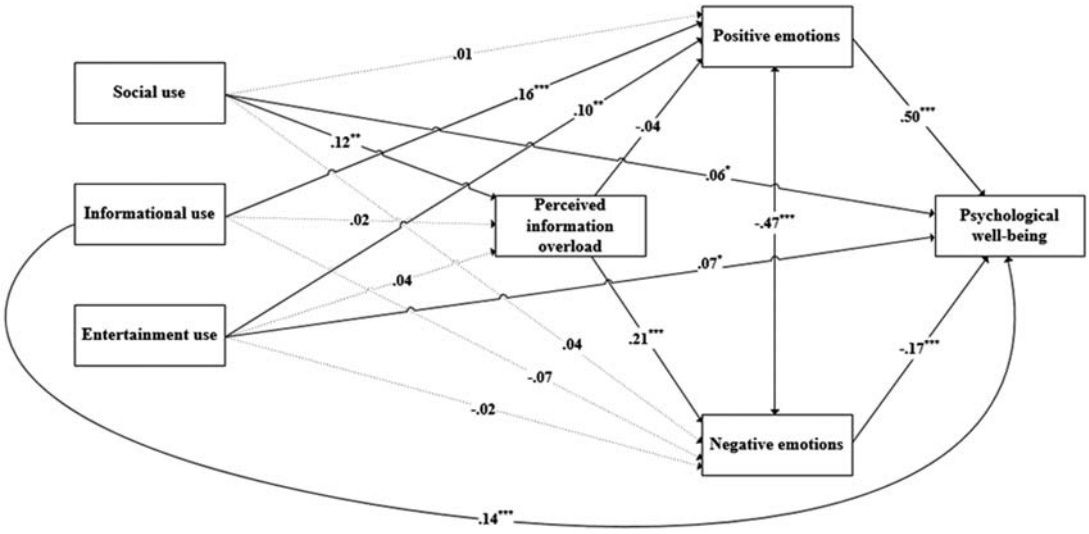

Figure 2. Direct and indirect influences of smartphone uses on well-being. Numbers are standardised beta coefficients. *$p < .05$, **$p < .01$, ***$p < .001$. R^2 for PWB = .46.

of smartphone use can be remarkably different. According to the partial correlation analyses (Table 1), all the smartphone uses are positively related to perceived information overload. However, only the effect of social use is retained when all smartphone uses are integrated into the path model as a whole (Figure 1). In fact, the functions of smartphones are not likely to be applied in isolation but complement each other in daily use, and have integrative effects on psychological consequences. For instance, social use of smartphones not only helps users extend social interaction but also keep them informed about social affairs. Therefore, it is essential to synthesise the dimensions of smartphone use constructed by technological affordances and systematically examine their impacts on psychological consequences.

Moreover, our study endorses the complementary perspective on media effects as all the smartphone uses positively predict psychological well-being. A plausible reason is the smartphone is now an all-in-one device embedding online and offline social relations and activities. While online and offline contexts are considered contentious at the onset of the Internet, smartphones can not only facilitate new activities but also maintain existing social ties and interactions. For instance, mobile social media are used to keep in touch with old friends (Quan-Haase and Young 2010) and provide information to supplement offline communications (Humphreys and Hardeman 2021). In this way, smartphones can augment personal needs and benefits.

It is also consistent with our hypotheses that social use of the smartphone leads to perceived information overload. As indicated by the literature review, such an association can be explained by the information characteristics such as amount and intensity, as well as the demanding procedures of information processing. When few subprocesses are demanded and the processes are under control, the psychological stress for information processing tends to be low. In contrast, social use of smartphone activates multiple subprocesses because it involves information and interruptions from different parties, which demands more cognitive resources to address the information overload.

Admittedly, there are more mechanisms that can be applied to examine the association between social use and perceived information overload, especially from the view of social relationship management. For instance, smartphones can be used to fulfil the need to belong in social interactions (Baumeister and Leary 1995). Yet, it may also inflate the expectation for reciprocal interaction since it provides a vehicle for perpetual access and open communication, which could be detrimental to personal autonomy or independence. To summarise, smartphones extend relational dialectics in the context of mobile-mediated communication by allowing for conflicting desires such as connectedness and separateness, openness and closeness (Baxter and Braithwaite 2008), which increases cognitive loads for interactants to undertake social interactions.

Previous studies suggest that information overload mainly results from media channels, such as email and phone calls (Bawden, Holtham, and Courtney 1999), and a potential solution would be to limit one's access to media channels since information overload is seen by some as a failure of information filtering (Shirky

Table 1. Partial correlations of main variables.

		(1)	(2)	(3)	(4)	(5)	(6)
1	Social	1.00					
2	Informational	.46***	1.00				
3	Entertainment	.44***	.42***	1.00			
4	PIO	.15***	.09**	.10**	1.00		
5	SPANE-P	.12***	.20***	.17***	−.02	1.00	
6	SPANE-N	.03	−.04	−.01	.21***	−.46***	1.00
7	PWB	.21***	.31***	.24***	.04	.63***	−.41***

$N = 896$. All betas are standardised coefficients. *$p < .05$, **$p < .01$, ***$p < .001$

2008). However, our findings suggest that smartphone uses can be sources of perceived information overload irrespective of the availability of media channels. The power of communication technology does not necessarily ascribe to media affordances but lies in its capacity to construct a new context or ecology for communication. Smartphones create spaces for social interaction that allows for gratification fulfilments but also breeds some negative elements extended to users' perceptions and behaviours, such as perceived information overload. As a consequence, an intentional restraint of media access cannot be an effective way to handle overload generated by the media environment. Instead, the communication environment shaped by technology would be a better starting point to deal with information overload.

Perceived information overload resulted from social use of smartphones deteriorates subjective well-being by promoting negative emotions, indicating that perceptions and negative emotions work conjointly to negate the positive influence of social uses on psychological well-being. The mediation effect empirically attests to the temporal stage model of subjective well-being which indicates that external events trigger personal appraisal or perception, which translates the influences to emotional reaction and finally affects cognitive well-being. In our study, social use of smartphones as external stimuli promoted the perception of information overload, information overload then bolstered negative emotions, based on which the positive impacts of social use on psychological well-being actually become negative.

Besides the negative mediation effects of social use on psychological well-being, this research adds to the literature about the mechanisms through which media uses are related to personal well-being. While previous studies revealed that social capital intensifies the positive effects of mobile phone uses on psychological well-being (Chan 2015; Chen and Li, 2017), our study further found that positive emotions can channel the positive effects of smartphone uses on psychological well-being, including informational use and entertainment use of smartphones. In fact, psychological well-being is based on diverse aspects of personal lives and requires a lot of cognitive resources to oversee all the relevant information, but emotion can be employed as a source to make an inference about psychological well-being because it is an ongoing process that can be easily judged as positive or negative (Diener, Scollon, and Lucas 2009). As emotions are not ephemeral sentiments but an effective element to affect cognitive well-being, it is necessary to combine media use, emotions, and cognitive responses to explicate the multiple determinants of life quality.

Furthermore, the results provide empirical findings to support the relationships between hedonic well-being and eudaimonic well-being (Ryan and Deci 2001). Hedonistic well-being focuses on emotions or affects while eudaimonic well-being is concerned about life meaningfulness, a cognitive dimension reflected by psychological well-being. The two forms of well-being are moderately associated as emotional problems deteriorate psychological health and emotional congruence benefits psychological development (DeNeve and Cooper 1998). Future research should examine the more complex dynamics between hedonistic and eudaimonic well-being, such as how some negative emotions like painfulness or emotional fluctuations contribute to psychological well-being in the long term.

6. Conclusions

To summarise, informational use and entertainment use of smartphones have positive impacts on subjective well-being directly or indirectly through positive emotions, while social use of smartphones reduces psychological well-being through perceived information overload and negative emotions. This research extends the literature about the positive and adverse mechanisms on how smartphone uses work on subjective well-being. In particular, affect can be a channel to transfer the positive impacts of smartphone uses to well-being, and has thus been a recent new factor to guide media effect research, such as sentiment analysis. Moreover, smartphone uses lead to negative outcomes not only due to the displacement effect nor problematic uses such as addiction and impulsive behaviours (Choliz

2010) but also because media creates a communication space where the floods of information would be beyond individual's capability to process.

These findings have practical implications. First, the design of mobile media should take users' cognitive capacity into account as all-in-one media platforms may overload users rather than promote access and convenience. Lee, Son, and Kim (2016) suggested that technology overload is increased as social media platforms are updated with increasingly more complex features. Similarly, information-intensive media and multimodal information (e.g. texts, pictures, and videos) may achieve less engagement and attention from users. Second, media uses grounded in gratification could be beyond one's personal control, and thus becomes a psychological stressor in information processing. One solution is to improve users' media literacy that contributes to users' cognitive resources so they can have more personal control over the process of information processing (Cohen, 1980).

7. Limitations

Several limitations have remained in this study. Despite our attempt to attain a representative sample of China, it was hard to reach those aged 55 and beyond through an online survey. As the effects of smartphone use on well-being vary across generations (Chan 2018), future research should adopt other sampling methods to engage the older generations in research. Second, the causal effect cannot be assumed through the cross-sectional design. Future research that employs panel samples and physiological data can elaborate more on the causal influence of communication technology on information overload and then on well-being. Third, this study addresses how emotional well-being impacts cognitive well-being based on the temporal stage model of subjective well-being, but it stands to reason to assume a reversed effect from psychological well-being to emotions because life quality can also affect emotions. Despite these limitations, this study makes an important contribution by explicating the different conditions in which smartphone use can positively and negatively affect well-being.

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ORCID

Xueqing Li http://orcid.org/0000-0002-4133-5953
Michael Chan http://orcid.org/0000-0001-9911-593X

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