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'Age Matters': A panel study investigating the influence of communicative and passive smartphone use on well-being

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ABSTRACT

Communicative and passive online use have been shown to affect individuals' well-being in opposite ways. While communicative use is often associated with beneficial outcomes, passive use may even harm individuals' well-being. However, existing studies have paid insufficient attention to the influence of age on these associations. Additionally, little evidence is available regarding the impact of communicative and passive *smartphone* use on individuals' well-being across the life-span. Drawing upon the theoretical approaches of Socioemotional Selectivity Theory, Social Convoy Model, and Social Compensation Hypothesis, we assumed that particularly communicative smartphone use may be beneficial for older adults' well-being, helping them to maintain their personal relationships. Results of a two-wave panel survey ($N_{T2} = 461$) revealed a significant negative influence of passive smartphone use on well-being irrespective of age. In line with the Socioemotional Selectivity Theory and Social Compensation Hypothesis, communicative smartphone use, however, only had a positive influence on well-being for adults older than 63 years, but not for younger adults. Our findings contribute to a broader understanding of the consequences of different types of smartphone use on well-being across generations in the longitudinal context.

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Smartphone use; communicative smartphone use; passive smartphone use; age; well-being

In recent years, we have been witnessing a rapid increase in smartphone usage, with nowadays 77% of adults who own a smartphone (Pew Research Center 2018). The majority of smartphone users spend three to five hours per day on their mobile phone devices (Statista 2018). First evidence from a 28-day smartphone tracking study suggested that the intensity of mobile phone use was not only high among adolescents, who spent on average 193 minutes a day on their smartphones, but also remarkably high among older age groups. More specifically, individuals older than 51 years used their smartphones 118 minutes on an average day (Andone et al. 2016). In this sense, smartphones have become a relevant tool for communicating, staying connected, and maintaining social relationships across all age groups (Vorderer, Krömer, and Schneider 2016). The constant accessibility to others via messages, smartphone-calls, and social networking sites (SNS) such as Facebook or Instagram, enables smartphone users to stay in touch with their close and distant ties anytime and anywhere (Ellison et al. 2014; McFarland and Ployhart 2015; Vorderer, Krömer, and Schneider 2016). These social activities and available applications enhance the need to use smartphones intensively and to be permanently online (e.g. van Deursen et al. 2015; Vorderer, Krömer, and Schneider 2016). Moreover, recent studies suggest that passive consumption (i.e. viewing or reading content) is among the most prevalent smartphone-related activities (Elhai et al. 2017). Similarly, passive use is more common than active use regarding SNS (Wang et al. 2018). These findings are crucial given that empirical findings suggest that passive use increases smartphone addiction and problematic use (Elhai et al. 2017; van Deursen et al. 2015).

Despite the extant body of literature, researchers have not yet examined the role of users' age, which might moderate the beneficial and harmful influences of smartphone use on well-being. Socioemotional Selectivity Theory states that with increasing age, people invest in particular significant relationships and disengage from other social relationships (Carstensen 1992). Following the Social Convoy Model (Kahn and Antonucci 1980; Antonucci and Akiyama 1987), individual's social relations can change across the life course. The inner-circle consists of core family members and close friends that remain a highly

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stable social network over time (Wrzus et al. 2013). To the contrary, the least close ties such as work colleagues are the least stable relationships and change over time due to pivotal life stages such as retirement. The changes in the individual's social convoy also occur due to the loss of members which mostly happens during older adulthood. The scarcity of personal ties in older adulthood can lead to social isolation (Cho 2015), which can in turn negatively influence mental health and consequently harm overall well-being (Lowenthal 1964). In this context, the Social Compensation Hypothesis suggests that those who have difficulties in maintaining offline social networks might benefit disproportionately from online communication or Internet use serving communicative purposes (Kraut et al. 2002; Valkenburg, Schouten, and Peter 2005). Building upon these approaches, we theorise that smartphone use is particularly beneficial for older people's well-being. Their real-life social contacts are often reduced due to their withdrawal from the workforce or due to health reasons, which impede frequent personal contact. However, using the smartphone for communicative purposes may compensate for these declines. Yet, researchers have thus far neglected to systematically investigate how different smartphone usage patterns affect individuals' well-being as a function of age.

Specifically, we have identified three major research gaps. First, existing research investigating the associations between smartphone use and well-being is dominated by cross-sectional surveys (e.g. Elhai et al. 2017; van Deursen et al. 2015). Consequently, those designs not only prohibit conclusions about the direction of the relationship between smartphone use and well-being, but also preclude inferences about the long-term consequences. Second, previous studies suggest that certain types of online communication such as communicative or social activities positively influence well-being (Burke and Kraut 2016; Oh, Ozkaya, and LaRose 2014), whereas other types of use, mainly passive or non-communicative use, undermine well-being (Verduyn et al. 2015; Wang et al. 2018). In the past, researchers have either focused on the use of SNS in general or on single SNS platforms such as Facebook. Yet, when investigating influences on well-being, researchers have largely neglected the miscellaneous activities carried out on a device that is becoming a permanent companion in individuals' daily life (Vorderer, Krömer, and Schneider 2016): the smartphone. Third and most importantly, researchers have virtually neglected older age cohorts when investigating the consequences of smartphone use for well-being. With only a few exceptions (e.g. Cho 2015; Hardy and Castonguay 2018; van Deursen et al. 2015), researchers have mostly employed samples of college students or adolescents (e.g. Chen et al. 2016; Frison and Eggermont 2015; Vorderer, Krömer, and Schneider 2016). There is some evidence suggesting that age might be the reason for existing contradicting results, since smartphone use in middle and late adulthood might not bear the resemblance of younger generations' usage patterns (Cho 2015; Hardy and Castonguay 2018; van Deursen et al. 2015). For instance, Chan (2015b; 2018) has showed that the influences of communicative mobile use on well-being vary across generations. However, it is not yet clear how age moderates the associations between specific smartphone use and well-being.

To address the identified research gaps, the present study draws upon the theoretical frameworks of Socioemotional Selectivity Theory, Social Convoy Model, and Social Compensation Hypothesis. We aim to advance the field by highlighting the role of age when investigating the influence of communicative and passive smartphone use on well-being. In doing so, we employed a two-wave panel design, which allows us to draw causal inferences about the direction of the effects. Overall, this study contributes to the ongoing debate of positive and negative consequences of smartphone use on individuals' well-being. Beyond that, our study sheds new light on the opportunities and risks of smartphone use across the life span.

1. Theoretical background

Socioemotional Selectivity Theory suggests that the motivations for maintaining social relationships differ across the life span (Carstensen 1992). According to the theory, the two main social motives are knowledge acquisition and emotion regulation. Specifically, these motivational differences depend on the resources of time individuals have at a certain age. The size of the social network is regulated based on the time constraints which shift motivational priorities for investing in social relationships (Carstensen, Isaacowitz, and Charles 1999; see also Wrzus et al. 2013). More specifically, as people age they perceive the time as finite which motivates them to devote greater importance to emotional satisfaction (Carstensen 1992). At a young age, people perceive their life time as unlimited. Therefore, they prioritise knowledge acquisition and invest their time in meeting new people and expanding their social network. Individuals in older age become aware of their increasingly limited life time. Thus, they prioritise emotional goals (Carstensen, Isaacowitz, and Charles 1999). Hence, their focus is directed more toward their close ties rather than their distant ones. This preference results in positive emotional outcomes and satisfaction with the size of their social network (Lansford, Sherman, and Antonucci 1998). It is already during early and middle adulthood that individuals start narrowing their social network and focus more on close relationships because they secure fulfilment and higher well-being (Carstensen 1992; English and Carstensen 2014).

Additionally, the Social Convoy Model adds to the theoretical framework of studying social relationships and their influences on well-being over time (Antonucci, Ajrouch, and Birditt 2013). Convoy refers to the individual's dynamic circles of close social ties. According to the model, an 'individual is surrounded by supportive others who move with them throughout the life course' (Antonucci, Ajrouch, and Birditt 2013, 84). In that sense, social convoy is explained by three main concentric circles. The first one refers to the closest ties (e.g. partner and the family) and these relationships are stable throughout the life. The second circle includes members that are more than the simple fulfilment of role requirements (e.g. relatives, friends) and these relationships might change over time. The third circle refers to the least close ties (e.g. work colleagues or neighbours) that are most likely to change over the life-course (Antonucci, Ajrouch, and Birditt 2013; Antonucci and Akiyama 1987; Kahn and Antonucci 1980). In particular, retirement from the work force affects the third circle as this life transition marks a point in life when older adults no longer have the opportunity to socialise with their work colleagues on a daily basis (Antonucci and Akiyama 1987). In a similar way to Socioemotional Selectivity Theory, social convoy theory makes assumptions for changes with regard to the increasing age as well as with regard to emotional closeness (Antonucci and Akiyama 1987). During young and middle adulthood, individuals invest more time in social relationships outside the family, e.g. in friends and co-workers than in older adulthood (Sherman, Wan, and Antonucci 2015). Additionally, older age groups experience more losses of support network members than younger adults because more people in their social network pass away (Antonucci and Akiyama 1987). Therefore, individuals' social convoy decreases as individuals age. To define the older age threshold, we followed Akman's (2009) definition in which he states that the start of older adulthood begins in the age group between 60 and 65 years.

In support of the Socioemotional Selectivity Theory, researchers showed that the association between quality of social interactions and subjective well-being is stronger for older respondents than for younger ones (Pinquart and Sörensen 2000). However, this development may not always benefit well-being of older age groups. Since the selectivity of preferred social contacts increases as adults age, disengagement from distant or weak social ties becomes more apparent (Carstensen 1992). In certain life situations, people in late adulthood experience societal withdrawal, due to retirement or health disadvantages (Cumming and Henry 1961). One way to buffer negative consequences of social isolation, might be through online communication (i.e. via smartphones) with social ties.

In this context, the Social Compensation Hypothesis adds that communicative online activities may mitigate feelings of detachment and assist older individuals with relationship maintenance. The Social Compensation Hypothesis postulates that individuals compensate for the lack of face-to-face friendships by extending their online social sphere (e.g. Valkenburg, Schouten, and Peter 2005; Zywica and Danowski 2008). That is, smartphone communication may serve as a bridging function between individuals and their close and distant social ties by increasing social engagement (Kim, Wang, and Oh 2016). Chesley and Johnson (2014) found that the main motivation for adopting new technologies is precisely because of 'the maintenance of intergenerational ties' (p. 597). More specifically, researchers have shown that communication with family and friends represents one of the key motivations for elderly people to use the Internet (Chou, Lai, and Liu 2013). Moreover, Ling (2008; 2010) explains that the mobile phone can provide unique affordances based on the preferences and characteristics of different age groups. For example, adolescents and young adults use social media channels and send text messages more frequently than older adults, whereas older adults rely more heavily on calling and sending e-mails (Chan 2018; Ling 2008; 2010).

The role and experiences of various new technologies which support and complement communication also differ across generations (Chesley and Johnson 2014). On the one hand, the so-called digital natives are born into a technologically-driven society and they are used to shape their social lives with the technology. On the other hand, the so-called digital immigrants had to adapt to the new technological possibilities and change their social habits, which can result in different approaches and usage styles (Prensky 2001). In line with this reasoning, existing research shows clear generational differences in mobile usage patterns (Chan 2015b; 2018). In particular, older age groups experience more social support following communicative mobile use, i.e. calling or mobile voice use, whereas younger age groups have more negative emotions related to mobile voice use (Chan 2018). Applied in this context, Socioemotional Selectivity Theory as well as Social Compensation Hypothesis provide a valuable theoretical framework to investigate the role of age in the association between smartphone use and well-being.

2. Literature review and hypotheses

2.1. Communicative and passive smartphone use and well-being

Smartphone use typically refers to a larger number of channels and activities, which are often used for social

interactions, maintaining close and distant relationships, and enhancing friendships (e.g. Ellison et al. 2014). However, smartphone use is not limited to social activities only, but consists of several different usage types (van Deursen et al. 2015). Therefore, a one-sided perspective is not sufficient in explaining the complexity of smartphone usage and its consequences. To avoid reductionism of the activities which are occurring on smartphones, researchers differentiated between communicative usage patterns and non-communicative, that is, passive usage patterns, often also referred to as process usage (Elhai et al. 2017; van Deursen et al. 2015). This distinction taps into the differentiation of communicative and passive use proposed by researchers investigating SNS use (Burke, Marlow, and Lento 2010; Wang et al. 2018). On the one hand, communicative usage patterns refer to the individual's engagement with others through participation in conversations, exchanging messages, calling, or simply reacting to other's content (e.g. Chan 2015a; Burke and Kraut 2016). On the other hand, passive usage patterns may be defined as non-communicative activities, observation of the content, as well as information seeking without any social or communicative engagement (e.g. Chan 2015a; Wang et al. 2018). Such a distinction is crucial for explaining the influences of smartphone use, because it summarises multiple functions which may relate to various outcomes (Chan 2015a). Particularly, in the context of SNS use, scholars have been investigating the consequences of communicative and passive usage patterns for individuals' well-being. Considering that SNSs, such as Facebook, are the most frequently used smartphone applications among adults (Pew Research Center 2019a, 2019b), these findings are also highly relevant in the context of smartphone use and its impact on well-being.

Defined as a multidimensional concept, well-being entails individuals' overall satisfaction with life (e.g. Diener, Oishi, and Tay 2018; Dodge et al. 2012). Securing positive levels of well-being is highly relevant, as it has important benefits on individuals' effective functioning in various domains in life, i.e. in relationships or in the workplace (Diener, Oishi, and Tay 2018). Researchers emphasise the importance of social networks, friendships, and positive relationships for securing high levels of well-being (Dodge et al. 2012; Ryff and Singer 2008). In this sense, well-being has broader effects on communities and society at large (Diener, Oishi, and Tay 2018).

In line with the established concepts, communicative use on SNSs, has been shown to positively influence individuals' well-being (see review by Clark, Algoe, and Green 2018). For instance, Vorderer, Krömer, and Schneider (2016) demonstrated that staying connected with others through smartphones and social media is more relevant for users than merely browsing or observing the content. Moreover, a large body of research indicates positive effects of communicative use suggesting that this type of use leads to increased social support (Manago, Taylor, and Greenfield 2012), reduced loneliness (Deters and Mehl 2012), higher levels of self-esteem (Valkenburg, Peter, and Schouten 2006), and increased social capital (Chan 2015a; Cho 2015). Additionally, van Deursen et al. (2015) asserted that using the smartphone for social experiences is rewarding, because it creates feelings of pleasure after receiving, for example, a notification on the social media account. Burke and Kraut (2016) examined the longitudinal benefits of online communicative use in detail, suggesting that receiving targeted and composed messages from close ties on Facebook enhances well-being over time. Extrapolating these previous findings into the context of smartphone use, we propose the following hypothesis:

H1: Communicative smartphone use will positively predict individuals' well-being over time.

With regard to passive, or non-communicative SNS use, a large body of literature indicated detrimental effects for individuals' well-being (Verduyn et al. 2015; Verduyn et al. 2017). Passive SNS use has been associated with depressive symptoms (Escobar-Viera et al. 2018), envy (Verduyn et al. 2015), negative social comparison (Vogel et al. 2014), or loneliness (Song et al. 2014). Chen et al. (2016) suggested that passive SNS use undermines well-being by reducing individuals' self-esteem. Corroborating these findings, Chan (2015a) found that passive (i.e. non-communicative) SNS use negatively predicted subjective well-being. Similarly, Burke and Kraut (2016) demonstrated that in contrast to other SNS activities, merely scrolling through online content posted by SNS contacts does not improve well-being. In a longitudinal panel study, Wang et al. (2018) also found that passive SNS use predicted lower levels of well-being over time. However, less is known about the relationship of passive *smartphone* use and well-being. First empirical evidence suggests that reducing overall smartphone use, for instance during bed-time, benefits individuals' well-being (Hughes and Burke 2018). Moreover, especially non-communicative smartphone use has been shown to lead to compulsive or problematic smartphone use (Elhai et al. 2017; van Deursen et al. 2015), which, in turn, has been related to stress (Lee et al. 2014). In the light of these findings, we assume that overall passive smartphone use will harm individuals' well-being. Accordingly, we hypothesise:

H2: Passive smartphone use will negatively predict individuals' well-being over time.

2.2. The moderating role of age

Regardless of the rise of smartphones, researchers have widely established the positive influence of social interactions on individuals' overall well-being (e.g. Diener 2000). One of the core dimensions of well-being are affirmative relationships with others (Ryff and Singer 2008). However, the quantity and quality of social relationships may vary with age. As suggested by Socioemotional Selectivity Theory (Carstensen 1992), older compared to younger adults, focus on relationships which help them enhance and maintain higher levels of well-being (Carstensen, Isaacowitz, and Charles 1999; Luong, Charles, and Fingerman 2011). For instance, Larson, Mannell, and Zuzanek (1986) showed that in late adulthood, friends have a stronger positive influence on well-being than family members, due to more active leisure time spent with them as well as satisfying personal exchanges. These findings were confirmed in a study by Huxhold, Miche, and Schüz (2013), who investigated the benefits of friendships in middle and older adulthood. Results showed that informal social activities with friends, especially in older age, have not only enhanced well-being, but have also reduced negative affect (Huxhold, Miche, and Schüz 2013).

However, when it comes to late adulthood, these meaningful relationships with friends may be difficult to maintain. According to the Social Convoy Model, late adulthood is often marked by changes in individuals' social network, which can be caused by retirement, health issues, and the loss of close members (e.g. Antonucci and Akiyama 1987). These life changes can reduce active engagement with others. Long-term social deficits may impose negative mental health outcomes, which are associated with depression (House 2001; Elhai et al. 2017). Due to a decrease in mental health caused by social isolation (Lowenthal 1964), the lack of real-life social interactions may lead to even more dissatisfaction among older people. Social Compensation Hypothesis postulates that individuals might compensate for the reduced face-to-face interactions with online communicative activities (e.g. Valkenburg, Schouten, and Peter 2005; Zywica and Danowski 2008).

Thus, in line with the Socioemotional Selectivity Theory, the Social Convoy Model, and the Social Compensation Hypothesis, we suggest that older individuals benefit from communicative smartphone use more than younger individuals. Researchers have established the improvement of social relationships with increasing age. Specifically, findings from previous research suggest that people in later life are more satisfied with their social relationships, which benefits their well-being (Luong, Charles, and Fingerman 2011; Löckenhoff and Carstensen 2004). Thus, testing the moderating role of age when investigating the effects of smartphone use on well-being is crucial. Accordingly, we propose the following hypothesis:

> H3: The positive influence of communicative smartphone use on well-being will increase with age over time.

Previous research suggests that mostly communicative online use leads to higher levels of well-being (e.g. Burke and Kraut 2016; Clark, Algoe, and Green 2018), whereas the opposite is true for passive online use (e.g. Verduyn et al. 2017; Wang et al. 2018). Moreover, in the context of smartphone use, it has been shown that age negatively influences both social (i.e. communicative) and process (i.e. passive) usage (van Deursen et al. 2015). However, whether age also moderates the influence of passive usage on individuals' well-being has not been established in this research. Taking the moderating role of age into account, Hardy and Castonguay (2018) found that SNS use can enhance anxiety for older but not for younger individuals. The authors explained this effect by the higher enjoyment of multitasking among younger cohorts. However, little is known about the role of age in the association of passive smartphone use and well-being. To our knowledge, no study thus far has considered age as a moderator when investigating the influence of passive smartphone use on well-being. Due to the lack of empirical findings, we thus state the following research question:

> RQ: Does age moderate the association between passive smartphone use and well-being over time?

3. Method

3.1. Participants and procedure

We conducted a two-wave panel survey ($N_{T2} = 461$) with a professional research institute in Germany. We collected data at two-time points between March/April 2018 (Time 1, T1) and July/August 2018 (Time 2, T2). The total number of participants in the first survey wave reached 833 (54.1% women) and in the second survey wave 461 (53% women), aged from 18 to 65 years old. In the first wave the mean age was 45.44 and in the second wave 48.65.

Based on previous research in this field and due to practical considerations, we chose the time lag of four months between both waves (e.g. Yao & Zhong 2014; Van Zalk et al. 2011). Within this timeframe we could keep a low attrition rate in the second wave, and assess possible behavioural changes, as is the case for slightly longer intervals (Ye and Ho 2018). The main

requirements to participate in the survey were the following: (1) ownership of an internet-enabling mobile phone (i.e. smartphone); (2) use of at least one social media channel on the smartphone; (3) minimum age 16 years (due to legal reasons).

Prior to survey participation, we informed the respondents that the survey deals with their smartphone and SNS use and we ensured anonymity. Only those respondents who provided their consent could continue with the questionnaire. A quota-sampling procedure was applied with regard to gender, age, and education in Germany. The sample was not restricted to any upper age limit. For the quota sampling procedure, participants had to indicate their age group in the first step. Our descriptive analysis revealed that after the second wave there were 12.1% participants between 16 and 29 years; 13.9% were 30–39 years old; 21.3% were 40–49 years old; 23.6% were 50–59 years old; and 29% were 60 years old and above. The representation of smartphone users in older age cohorts in our sample corresponds with the recent Pew Research data (2018) showing that smartphone ownership drops after the age of 65. More precisely, in the age group of 50–64 years, there are 73% of U.S. Americans who own a smartphone device. Above the age of 65, however, only 46% are smartphone owners. Against that background, the representation of older age groups is considerably high in our survey with older adults being the highest represented age group. In a second step, we also asked participants' exact age at the end of the survey.

The overall attrition rate between the two survey waves was 45%. To examine whether attrition biased our sample, we examined the differences between those who participated in both waves and those who participated in one wave only. The analysis indicated that participants who dropped out at Time 2 had a slightly higher communicative ($F(1,831) = 15.162$, $p < .001$) and passive smartphone use at Time 1 ($F(1,831) = 30.289$, $p < .001$). Additionally, participants who dropped out were significantly older than those who remained in the sample ($F(1,831) = 42.643$, $p = < .001$). However, participants who dropped out at Time 2 did not differ with regard to their well-being at Time 1 ($F(1,831) = 0.62$, $p = .433$). The analytical sample of this study was restricted to participants who took part in both survey waves ($N = 461$). All the following descriptive statistics and data analyses are based on this sample.

3.2. Measures

We used formative indices to assess communicative and passive smartphone use. That is, the construct of communicative and passive smartphone use can be conceived of the combination of several different indicators, i.e. smartphone activities (Diamantopoulos and Siguaw 2006).

Communicative smartphone use. To assess communicative smartphone use, we followed the items used by Chan (2015a). The participants indicated their responses on a 6-point scale, ranging from 1 ('never') to 6 ('several times during the day'). We used five items asking participants how often they used their smartphone to (1) talk to their family, (2) talk with their friends, (3) communicate with others on social media, (4) read or send emails, and (5) post or send photos or videos on social media platforms ($M = 3.46$; $SD = 0.99$ at Time 1).

Passive smartphone use. We measured passive smartphone use, i.e. non-communicative smartphone use, with seven items adopted from Chan (2015a). The respondents indicated on a 6-point scale how often they used SNSs on their smartphones ranging from 1 ('never') to 6 ('several times during the day'). Specifically, we asked respondents how often they use their smartphone for (1) reading online news, (2) getting information on, e.g. Wikipedia or blogs, (3) listening to radio, podcasts, or music, (4) watching movies or video clips on, e.g. YouTube or Netflix, (5) playing games, (6) taking pictures or videos with their smartphone, and (7) viewing profiles of friends and families on social media platforms ($M = 2.85$; $SD = 1.09$ at Time 1).

Age. We assessed age using a single item asking participants to indicate their age in years ($M = 48.38$ years, $SD = 13.01$, ranging from 18 to 65 years at Time 1).

Well-being. Following similar studies investigating smartphone or SNS use and well-being (e.g. Chan 2014; Verduyn et al. 2015; Volkmer and Lermer 2019; Wang et al. 2018; see Lyubomirsky, King, and Diener 2005 for a review), we measured well-being with the Satisfaction with Life Scale (SWLS) developed by Diener et al. (1985). We also chose the SWLS because it has been described as suitable for all age ranges (Diener et al. 1985). We asked respondents to indicate their agreement on a 5-point Likert scale, ranging from 1 ('strongly disagree') to 5 ('strongly agree'). We included the following five statements: 'In most ways my life is close to my ideal'; 'The conditions of my life are excellent'; 'I am satisfied with my life'; 'So far I have gotten the important things I want in life'; and 'If I could live my life over, I would change almost nothing' ($\alpha = .91$; $M = 3.20$; $SD = 0.93$ at Time 1, $\alpha = .88$; $M = 3.27$; $SD = .90$ at Time 2).

Covariates. We assessed individuals' gender and educational level as covariates. The latter was grouped into a binary dummy variable with a low education category subsuming educational degree below a high school degree (67.2%) and a high education category subsuming

high school degree and higher degrees (32.8%). Furthermore, we assessed individuals' regular face-to-face contact with three items adapted from Jin and Park (2012). Specifically, we asked respondents to indicate the number of (a) family members ($M = 10.97$, $SD = 37.46$ at Time 1), (b) relatives ($M = 6.72$, $SD = 15.13$ at Time 1), and (c) friends ($M = 12.35$, $SD = 25.90$ at Time 1) they see at least once a year. We additionally assessed the average time individuals spend with (a) family members ($M = 105.48$, $SD = 136.30$ at Time 1), (b) relatives ($M = 23.23$, $SD = 45.55$ at Time 1), and (c) friends ($M = 43.82$, $SD = 75.72$ at Time 1) in minutes per day with one item respectively.

3.3. Data analysis

We tested our hypotheses using stepwise linear regression analyses in *R* (Figure 1).[1] Only respondents who participated in both waves were included in the analyses. In Model 1 (Table 2), we tested the main effects of all predictors at Time 1 on well-being at Time 2. In addition to our hypothesised predictors, we controlled for participants' gender, education, as well as for the number of family members, relatives, and friends, the participants see at least once a year.[2] Moreover, we controlled for the autoregressive effect of well-being at Time 1 on well-being at Time 2 in all analyses. To test the moderating effect of age, we computed interaction terms between age and communicative smartphone use as well as age and passive smartphone use at Time 1 using the *interactions* R package (Long 2019). We included the interaction terms separately in our analyses to avoid issues of multicollinearity. Model 2 (Table 2) presents the analysis including the interaction effect of age and communicative smartphone use, while Model 3 (Table 2) shows the analysis including the interaction effect of age and passive smartphone use. The interaction plot (Figure 3) was generated with the *jtools* R package (Long 2018).

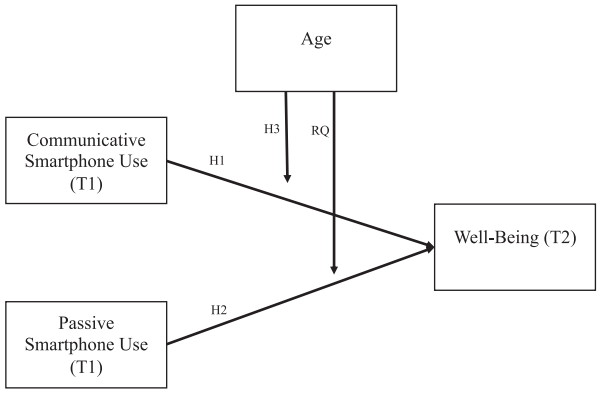

Figure 1. Hypothesised model.

4. Results

Table 1 presents descriptive statistics, that is, range of variables, means, standard deviations, and zero-order correlations. Table 2, Figures 2 and 3 present all of our results. Our first hypothesis (H1) assumed that communicative smartphone use would positively predict individuals' well-being over time. However, we found no significant influence of individuals' communicative smartphone use at Time 1 on their well-being at Time 2 ($b = 0.03$, $SE = 0.04$, $p = .464$), thus H1 was not supported.

In our second hypothesis (H2), we assumed that passive smartphone use would negatively predict individuals' well-being over time. Our results confirmed a negative, significant influence of passive smartphone use at Time 1 on individuals' well-being at Time 2 ($b = -0.08$, $SE = 0.04$, $p = .049$). That is, our second hypothesis (H2) was supported.

Next, we tested whether age moderated the influence of communicative smartphone use at Time 1 on well-being at Time 2. Our results showed a positive, significant interaction effect of age and communicative smartphone use at Time 1 on individuals' well-being at Time 2 ($b = 0.01$, SE = 0.00, $p = .025$, see Table 2, Model 2). That is, our third hypothesis (H3) was confirmed. Next, we probed this interaction effect using the Johnson-Neyman procedure (Hayes and Matthes 2009). The analysis revealed that there was a significant effect of communicative smartphone use on well-being (Time 2) for those over 63 years (see Figure 3). For those younger than that age, we found no significant effect of communicative smartphone use on well-being (Time 2).

As for the interaction effect of age and passive smartphone use at Time 1, our results did not show a moderating effect of age on the relationship between passive smartphone use at Time 1 on well-being ($b = 0.00$, $SE = 0.00$, $p = .123$, see Table 2, Model 3), which answers our research question (RQ). Overall, the predictors explained 56% of the variance in well-being (Time 2).

4.1. Additional analyses

Against the background of Socioemotional Selectivity Theory and the Social Convoy Model, which suggest that adults decrease the contact with weak ties (e.g. distant friends and acquaintances) but increase the contact with strong ties (e.g. family members) as they age, we additionally tested if number of family members, relatives, or friends interacted with communicative or passive smartphone use and age on well-being. To that end, we tested three-way interactions between smartphone use, age, and number of face-to-face contacts

Table 1. Descriptive statistics and zero-order correlations.

		Min	Max	M (*SD*)	1.	2.	3.	4.	5.	6.	7.
1.	Age (T1)	18	65	48.38 (13.01)	1						
2.	Gender (T1)	1	2	1.46 (0.49)	.122**	1					
3.	Education (T1)	1	7	3.98 (1.76)	−.200***	−.004	1				
4.	Communicative smartphone use (T1)	1	6	3.45 (0.99)	−.212***	.017	.045	1			
5.	Passive smartphone use (T1)	1	6	2.84 (1.09)	−.391***	−.015	.135**	.717***	1		
6.	Well-being (T1)	1	5	3.20 (0.92)	.107*	−.036	.120*	.108*	.052	1	
7.	Well-being (T2)	1	5	3.27 (0.90)	.059	−.041	.064	.049	−.014	.744***	1

Note. $N = 461$, T1 = Time 1, T2 = Time 2; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 2. Results of the linear regression analyses.

	Well-being (T2)		
	Model (1)	Model (2)	Model (3)
Constant	1.30*** (0.20)	2.21*** (0.45)	1.78*** (0.37)
Age (T1)	−0.004 (0.002)	−0.02** (0.01)	−0.01* (0.01)
Gender (T1)	−0.02 (0.06)	−0.02 (0.06)	−0.02 (0.06)
Education (T1)	−0.05 (0.06)	−0.05 (0.06)	−0.05 (0.06)
Well-being (T1)	0.73*** (0.03)	0.74*** (0.03)	0.74*** (0.03)
Number of friends (T1)	−0.00 (0.001)	−0.00 (0.001)	−0.00 (0.00)
Number of family members (T1)	−0.00^{+} (0.00)	−0.00^{+} (0.00)	−0.00^{+} (0.00)
Number of family relatives (T1)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Communicative smartphone use (T1)	0.03 (0.04)	−0.24^{+} (0.13)	0.02 (0.04)
Passive smartphone use (T1)	−0.08* (0.04)	−0.07^{+} (0.04)	−0.23* (0.10)
Communicative smartphone use*age (T1)		0.01* (0.002)	
Passive smartphone use*age (T1)			0.00 (0.00)
Observations	459[a]	459[a]	459[a]
R^2	0.56	0.57	0.57
Adjusted R^2	0.55	0.56	0.56
Residual Std. Error	0.60 ($df = 449$)	0.60 ($df = 448$)	0.60 ($df = 448$)
F Statistic	64.36*** ($df = 9$; 449)	58.94*** ($df = 10$; 448)	58.34*** ($df = 10$; 448)

[a]Two cases are missing due to invalid answers in the variable Number of Friends.
+$p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

(i.e. with family members, relatives, and friends; not shown in Table 2). Our data revealed no support for three-way interaction effects neither for communicative nor for passive smartphone use. Additionally, we tested whether the time spent per day with family members, relatives, or friends had a significant interaction effect with age and smartphone use on well-being. Testing the three-way interactions of smartphone use, age, and quantitative time with family members, relatives, or friends on well-being also revealed no significant relationships.

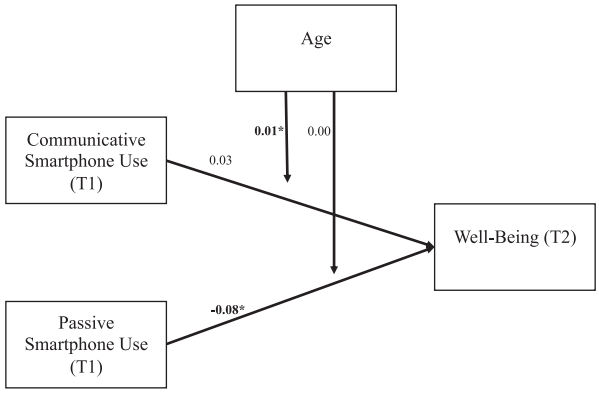

Figure 2. Unstandardised path coefficients.

Note. Controlled for well-being (T1), gender, education, number of family members, number of relatives, and number of friends, participants see at least once a year.

However, we did find significant negative correlations between age and time spent per day with relatives ($r = -.14$, $p = .001$) and friends ($r = -.18$, $p < .001$), but not family members ($r = -.08$, $p = .08$) at Time 1. These findings suggest that older individuals indeed spend less time with relatives and friends than younger ones, but they do not have less contact with family members than younger ones. No significant correlations were found between age and the mere number of family members ($r = -.01$, $p = .71$), relatives ($r = .01$, $p = .71$), and friends ($r = -.02$, $p = .60$) individuals see at least once a year at Time 1.

5. Discussion

The goal of our study was to examine how different types of smartphone use, that is communicative and passive usage patterns, are related to well-being over time. As a key contribution of our study, we have focused for the

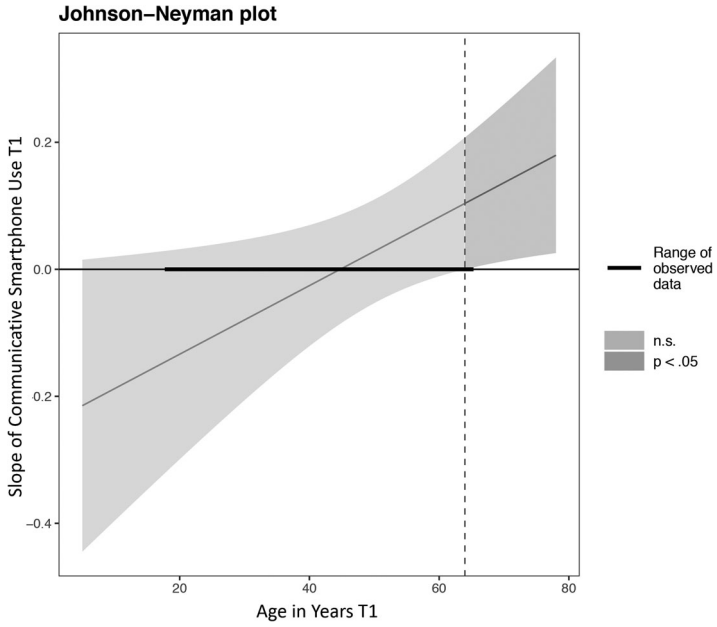

Figure 3. Interaction effect of communicative smartphone use and age.

Note. Controlled for well-being (T1), gender, education, number of family members, number of relatives, and number of friends, participants see at least once a year.

first time on the highly relevant—but mostly neglected—role of age as a moderator of the effects of smartphone use on well-being. Existing research focusing on age differences in SNS communication (Chan 2018; Cho 2015; Hardy and Castonguay 2018; van Deursen et al. 2015) suggests that age is a crucial variable when investigating the consequences of smartphone and SNS use on well-being. Drawing from the theoretical approaches of Socioemotional Selectivity Theory, Social Convoy Model, and Social Compensation Hypothesis, we, therefore, assumed that age might condition the associations between smartphone uses and well-being over time.

Extrapolating findings from prior research that indicate positive outcomes following more active and social-oriented SNS use (see review by Clark, Algoe, and Green 2018), we have tested the direct influence of communicative smartphone use on well-being over time. Inconsistent with the literature, we did not find support for a universal positive influence of communicative smartphone use on individuals' well-being. Therefore, we cannot claim a direct positive effect of communicative smartphone use on well-being across age cohorts. Instead, our results showed that the influence of communicative smartphone use was contingent on individuals' age. We found that individuals aged 63 and older, benefitted from communicative smartphone use. That age corresponds with the average age of retirement in Germany, therefore suggesting that communicative smartphone use is particularly beneficial for those who are not in the workforce anymore, thus naturally reducing the number of people they are seeing each day. This finding is in line with the Social Convoy Model (Kahn and Antonucci 1980), which suggests that close relationships with co-workers do 'not transcend the work environment or persist after retirement' (Antonucci and Akiyama 1987, 519). Additionally, adults in and above this age group may experience health-related problems, and some can be administered to nursing homes, or care facilities, where their regular contacts with close social ties are diminished. These assumptions were confirmed through the additional correlation analyses, which indicated that individuals with increasing age spent less time with friends and relatives in comparison to younger ones. Although our analysis does not allow a definite conclusion about the reasons for that effect, from a theoretical standpoint it may be assumed that using the smartphone for communicative purposes may compensate for a lack of offline interactions in late adulthood. Although our analytical sample consisted of 66 adults aged 63 and older (14.3%), more research including older age groups is needed. The analysis also showed that more pronounced effects are to be expected for adults older than 65 years. Previous research suggests that especially for people in later life who are living in nursing homes, the new technologies can positively influence their quality of life through social connections (Chaumon et al. 2014).

Moreover, our findings are in line with previous research showing that mobile phones are important tools that can improve the aging population's quality of

life (e.g. Plaza et al. 2011). Specifically, one study has shown that older age groups understand mobile phones as devices that provide access to social support by their social network members (Martinez-Pecino, Lera, and Martinez-Pecino 2012). In another study, researchers suggested that by using a mobile phone, older age groups extend their communication with their support networks (Petrovčič et al. 2015).

Socioemotional Selectivity Theory postulates that adults start narrowing down their number of friends and social partners during adulthood based on the time they perceive to have left, that is, their impending mortality (Carstensen 1992). Reducing the number of peripheral social ties secures free time which is directed towards selected, mostly close social ties (Carstensen, Isaacowitz, and Charles 1999; English and Carstensen 2014). Older age groups focus on emotionally rewarding relationships, which help them enhance and maintain higher levels of well-being (Carstensen, Isaacowitz, and Charles 1999; Luong, Charles, and Fingerman 2011). However, if those remaining social circles do not fulfil individuals' need for social support, they might lead to dissatisfaction (Lang and Carstensen 2002; Luong, Charles, and Fingerman 2011; Rook 2009). In that sense, smartphones offer a wide range of possibilities to engage with others (e.g. via social media), which have been shown as important tools for providing social support and enhancing the subjective well-being (e.g. Chang and Hsu 2016). Our findings suggest that using the smartphone for communicative purposes (i.e. calling) may buffer negative effects associated with smaller social circles or societal withdrawal (i.e. from workplace or family home) (Zywica and Danowski 2008) and in particular benefit individuals' well-being in high age. Therefore, our findings can be interpreted in line with the Social Compensation Hypothesis, which suggests that individuals who lack offline friends use online communication and social interaction on SNS to make up for it (Frison and Eggermont 2015; Zywica and Danowski 2008).

With regard to passive smartphone use, we did not find support for a moderating role of age. In line with previous findings demonstrating negative consequences following non-social smartphone use (Elhai et al. 2017; van Deursen et al. 2015) and passive SNS use (Verduyn et al. 2017; Wang et al. 2018), we found that passive smartphone use (i.e. viewing and reading content) undermined well-being across all age groups to the same extent. Thus, our study builds upon previous research, which suggests negative outcomes after using SNS for non-communicative purposes among college students (Wang et al. 2018) and adolescents (Frison and Eggermont 2015). Specifically, we demonstrated a longitudinal negative effect of passive smartphone use on well-being, for all age groups. Our results show that overall passive activities such as scrolling through other social media profiles, gaming, reading, or searching for information online leads to lower levels of well-being and has an equal negative effect on individuals.

5.1. Limitations and future research

Inevitably, our study is subjected to several limitations. First, although we didn't restrict our sample with regard to age, the recruiting process led to a sample with participants no older than 65 years old. Our data collection was open for all individuals who were above 16 years old. Thus, we could not influence the turnout of older age groups. Clearly, future research should consider including individuals older than 65 years to verify the moderating role of age. However, our findings are nevertheless meaningful for two reasons: (1) In our analytical sample 66 adults were aged 63–65 years (14.3%) which is a considerable part of the sample. (2) Based on probability estimations, our analysis allowed inferences about adults older than 65 years (see Figure 2) suggesting more pronounced effects with increasing age.

Second, although our study is among the first ones to show the significant influence of age on the relationship between smartphone use and well-being, we haven't investigated underlying mechanisms of this relationship. Including other concepts which are shown to influence well-being (e.g. loneliness) might be a further research avenue (Golden et al. 2009).

Third, the intensity of communicative smartphone use for people in later life might depend on their digital skills (Büchi, Festic, and Latzer 2018), which we have not taken into account here. Since digital competence is necessary for engaging with smartphones, an important avenue for future research should thus be the investigation of the moderating influence of digital skills on the relationship between communicative smartphone use and well-being. Additionally, distinguishing between different types (i.e. dimensions) of communicative smartphone use should be taken into consideration in future research. Smartphones and mobile social media use allow for public and private communication (e.g. on Facebook, see Frison and Eggermont 2016) as well as visual and textual communication. Moreover, communicative activities can occur on different social media sites or through various applications which might differentially influence well-being (e.g. Schmuck, Karsay, Matthes, and Stevic, 2019). Not only the type of use but also the type of relationship —that is, whether the communication takes place with close or distant social ties, might impact well-being (e.g.

as on SNSs, Krämer et al. 2014). Future research should, therefore, examine more closely the quality of interpersonal relationships among older age groups and their communicative activities on smartphones. Investigating whether they communicate more intensely with their close rather than distant ties and whether this particular kind of communication is responsible for increases of well-being should be subject of future research.

Fourth, the effect of passive smartphone use on well-being found in our study was rather weak. Yet, we demonstrated this relationship in a longitudinal context controlling for auto-regressive effects. Therefore, although weak, this finding proves to be robust in a longitudinal analysis (Adachi and Willoughby 2015). The finding is also in line with studies showing detrimental consequences of passive online communication on well-being (e.g. Wang et al. 2018).

Fifth, the distinct effects of specific types of passive smartphone activities (i.e. scrolling, reading, lurking) have not been in the focus of our study and need future research attention. Related to that, we have not distinguished between different aspects of well-being such as physical, psychological, and social well-being (e.g. Burke and Kraut 2016; Dodge et al. 2012). Whether communicative and passive smartphone use affect those different facets of well-being differently should be an important avenue for future research.

Lastly, our study relied on self-reported measures that may be prone to measurement error (Naab, Kranowski, and Schlütz 2019; Scharkow 2019), can result in socially-favorable answers (Holbrook 2008), and may not necessarily predict smartphone users' actual behaviour. Scholars have revealed, however, that behavioural intentions can be a good proxy for actual behaviour (Webb and Sheeran 2006). Nevertheless, future studies should employ tracking measures of smartphone use that account for users' actual behaviour to further bolster the findings of this study.

6. Conclusion

Nowadays, it is hard to imagine not owning a smartphone device. After all they are designed to provide support in miscellaneous situations in individuals' daily lives (van Deursen et al. 2015). Therefore, investigating the longitudinal consequences of smartphone use is of utter relevance. Our study makes one step further in illustrating positive and negative consequences of smartphone use and sheds new light on the interplay between smartphone use and well-being over time. Our findings are among the first ones to highlight the crucial role that age plays in this association. In this sense, we have made an important contribution showing the positive influence of communicative smartphone use on well-being for adults older than 63 years. Even though communicative smartphone use cannot replace real-life social interactions, it nevertheless holds benefits for higher well-being and helps maintaining social relationships (Elhai et al. 2017). From a theoretical standpoint, our research confirmed the main postulates of Socioemotional Selectivity Theory, Social Convoy Model, and Social Compensation Hypothesis, demonstrating the high relevance of these theoretical approaches in explaining the benefits of smartphone use on older adults' well-being. Moreover, we have shown that passive smartphone use has a direct negative influence on well-being across all age cohorts, suggesting that not only adolescents, but also adults, should become aware of the negative consequences smartphone use can have on their lives. In a broader sense, this finding suggests the necessity to reduce passive smartphone use to secure higher levels of life satisfaction.

Notes

1. We also tested whether or not the relation between age and well-being is nonlinear, which was not the case. Therefore, we proceeded with linear regression analyses.
2. We also computed alternative analyses controlling for quantitative time spent with family members, relatives, and friends per day. These analyses revealed similar results. All significant effects remained robust.

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