"Looking Up and Feeling Down"

The Influence of Mobile Social Networking Site Use on Upward Social Comparison, Self-Esteem, and Well-Being of Adult Smartphone Users

Abstract

Exposure to carefully selected information on social networking sites (SNSs) showing a flawless self and an ideal life has been found to harm young individuals' self-esteem and well-being. However, SNS use is no longer limited to young people. Fueled by the sharp increase of smartphone ownerships, which allow users to access information about others anytime and anywhere, nowadays, a wide range of age groups uses SNSs. Accordingly, this study investigated the relationships between mobile SNS use, upward social comparison, self-esteem, and well-being for the first time. We employed a two-wave panel survey ($N_{T2} = 461$) using a quota sample of adults. Results revealed that Facebook use predicted upward social comparison, which harmed individuals' self-esteem and well-being over time, while Instagram use directly influenced well-being negatively over time. Additionally, we found support for reciprocal relationships between upward social comparison on SNSs and self-esteem as well as well-being in a longitudinal context.

Keywords: social networking sites, social comparison, self-esteem, well-being

1. Introduction

Social networking sites (SNSs) play an increasingly important role in people's daily life around the globe. Recent data show that more than 60% of the population in advanced economies and more than 50% in emerging economies are active SNS users (Pew Research Center, 2018b). In this context, SNS usage is no longer limited to young people—nowadays, a wide range of demographic groups use SNSs (Pew Research Center, 2018b). The increasing SNS use among all age groups has been fueled by the sharp increase of smartphone ownerships (Pew Research Center, 2018a) enabling SNS use to happen anytime and anywhere (Lup et al., 2015). Among adults, Facebook is still the most frequently used SNS. Yet, adult SNS use well extends beyond the use of Facebook, closely followed by the video-sharing site YouTube and the photo-sharing platform Instagram (Pew Research Center, 2018b).

The increasing global SNS penetration has sparked an abundance of research dedicated to the consequences of SNS use on people's self-perceptions and well-being. Although the existing studies have shown positive outcomes of SNS use (Gonzales et al., 2011; Huang, 2016; Meier and Scha, 2018), the large number of studies has also demonstrated that SNS use negatively influences individuals' self-esteem (Vogel et al., 2014; Wang et al., 2017) and various dimensions of well-being (Chou et al., 2012; Liu et al., 2017; Lup et al., 2015; Shakya and Christakis, 2016; Vries et al., 2018; Vries and Kühne, 2015; Wang et al., 2017; Yoo and Jeong, 2017). Existing research has particularly pointed out upward social comparison processes as a responsible underlying mechanism for those negative effects (Vogel et al., 2014; Vries and Kühne, 2015; Wang et al., 2017). Since self-presentation on SNSs is often motivated by impression management (Rosenberg, 2011), the presented information is mostly positively skewed showing carefully selected photographs depicting a flawless self and an ideal life (Appel et al., 2016; Chou et al., 2012; Reinecke and

Trepte, 2014; Wang et al., 2017). Given that individuals at least partly base their self-perceptions on how they are doing in comparison with others (Festinger, 1954), being frequently exposed to idealized SNS profiles, pictures, and status updates of others can have detrimental effects on individuals' self-esteem (Cramer et al., 2016; Valkenburg et al., 2017; Wang et al., 2017). A poor self-esteem in turn can have negative consequences for various dimensions of subjective well-being (Chou et al., 2012; Diener and Diener, 1995; Liu et al., 2017; Neff and Vonk, 2009; Paradise and Kernis, 2002; Vries et al., 2018).

Although findings from past studies have significantly contributed to our overall understanding of the relationship between SNS use and well-being, we identify three important research gaps. First, current poll data suggest that SNS use is no longer limited to young individuals (Pew Research Center, 2018b). Yet, existing research has insufficiently accounted for the longitudinal relationships between SNS use, upward social comparison, self-esteem, and well-being in adulthood. The available studies dealing with social comparison processes in response to SNS use have either focused on student samples (Cramer et al., 2016; Lee, 2014; Steers and Wickham, 2014; Vogel et al., 2014), adolescents (Frison and Eggermont, 2016; Valkenburg et al., 2006, 2017), or emerging adults (Vries and Kühne, 2015; Wang et al., 2017). Even if younger age groups have often been described as being more susceptible to social comparison behavior than adults (Lee, 2014), literature on developmental psychology suggests that comparing oneself to others who seem to be more attractive or successful may fuel threats to one's self-esteem and harm one's well-being across the life-span (Heckhausen and Krueger, 1993). Therefore, it is of utter importance to consider a broad age range when investigating the influence of SNS use on social comparison processes, self-esteem, and well-being.

Second, although previous research efforts have been dedicated to the investigation of longitudinal relationships between SNS use and well-being among adults (e.g., Shakya and

Christakis, 2016; Yoo and Jeong, 2017), studies focusing on the contribution of social comparison processes on SNSs to self-esteem or well-being in the long-term are lacking. The available cross-sectional findings (e.g., Wang et al., 2017) are no doubt plausible, yet, they remain subject to the well-known limitations of correlational data such as the difficulty to determine the direction of the relationships (Lee, 2014). As a consequence, longitudinal panel designs are needed to establish a temporal order for the relationships of SNS use, upward social comparison, self-esteem and well-being in adulthood, which allow more reliable inferences about the causality of these relationships (Appel et al., 2016).

Third, many researchers investigating social comparison processes on SNSs have exclusively focused on one SNS platform such as Facebook (Vries and Kühne, 2015) or Instagram (Lup et al., 2015), while others have insufficiently distinguished between different platforms by measuring SNS use in general (Wang et al., 2017). However, when examining the consequences of SNS use, the whole array of SNSs individuals use needs to be investigated simultaneously, as their features and therefore their potential for upward social comparison processes may differ (Khan, 2017; Phua et al., 2017).

To fill those crucial research gaps, the current study investigated the longitudinal influences of the use of various SNSs on well-being with a quota sample of adult SNS users reflecting a broad age range from early to late adulthood (i.e., 16 to 65 years) using a two-wave panel survey. Specifically, we included the current most popular SNS platforms in COUNTRY (BLINDED FOR PEER REVIEW, 2017), where we conducted the study (i.e., Facebook, Instagram, YouTube, Snapchat, and WhatsApp). However, all of those platforms are also among the most popular ones around the globe (Statista, 2018).

In doing so, we focused on *mobile* SNS use via smartphones. Due to its portability and constant connectivity, smartphones provide a platform for users to constantly access SNS (Jeong et al., 2016). The permanent use of smartphones makes exposure to idealized images

on SNSs highly likely, extending the potential of social comparison to every part of one's daily life (Lup et al., 2015). As mobile SNS use is rapidly increasing (Pew Research Center, 2018a), it is crucial to examine its influences on individuals' self-esteem and overall well-being.

2. Theoretical Foundation

2.1. SNS Use and Upward Social Comparison

SNSs are an important venue where people can evaluate themselves in comparison to others (Lee, 2014). Social comparison is a human state of evaluating one's opinions and abilities in comparison with others, and serves as an essential function for establishing self-identity (Festinger, 1954). Based on social comparison theory (Festinger, 1954), researchers differentiate between downward and upward social comparison (Buunk and Gibbons, 2006). The state of comparing to perceived inferior others, induces more positive self-evaluation and is referred to as downward social comparison (Wills, 1981). In contrast, upward social comparison refers to comparisons with perceived superior others (Vogel et al., 2014). It is theorized that upward social comparison typically induces more negative feelings about oneself, because it fuels the perception that others are better off than oneself (Buunk and Gibbons, 2006; but see Buunk et al., 1990 for positive consequences of upward social comparison in threat situations).

On SNSs, users are confronted with an abundance of personal information from their close and distant ties, which are not apparent offline in their daily lives (Appel et al., 2016; Vogel et al., 2014; Wang et al., 2017). Even though SNSs allow for an authentic self-presentation, positive forms of authenticity are more common than the negative aspects of the true self, which is referred to as the positivity bias on SNSs (Reinecke and Trepte, 2014). Thus, SNSs serve as platforms for presenting idealized and optimized information about oneself to ensure positive impressions (Wang et al., 2017). Therefore, upward social

comparison is more salient on SNSs than offline (Appel et al., 2016). As Vogel and colleagues (2014) suggest, SNS users are comparing their actual selves to the ideal *online* versions of the others, and precisely this mismatch leads to more dissatisfaction.

Several studies have identified a tendency toward upward social comparison while using SNSs (Chou et al., 2012; Liu et al., 2017; Steers and Wickham, 2014). More specifically, researchers have demonstrated that Facebook use in particular is associated with more upward social comparison (Haferkamp et al., 2011; Lee, 2014; Vogel et al., 2014; Vries and Kühne, 2015). For instance, using an experimental approach, Vogel and colleagues (2014) found that individuals with higher exposure to Facebook tended to evaluate themselves less positively. Similarly, Lee's (2014) findings suggest that college students with a higher frequency of Facebook use were more likely to engage in social comparison processes. Yet, the authors themselves admitted that the direction of this relationship was unclear due to their cross-sectional data. Therefore, longitudinal data allowing for a causal interpretation of the relationships between SNS use, upward social comparison, self-esteem, and well-being in adulthood is highly needed.

However, existing research is not limited to Facebook. Researchers have also dealt with Instagram to investigate the phenomenon of upward social comparison (e.g., Kleemans et al., 2018; Lup et al., 2015; Meier and Scha, 2018; Vries and Kühne, 2015). Instagram use is particularly prone to tendencies of social comparison (Vries et al., 2018), as it focusses on images, which can be edited with the use of filters. This feature serves to improve the pictures' aesthetic and overall representativeness—therefore, even strengthening the positive bias (Lup et al., 2015).

Although Facebook and Instagram differ with regard to their unique affordances, both SNSs may have similar consequences for upward social comparison. Activities on Facebook and Instagram have been found to be overall passive such as observing (or reading) what

others share rather than creating own content (Pempek et al., 2009). Seeing polished content and photographs on the newsfeed describing how others look and what others have achieved might cause upward social comparison among SNS users (Lee, 2014). Since both Facebook and Instagram are regarded as visual platforms focusing on individual profile information and often highly edited content and photographs, we propose the following hypothesis:

H1: a) Mobile Facebook use and b) mobile Instagram use increases upward social comparison on SNSs over time.

As stated above, in the context of upward comparison, previous research has either exclusively focused on Facebook (Cramer et al., 2016; Hanna et al., 2017) or on Instagram (Lup et al., 2015; Meier and Scha, 2018) while neglecting other popular SNSs such as YouTube, WhatsApp, and Snapchat. However, these platforms might as well influence social comparison, especially due to their specific features. YouTube is characterized as a broadcasting channel and is the second most used SNS after Facebook (Pew Research Center, 2018b). More specifically, YouTube is a news and entertainment SNS, which is not based or focused on personal profiles only but contains many social elements (Khan, 2017). Despite its broad affordances, YouTube is a video-based platform, where mostly celebrities and influencers are followed. This one-sided interaction might trigger upward social comparisons (Brown and Tiggemann, 2016). On the other hand, YouTube is predominantly used for informative or entertainment reasons (Khan, 2017), which is the reason why influences on social comparison could be small or non-existing. Therefore, it is necessary to examine and understand if YouTube use influences upward social comparison overall.

WhatsApp and Snapchat are defined as SNSs which serve the communicative and social interaction purpose between close ties (Karapanos et al., 2016; Phua et al., 2017). Their main feature is the focus on personal profiles and private information, which is mostly shared among personal connections. In particular, Snapchat serves the purpose of ephemeral and

instant interactive communication (Grieve, 2017). Aside from their main communicative

goal, messaging-based SNSs, also allow for a dissemination of visual content (i.e., edited

photographs and videos), which can lead to increases in social comparison (Wang et al.,

2017). Despite their visual affordances, the two platforms also serve for relationship

maintenance purposes, which are not necessarily related to social comparison (Karapanos et

al., 2016; Makki et al., 2018). Therefore, it remains unclear if using WhatsApp or Snapchat

predicts upward social comparison. Since existing research has not yet investigated mobile

YouTube, Snapchat, or WhatsApp use and their tendency to influence upward social

comparison, we formulate the following research question:

RQ1: Does a) mobile YouTube use, b) mobile Snapchat use, and c) mobile WhatsApp

use influence upward social comparison on SNSs over time?

2.2. Upward Social Comparison, Self-Esteem, and Well-Being

Self-esteem is an encompassing concept that refers to the positive or negative

evaluations of oneself (Rosenberg et al., 1995). Essentially, self-esteem is formed and

monitored on the basis of social acceptance, social relationships, and received social

feedback (Leary et al., 1995). This particular social feedback is the most relevant aspect in

establishing personal self-esteem. It is influenced by social support or exclusion, from close

and distant ties. In this sense, comparing oneself with others inevitably enhances or

diminishes one's self-esteem. It can be regarded as a stable trait, but also as a fluid state

influenced by various contextual situations (Kernis, 2002; Vogel et al., 2014). Notably,

online use and especially SNS have the potential to affect temporary states of self-esteem

(Gonzales et al., 2011). The relationship between social comparison in response to SNS use

and self-esteem has been investigated in a large number of cross-sectional studies (Liu et al.,

2017; Wang et al., 2017; see Vogel et al., 2014 for experimental evidence), but longitudinal

studies, which allow the establishment of temporal associations and causal conclusions, are still scarce.

Researchers have suggested that self-esteem might be affected especially after longer exposure to SNSs. In particular, a study by Vogel and colleagues (2014) showed that higher levels of Facebook use led to increases in upward social comparison and to decreases in self-esteem. In addition, specifically upward social comparison on SNSs has been shown to directly and negatively influence self-esteem (Liu et al., 2017; Wang et al., 2017). Building upon previous research, it is therefore conceivable that frequent upward social comparison on SNSs might decrease individuals' self-esteem over time. Accordingly, we hypothesized:

H2: Upward social comparison on SNSs decreases self-esteem over time.

An undermined self-esteem might in turn affect individuals' overall well-being (Wang et al., 2017). Higher levels of well-being are valuable for effective functioning on many levels, such as relationship quality, academic, and work performance (Diener et al., 2018). Well-being is relevant not only on the level of the individual, but taken together, it has important benefits for society at large. Well-being is broadly defined as a multidimensional concept consisting of various indicators. In recent years, researchers have identified satisfaction with life or quality of life as a main component of well-being (Diener et al., 2018).

As one of the most important predictors of satisfaction with life, self-esteem is pivotal in ensuring positive self-worth (Diener and Diener, 1995; Kernis, 2002). A large body of literature suggests a strong positive relationship between personal self-esteem and subjective well-being (Paradise and Kernis, 2002). Moreover, previous findings suggest that self-esteem is not the consequence, but rather a cause of various life outcomes (Neff and Vonk, 2009; Orth et al., 2012). Self-esteem, has been found to positively predict well-being, both in adolescence and adulthood (Burke and Kraut, 2016; Szabo et al., 2019; Valkenburg et al.,

2006). Therefore, negative self-evaluations in response to idealized and skewed information of others, which triggers upward social comparison, may influence overall satisfaction with life—that is, individuals' well-being (Wang et al., 2017). In line with that assumption, cross-sectional studies suggest that changes in individuals' self-esteem in response to SNS use entail changes in one's well-being (Liu et al., 2017; Wang et al., 2017). Thus, enhanced levels of self-esteem result in higher well-being over time (i.e., low levels of self-esteem decrease well-being over time). Therefore, our last hypothesis states:

H3: Self-esteem increases well-being over time.

Figure A.1 displays the hypothesized model.

[Figure A.1 here]

3. Method

3.1. Procedure

We used longitudinal data from a two-wave panel survey. A private, large research institute collected survey data at two time points between March/April 2018 and July/August 2018 (i.e., in a four-month-interval) in COUNTRY. A quota-sampling procedure was applied with regard to gender, age, and education. All participants consented in written form to (1) the strictly scientific purpose of the research, (2) their right to refuse to participate, (3) their right to stop their participation at any point of the study, and (4) the strict confidentiality of their responses. The time lag of four months between both waves was based on feasibility considerations and previous research (van Zalk et al., 2011; Yao and Zhong, 2014). Participants were included in our study if they possessed an internet-enabled mobile phone (i.e., smartphone) and had used a SNS on their smartphone at least once prior to study participation, resulting in 833 participants at Time 1 (54.1% women, $M_{age} = 45.44$, $SD = 14.83$), and 461 individuals at Time 2 (53% women, $M_{age} = 48.65$, $SD = 13.02$). Participants ranged between 16 and 65 years. Participants over 65 years were not included, as mobile SNS

use is still only marginal in this age group (Pew Research Center, 2018b). The attrition rate

was 45% for Time 2. Participants who dropped out at Time 2 used WhatsApp, $F(1,825) =$

6.40, $p = .012$, $\eta^2 = .01$, Facebook $F(1,824) = 7.76$, $p = .005$, $\eta^2 = .01$, Snapchat $F(1,802) =$

23.31, $p < .001$, $\eta^2 = .03$, YouTube, $F(1,819) = 21.01$, $p < .001$, $\eta^2 = .03$, and Instagram

$F(1,809) = 26.61$, $p < .00$, $\eta^2 = .03$, more frequently, and had lower social comparison scores

at Time 1, $F(1,831) = 11.09$, $p = .001$, $\eta^2 = .01$. However, the effect sizes show that these are

only small effects ($\eta^2 < .06$), which become significant due to the large group sizes.

Participants in the two waves did not differ with regard to their self-esteem at Time 1,

$F(1,831) = 0.23$, $p = .632$, $\eta^2 = .00$, or well-being at Time 1 $F(1,831) = 0.62$, $p = .433$, $\eta^2 =$

.00. Prior to survey participation, we informed the respondents that the questions would deal

with their smartphone and SNS use and ensured anonymity.

3.2. Measures

Frequency of SNS use. Respondents indicated on a 6-point scale ranging from "1

never" to "6 several times during the day" how often they used SNSs on their smartphones.

Specifically, we assessed the use of WhatsApp ($M = 4.86$; $SD = 1.42$ at Time 1, $M = 4.70$; SD

$= 1.52$ at Time 2), Facebook ($M = 3.44$; $SD = 1.98$ at Time 1, $M = 3.21$; $SD = 1.99$ at Time 2),

Instagram ($M = 2.21$; $SD = 1.82$ at Time 1, $M = 1.97$; $SD = 1.67$ at Time 2), Snapchat ($M =$

1.58; $SD = 1.31$ at Time 1, $M = 1.34$; $SD = 0.99$ at Time 2), and YouTube ($M = 2.77$; $SD =$

1.63 at Time 1, $M = 2.50$; $SD = 1.58$ at Time 2).

Upward social comparison on SNSs. In order to measure upward social comparison

on SNSs, we adapted a scale from Lee (2014). On a 5-point Likert scale ranging from 1

(strongly disagree) to 5 (strongly agree), respondents were asked to indicate their agreement

with the following three statements: "I often think that others have a happier life, when I read

their news feed or see their photos"; "I often think that others have a better life when I read

their news feeds or see their photos"; and "I often think that others feel better than me when I

read their news feeds or see their photos" (α = .98; M = 2.40; SD = 1.20 at Time 1, α = .97; M = 2.28; SD = 1.2 at Time 2).

Self-esteem. The self-esteem concept was measured with four items of the Rosenberg scale (Rosenberg, 1965) using the revised COUNTRY version developed by BLINDED FOR PEER-REVIEW. The Rosenberg scale captures global self-esteem typically used for trait assessments. However, an abundance of cross-sectional surveys and longitudinal panel studies investigating self-esteem as a dependent variable have used this scale to capture temporary changes in self-esteem especially in relation with SNS use (Gonzales et al., 2011; Schou et al., 2017; Steinfield et al., 2008). On a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), respondents were asked to indicate their agreement with the following statements: "Overall, I am satisfied with myself"; "I feel that I have a number of good qualities"; "I am able to do things as well as most other people"; and "I take a positive attitude toward myself" (α = .87; M = 3.75; SD = 0.75 at Time 1, α = .88; M = 3.80; SD = 0.79 at Time 2).

Well-being. Well-being was assessed on a 5-point Likert scale based on the Satisfaction with Life scale (SWLS; Diener et al., 1985). The respondents were asked to indicate their agreement ranging from 1 (strongly disagree) to 5 (strongly agree) with 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"; (α = .90; M = 3.18; SD = 0.91 at Time 1, α = .89; M = 3.27; SD = 0.9 at Time 2).

Zero-order correlations of all variables are depicted in Table A.1.

[Table A.1 here]

4. **Data Analysis**

We conducted Structural Equation Modeling in *lavaan* (R) using Maximum Likelihood estimation. To deal with missing values, the Full Information Maximum Likelihood (FIML) procedure was employed. We used the chi-squared to degrees of freedom ratio (χ^2/df), the comparative fit index (CFI), the Tucker-Lewis-Index (TLI), and the root mean square error of approximation (RMSEA) to determine the model fit indices. In general, RMSEA values smaller than .05 and a CFI or TLI higher than .95 indicate good model fit, and RMSEA values between .05 and .08 and CFI or TLI values between .90 and .95 indicate acceptable model fit (Byrne, 2001).

We controlled for participants' gender and age by adding them as predictors for the endogenous variables in our model. In addition, we controlled for autoregressive paths (i.e., social comparison at Time 1 as a predictor of social comparison at Time 2). Such an autoregressive model allows us to explain changes in the dependent variables from wave 1 to wave 2 which are not explained by individuals' wave 1 scores. This panel design reduces problems related to omitted variables, selection bias, and reverse causation, because changes in the dependent variables from wave 1 to wave 2 cannot affect wave 1 characteristics (Adachi and Willoughby, 2015).

5. Results

5.1. Descriptive Results

The relative number of participants that indicated to never use the respective SNS platform was 78.9 % for Snapchat, 63.0 % for Instagram, 31.5 % for YouTube, 30.3 % for Facebook, and only 5.8 % for WhatsApp at Time 1. In contrast, the relative number of those who indicated to use the platform several times a day was 4.0 % for Snapchat, 10.7 % for Instagram, 7.7 % for YouTube, 21.1 % for Facebook, and 45.6 % for WhatsApp at Time 1.

5.2. Measurement Invariance

We tested for longitudinal measurement invariance, by constraining all factor loadings of the same constructs across measurement occasions as equal to establish metric invariance and all intercepts of the same constructs across measurement occasions as equal to ensure scalar invariance (Vandenberg and Lance, 2000). The constrained model revealed a good fit: CFI = .96; TLI = .96, χ^2/df = 2.88; p < .001; RMSEA = .05, 90% CIs [.04; .05]. We found no significant difference between upward social comparison on SNSs at Time 1 and Time 2 (p = .228), which confirms metric and scalar invariance for upward social comparison on SNSs. Yet, the differences between self-esteem and well-being at Time 1 and Time 2 were significant. Therefore, we released the constraints on the intercepts of one item of self-esteem and four items of well-being, which revealed no significant differences of self-esteem between time points (p = .647) and no significant differences of well-being between time points (p = .184). Therefore, for self-esteem and well-being full metric invariance and partial scalar invariance could be established.

5.3. Structural Equation Model

Table A.2 and Figure A.2 show all of our findings. The hypothesized model revealed a good model fit: CFI = .95; TLI = .94, χ^2/df = 2.64; p < .001; RMSEA = .04, 90% CIs [.04; .05]. In our first hypothesis, we assumed that frequent mobile Facebook and Instagram use would enhance upward social comparison on SNSs over time. Our findings revealed that frequent mobile Facebook use at Time 1 positively predicted upward social comparison on SNSs at Time 2, b = .08, SE = .03, β = .13, p = .005. However, we found no support for a significant relationship between mobile Instagram use at Time 1 and individuals' upward social comparison on SNSs at Time 2, b = .02, SE = .04, β = .03, p = .600. Thus, H1a could be confirmed, but H1b had to be rejected.

Next, we investigated how the mobile use of other SNSs, that is, YouTube, Snapchat, and WhatsApp, was related to individuals' upward social comparison levels. We found no

significant relationship between Time 1 mobile YouTube use, $b = .02$, $SE = .04$, $\beta = .03$, $p = .502$, mobile Snapchat use, $b = -.02$, $SE = .05$, $\beta = -.02$, $p = .722$, or mobile WhatsApp use, $b = -.02$, $SE = .03$, $\beta = .01$, $p = .778$, and upward social comparison on SNSs at Time 2, which answers our research question (RQ1).

In our second hypothesis, we postulated that upward social comparison on SNSs would negatively predict individuals' self-esteem. Our findings confirmed that assumption, as upward social comparison on SNSs at Time 1 had a significant negative influence on self-esteem at Time 2, $b = -.08$, $SE = .03$, $\beta = -.11$, $p = .015$. Therefore, H2 was confirmed.

In our third hypothesis, we assumed a positive relationship between self-esteem and individuals' overall well-being. Confirming that assumption, we found that self-esteem at Time 1 had a significant positive influence on individuals' well-being at Time 2, $b = .15$, $SE = .06$, $\beta = .14$, $p = .006$. H3 could therefore also be accepted. Additionally, we found a direct negative influence of Instagram use at Time 1, $b = -.05$, $SE = .02$, $\beta = -.10$, $p = .037$, and social comparison at Time 1, $b = -.07$, $SE = .03$, $\beta = -.09$, $p = .027$, on well-being at Time 2.

Among the covariates, we found a strong negative relationship of age and upward social comparison on SNSs at Time 2, $b = -.02$, $SE = .00$, $\beta = -.19$, $p < .001$, and well-being at Time 2, $b = -.01$, $SE = .00$, $\beta = -.09$, $p = .046$. Overall, all predictors in the model explained 63% of the variance in individuals' well-being ($R^2 = .63$). With regard to the effect sizes of the predictors, our results have to be weighted by an appropriate consideration of the stability of pathways among variables. The strong autoregressive effects we found imply that changes in levels of upward social comparison, self-esteem, and well-being over time are small. Thus, controlling for the stability removes a large portion of the variance. Therefore, given the high stability of the outcomes, even small effects of other predictors are meaningful (Adachi and Willoughby, 2015).

[Table A.2 and Figure A.2 here]

5.4. Additional Analyses

5.4.1. Analyses of Reversed Causality

Previous research suggests that the nature of the relationships between SNS use, social comparison processes, self-esteem, and well-being may not be one-directional, but reciprocal (Frison and Eggermont, 2016; see also Frison and Eggermont, 2017; Reinecke and Trepte, 2014; Yoo and Jeong, 2017). Therefore, we tested for reversed causality effects between those constructs. Specifically, we analyzed whether self-esteem or well-being at Time 1 influenced SNS use or upward social comparison processes on SNSs at Time 2. Controlling for the autoregressive effects, we found no significant relationships of self-esteem or well-being at Time 1 with Facebook, Instagram, YouTube, Snapchat, or WhatsApp use at Time 2. However, we did find that lower self-esteem at Time 1 ($b = -0.21$, $SE = 0.07$, $p = .002$) as well as lower well-being at Time 1 ($b = -0.15$, $SE = 0.05$, $p = .001$) were related to higher upward social comparison processes on SNSs at Time 2. Taken together, our findings suggest a reciprocal causality between upward social comparison processes and self-esteem as well as well-being.

5.4.2. Analyses of Interaction Effects

Since this study employed for the first time a quota sample of adult SNS users reflecting a broad age range from young to late adulthood, we additionally tested whether the significant influences found were independent of age. To that end, we included the interaction terms of age and SNS channels separately in our structural equation model in addition to the other predictors (analyses not shown in Table A.2). We found no significant interaction effect of Facebook use and age ($b = 0.00$, $SE = 0.00$, $\beta = .02$, $p = .896$), Instagram use and age ($b = -0.00$, $SE = 0.00$, $\beta = -.04$, $p = .712$). YouTube use and age ($b = 0.00$, $SE = 0.00$, $p = .879$), Snapchat use and age ($b = 0.01$, $SE = 0.00$, $\beta = .21$, $p = .053$), and WhatsApp use and age ($b = -0.00$, $SE = 0.00$, $\beta = -.01$, $p = .976$) on upward social comparison on SNSs

(Time 2). Therefore, our results suggest that upward social comparison processes in response to SNS use are independent of age and seem to be equally prevalent in all age groups.

Additionally, given that previous research has suggested that the effects of SNS use depend on the specific activities that individuals engage in online (Burke and Kraut, 2016; Frison and Eggermont, 2016), we additionally tested which mobile SNS activities affected upward social comparison. We asked individuals how often they engaged in several activities on their smartphone such as talking to one's family on the phone ($M = 3.49$, $SD = 1.32$), talking to one' friends on the phone ($M = 3.43$, $SD = 1.32$), reading or sending messages ($M = 3.88$, $SD = 1.67$), posting or sending photos or videos ($M = 2.61$, $SD = 1.48$), reading news online ($M = 3.67$, $SD = 1.68$), researching information ($M = 3.34$, $SD = 1.48$), listening to radio/podcasts/music ($M = 2.61$, $SD = 1.60$), watching television or video clips ($M = 2.53$, $SD = 1.57$), playing games ($M = 2.88$, $SD = 1.76$), taking photos or videos ($M = 3.26$, $SD = 1.28$), and viewing profiles of one's friends and family ($M = 2.99$, $SD = 1.67$).

Using a structural equation model (see details above), we tested how those different activities at Time 1 predicted upward social comparison at Time 2. Our findings showed that only passively scrolling through others' profiles (Time 1) had a significant and positive effect on upward social comparison on SNSs (Time 2), $b = .09$, $SE = .04$, $\beta = .13$, $p = .016$. No other mobile activities had a significant effect on upward social comparison.

6. Discussion

The aim of this study was to examine how mobile SNS use among adults is related to upward social comparison on SNSs and how these comparison processes affect self-esteem and subjective well-being in the long term. Using a longitudinal two-wave panel design we aimed to overcome the shortcomings of existing studies which are mostly based on cross-sectional designs (Chou et al., 2012; Wang et al., 2017) and therefore do not allow causal inferences (see Appel et al., 2016 for an overview).

Our findings revealed that among all the SNSs under investigation (i.e., Facebook, Instagram, WhatsApp, Snapchat, and YouTube), only mobile Facebook use predicted upward social comparison processes among adult SNS users over time. Previous research suggests an important influence of Instagram use on social comparison processes (e.g., Kleemans et al., 2018), which was confirmed by the cross-sectional correlations in our study. Yet, we found no evidence that mobile Instagram use could explain changes in upward social comparison over time in our adult sample. One important reason for this finding is presumably the low number of adults in our quota sample who frequently used Instagram, which was even lower in the second wave. Therefore, in order to clarify whether the lacking effect is due to the sample size or other factors such as the age group, future studies exclusively focusing on the investigation of adult Instagram users should be conducted.

However, the frequency of YouTube use was comparable to the frequency of Facebook use and the frequency of WhatsApp use was even higher. Yet, we found no evidence for a relationship with upward social comparison processes, which can be explained by the specific features of those platforms. First, WhatsApp and Snapchat may be mostly used for communicative purposes. Second, their main feature lies in the private use rather than in sharing public content (Vaterlaus et al., 2016; Waterloo et al., 2018). Although those social networking sites are also frequently used for sharing pictures, those pictures are shared with reduced self-presentational concerns (see Bayer et al., 2016 for Snapchat). Therefore, they may be less carefully selected and less idealized than on, for instance, Facebook or Instagram, where pictures are presented to a larger public. Second, the primary goals of YouTube use are information and entertainment (Khan, 2017), which have lower potential for social comparison processes. However, future research should account for YouTube use that is mainly focused on following influencers or "YouTube stars", as exposure to videos of celebrities might also foster social comparison processes (Brown and Tiggemann, 2016).

Overall, our findings corroborate existing cross-sectional studies conducted with adolescents or young adults (e.g., Frison and Eggermont, 2016; Vries and Kühne, 2015; Wang et al., 2017) suggesting that Facebook use has a high potential to stimulate more negative self-perception through upward social comparison. Thus, although our results revealed that upward social comparison is generally less likely with increasing age, frequent mobile Facebook use nevertheless predicted higher levels of upward social comparison in adulthood. Moreover, our additional analyses revealed that the effect of Facebook use on upward social comparison is not moderated by age and is therefore prevalent in all age groups. Therefore, our findings suggest, for the first time, that upward social comparison processes in response to Facebook use are not merely limited to adolescents and emerging adults. Instead, middle-aged and older adults also engage in upward social comparison processes on SNSs in response to information about others' lives on Facebook.

This finding is in line with studies from developmental psychology suggesting that upward social comparison processes are not limited to a specific age group. Against the background of wide-spread negative images of aging and age-related stereotypes (Kornadt and Rothermund, 2012), it is not surprising that upward social comparison in response to idealized social media portrayals are an important issue across all ages. Our findings suggest that Facebook use provides opportunities for upward social comparisons across a broad range of ages, which has negative consequences for one's self-esteem and well-being. Against the background that Facebook is the most widely used SNS among adults (Pew Research Center, 2018b), this finding is worrisome. Future research should further examine differences between age cohorts and take age-graded upward social comparison processes into account— meaning that each age group chooses its own reference group (Heckhausen and Krueger, 1993).

Also supporting previous findings, our additional analyses revealed that passive SNS use, more specifically, passively scrolling through other profiles and news feeds, predicted upward social comparison. This finding corroborates growing evidence showing that passive use in particular has detrimental consequences on well-being (Escobar-Viera et al., 2018; Frison and Eggermont, 2017; Verduyn et al., 2015), but few studies also suggest positive effects of passive use for social capital building (Metzger and Zhao, 2018). When users restrain from engaging with others, their SNS use fails to fulfill the connection affordance. Thus, this type of use may lead to more social comparison, as users only "lurk" into other lives, reading their content but not being part of it (Khan, 2017). Our findings show, for the first time for an adult sample, that passively viewing others' profiles predicts upward social comparison. That finding is crucial against the background that viewing others' profiles has been found to be the most prevalent SNS activity (Pempek et al., 2009).

Our findings also indicate important consequences of upward social comparison processes over time. Results revealed that upward social comparison was negatively related to individuals' self-esteem, which predicted lower subjective well-being. As such, our findings shed some light on the underlying mechanisms of SNS use and well-being by revealing that upward social comparison and self-esteem explain that relationship. In doing so, our findings bolster previous research by showing that SNS use can indeed predict decreased life satisfaction and frustration with users' own lives (Chou et al., 2012). In this context, our findings contribute to the existing research in an important way by scrutinizing the underlying mechanisms, which predict changes in well-being over time.

We also found a direct negative effect of Instagram use on well-being. This negative influence might be explained by other processes than upward social comparison, which have not been investigated in this study. For example, researchers found that posting selfies on Instagram can lead to conflicts with the romantic partner and might entail negative

relationship outcomes (Ridgway and Clayton, 2016). Moreover, Instagram use has been found to be positively related with depressive symptoms, which reduce overall well-being (Lup et al., 2015). Finally, the negative relationship between Instagram use and well-being might be explained by viewer's mood changes and negative emotional consequences (Vries et al., 2018), which may in turn affect individuals' overall well-being (Fredrickson and Joiner, 2002).

Our findings furthermore revealed a direct negative effect of upward social comparison on well-being. This finding suggests that self-esteem is only one factor accounting for lower well-being and that upward social comparison can also directly affect well-being in a negative way. For instance, upward social comparison may produce envy and frustration (Appel et al., 2016). These stressors may in turn directly lower individuals' subjective well-being without necessarily affecting their self-esteem first. Additionally, individuals who compare themselves to others may be more likely to think that life is not fair (Chou et al., 2012), which can also directly affect subjective well-being.

Finally, our additional analyses suggested reciprocal relationships between upward social comparison processes on SNSs and self-esteem as well as well-being. Thus, we find first evidence for a negative spiral of upward social comparison processes on SNS and losses in self-esteem and overall well-being in adulthood (see for similar findings among adolescents Frison and Eggermont, 2016; for SNS use and depression see Yoo and Jeong, 2017).

6.1. Limitations

This study has some notable limitations. Although using a longitudinal approach to establish the relationship between SNS usage and well-being, we only had two panel waves. Therefore, causal relationships between constructs were only tested using two time points, which is a common data analysis strategy in two-wave panel studies (Reinecke and Trepte,

2014). Although this relationship is a good predictor for consequences at later time points, ideally, a study using four panel waves should be employed to establish the single causal relationships between the independent variables, the mediators, and dependent variables.

Related to this, we do not find direct longitudinal relationships between Facebook use and self-esteem or well-being. However, we find longitudinal relationships (1) between Facebook use and upward social comparison on SNSs, (2) between upward social comparison on SNSs and self-esteem, and (3) between self-esteem and well-being. These relationships as well as social comparison theory and previous research (e.g., Vogel et al., 2014; Wang et al., 2017) suggest an indirect relationship between Facebook use and self-esteem respectively well-being via upward social comparison processes on SNS. However, since we only had two panel waves, we could not test such indirect relationships. Therefore, further longitudinal research employing more panel waves is necessary.

Along similar lines, upcoming studies should test whether the relationships found here also hold for longer time intervals such as for instance a whole year. We chose an interval of four months based on previous research (van Zalk et al., 2011, Yao and Zhong, 2014) and feasibility considerations of the survey company, in order to avoid an even higher dropout rate. However, finding an effect over time in a four-month interval suggests that our detected relationships are meaningful, as stability effects of the outcome might be stronger in shorter than longer time intervals. These stability effects explain a large proportion of the outcome's variable (Adachi and Willoughby, 2015) and make it more difficult to detect an effect in shorter time intervals. The predictive effects of upward social comparison on change in levels of self-esteem and well-being may reflect an ongoing process of cumulative effects, and thus may exert an even more meaningful impact in the course of longer time intervals. Therefore, future studies should investigate longer time intervals or combine shorter and longer time intervals (i.e., measurement burst designs, Stawski, MacDonald and Sliwinski, 2015) to

further understand the complex dynamics between SNS use, social comparison, self-esteem, and well-being.

Additionally, individuals with more frequent SNS use were more likely to drop out in our study, presumably because of lower time resources. Although, effect sizes were very small, future studies should take on the challenge to prevent systematic dropout in order not to lose excessive smartphone users over time.

Furthermore, although our study suggests that passively scrolling through other profiles seems to be the activity mainly responsible for upward social comparison on SNSs, our study did not distinguish between different activities on the single platforms. Future research should identify the effects resulting from different combinations of specific activities on different SNSs. Finally, our study is limited to five different SNSs, which have been found to be the most frequently used SNSs in COUNTRY (BLINDED FOR PEER REVIEW, 2017). However, other SNSs such as Pinterest, Twitter, or LinkedIn have not been included and should also be investigated in relation to social comparison in future studies.

6.2. Implications

Recent poll data suggest that Facebook is still the most widely used SNS across various demographic groups (Pew Research Center, 2018b; Statista, 2018).While existing research has predominantly focused on the risks of Facebook use for adolescents and college students, its impact on adults has largely been ignored. Adults may feel rather safe when using SNS, thinking they have control over their SNS use as well as its effects. Indeed, studies suggest that problematic Internet use is lower among adults compared to adolescents (Morrison and Gore, 2010). However, the present findings suggest that upward social comparison processes on SNSs are most likely stimulated by Facebook use, which is the most popular SNS among adults. Given our findings that there are mutual influences of upward social comparison processes on SNSs and lower self-esteem and life satisfaction in the long

term, future information campaigns should increasingly target adults to enhance their

awareness about the potential negative implications of Facebook use on their well-being.

Ensuring people's well-being is pivotal in a permanently online society, as well-being

ultimately contributes to better health, a longer life, more successful relationships, and a

higher community commitment (Diener et al., 2015; Lyubomirsky et al., 2005).

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Appendices

Table A.1

Zero-Order-Correlations

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Mobile Facebook Use (T1)	1										
2. Mobile WhatsApp Use (T1)	.29***	1									
3. Mobile YouTube Use (T1)	.40***	.25***	1								
4. Mobile Snapchat Use (T1)	.21***	.19***	.43***	1							
5. Mobile Instagram Use (T1)	.40***	.29***	.50***	.58***	1						
6. Upward Social Comparison (T1)	.21***	.07	.31***	.18***	.29***	1					
7. Upward Social Comparison (T2)	.29***	.12*	.34***	.22***	.34***	.57***	1				
8. Self-Esteem (T1)	-.04	.06	-.09*	-.04	-.08*	-.40***	-.44***	1			
9. Self-Esteem (T2)	-.07	.06	-.14***	-.09*	-.14**	-.39***	-.39***	.76***	1		
10. Well-Being (T1)	-.02	.07*	-.10**	.00	-.06	-.42***	-.39***	.72***	.61***	1	
11. Well-Being (T2)	-.03	.08	-.12**	-.02	-.10*	-.45***	-.35***	.73***	.77***	.82***	1

Note. $N = 833$, T1 = Time 1, T2 = Time 2, * $p < .05$, ** $p < .01$, *** $p < .001$

Table A.2

Results of the hypothesized structural equation model based on the Full Information Maximum Likelihood procedure controlling for baseline

assessments of the outcomes to assess residual changes.

	Upward Social Comparison on SNSs (T2)			Self-Esteem (T2)			Well-Being (T2)		
Predictor	*b*	*SE*	*β*	*b*	*SE*	*β*	*b*	*SE*	*β*
Gender (T1)	.01	.09	.01	-.07	.07	-.04	-.02	.06	-.01
Age (T1)	-.02***	.00	-.19	.00	.00	.00	-.01*	.00	-.09
Mobile Facebook Use (T1)	.08**	.03	.13	.00	.02	.00	.01	.02	.02
Mobile WhatsApp Use (T1)	-.02	.03	-.03	.02	.02	.04	.01	.02	.01
Mobile YouTube Use (T1)	.02	.04	.03	.00	.03	.00	-.00	.02	-.00
Mobile Snapchat Use (T1)	-.02	.05	-.02	-.04	.04	-.06	.03	.03	.05
Mobile Instagram Use (T1)	.02	.04	.03	-.01	.03	-.02	-.05*	.02	-.10
Upward Social Comparison (T1)	.53***	.04	.53	-.08*	.03	-.11	-.07*	.03	-.09
Self-Esteem (T1)				.66***	.05	.65	.15**	.06	.14
Well-Being (T1)							.65***	.05	.65
Adj. R²		.35			.49			.63	

*Note. N = 833, T1 = Time 1, T2 = Time 2, * p < .05, ** p < .01, *** p < .001*
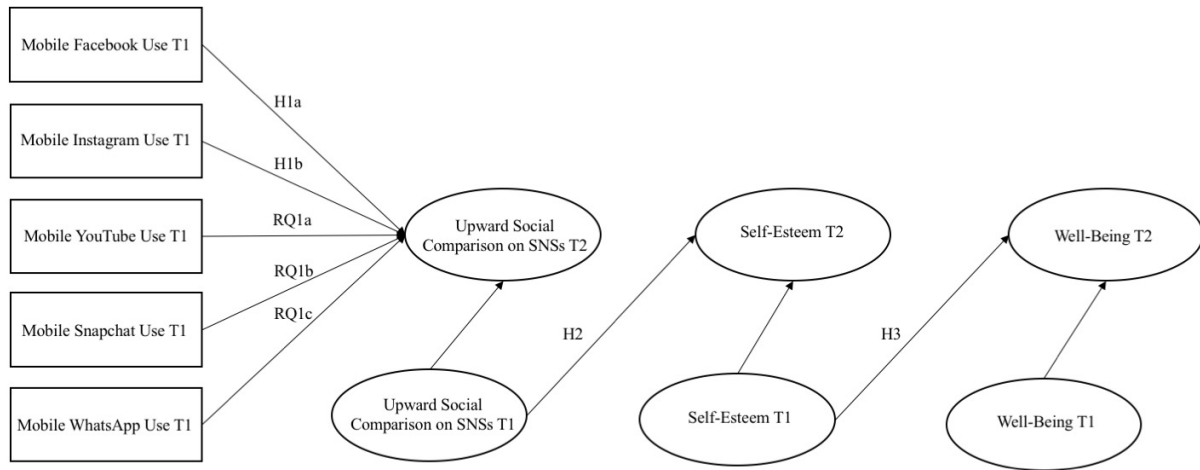
Figure A.1 Model examining the relationships between different types of SNS use, upward

social comparison on SNSs, self-esteem, and well-being.
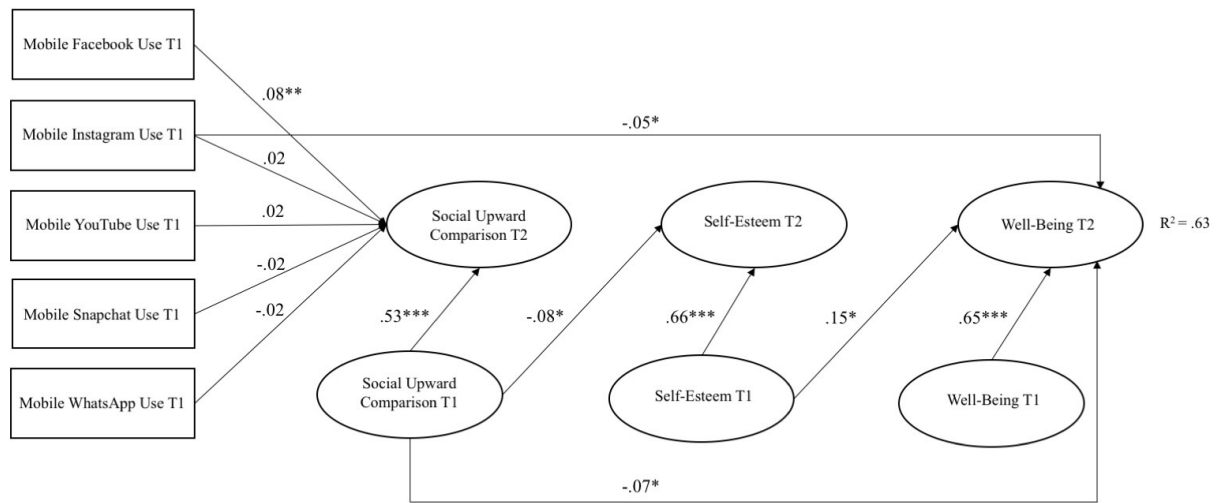
Note. T1 = Time 1, T2 = Time 2.

Figure A.2 Model examining the hypothesized relationships between different types of SNS use, upward social comparison on SNSs, self-esteem, and well-being.

Note. Values reflect unstandardized coefficients. Rectangles reflect manifest variables, ovals reflect latent variables. For clarity, error terms, covariances, control variables, and measurement items are not shown. T1 = Time 1; T2 = Time 2. *p < .05; **p < .01; ***p < .001.