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Active Public Facebook Use and Adolescents’ Feelings of Social Loneliness: Evidence
for a Curvilinear Relationship

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Abstract

Inconsistent results have been reported concerning the relationships between SNS usage and loneliness. The current two-wave panel study with a one year interval examined the possibility of reciprocal and curvilinear relationships between active public Facebook use and adolescents' social/emotional loneliness. Belgian adolescents from fifteen high schools participated ($N = 1188$, 55% male). The results showed a U-shaped relationship between (1) active Facebook use and social/emotional loneliness and (2) emotional loneliness and active Facebook use. Specifically, active Facebook use predicted decreased social/emotional loneliness among low to moderate users, while among heavy users, increased levels of social/emotional loneliness were predicted by active Facebook use. Emotional loneliness predicted higher active Facebook use among lonely adolescents. At the same time, emotional loneliness predicted decreased active Facebook use among adolescents who did not feel lonely. These findings stress to consider different types of loneliness, and reciprocal and curvilinear relationships in future social media research.

Keywords: active public Facebook use, loneliness, curvilinear relationship, adolescents, media effect, media selection

Active Public Facebook Use and Adolescents' Feelings of Loneliness: Evidence for a Curvilinear Relationship

During adolescence, teens shift from a relatively great dependence on parents for interaction and support to a greater reliance on peers. Failure in dealing with this shift may lead to feelings of loneliness or “the unpleasant experience that occurs when a person's network of social relations is deficient in some important way” (Perlman & Peplau, 1981, p. 31). Given that loneliness has been linked to poor physical and mental health outcomes (e.g., Qualter et al., 2013), the present study aims to learn more about loneliness during adolescence by investigating its relationship with social media use.

Today, social networking sites (SNSs) are important venues for communicating and interacting with peers, with Facebook being the most dominant SNS platform among teens (e.g., Lenhart, 2015; Van Waeg, Van Hoecke, Demeulenaere, & D’hanens, 2016). As a result, many researchers have investigated whether SNSs, such as Facebook, make people feel less or more lonely (e.g., Lou, Yan, Nickerson, & McMorris, 2012; Pittman & Reich, 2016). Because these studies produced inconsistent findings, scholars recently called for more research studying the relationships between specific types of Facebook use, rather than general Facebook use, and young individuals’ well-being (e.g., Verduyn et al., 2015). In line with this call, the present study focuses on *active public Facebook use* or “Facebook activities that facilitate direct interactions between the user and other Facebook friend(s) in a public setting” (e.g., status updating, sharing of photos, etc.) (Frison & Eggermont, 2015, p. 4).

Although the relationship between public Facebook activities and loneliness recently attracted research attention (e.g., Deters & Mehl, 2013), little is known about the direction of this relationship, especially during adolescence. To fill this important

lacuna, the present longitudinal study will examine the reciprocal relationships between active public Facebook use and adolescents' feelings of loneliness.

Active Public Facebook Use and Loneliness from a Media Effect Perspective

Regarding the consequences of the Internet in general, two conflicting hypotheses have appeared in the literature. Initial research related Internet use to a decrease in individuals' well-being, because time online (which is typically spent with weak ties) may displace time offline (which is typically spent with strong ties, for instance, close friends), hereby reducing the quality of existing friendships. In line with this *displacement hypothesis*, early studies found that Internet use was related to increased feelings of loneliness (e.g., Kraut et al., 1998). Later studies related Internet use to increases in individuals' well-being, because time online may increase social interaction with strong ties, hereby enhancing the quality of existing friendships. In line with this *stimulation hypothesis*, studies found that Internet use in particular may indeed decrease loneliness (e.g., Shaw & Gant, 2002).

With the widespread use of SNSs, interest in whether SNSs may harm or enhance users' well-being rapidly increased. Similar to research on the effects of Internet use, these studies revealed both positive and negative associations between SNS use and loneliness (Lou et al., 2012; Pittman & Reich, 2016; Primack et al., 2017), hereby providing evidence for both the displacement and stimulation hypothesis. For instance, Pittman and Reich (2016) argued that image-based social media use is related to a decrease in loneliness. And according to a systemic review, social media use may lower the level of loneliness by increasing feelings of social connectedness (Seabrook, Kern, & Rickard, 2016). Lou et al. (2012), however, indicated that college students'

Facebook intensity is associated with an increase in loneliness. Still other studies (e.g., Wohn & Larose, 2014) found no relationship between Facebook use and loneliness.

These inconsistent findings might be, in part, due to the fact that these studies defined SNS use very broadly, without differentiating among the various activities users can engage in. Recent studies that used more nuanced measures of SNS use found that directed communication and interaction on SNSs decreased users' feelings of loneliness (Burke, Marlow, & Lento, 2010; Yang, 2016), whereas browsing on Facebook was related to an increase in lonely feelings (Burke et al., 2010; Matook, Cummings, & Bala, 2015). Although there is growing consistency in the literature about the beneficial outcomes of SNS interaction and harmful outcomes of SNS browsing, results are far less consistent with regards to SNS broadcasting (e.g., status updating, photo sharing, etc.). Yang (2016), for instance, found that Instagram broadcasting was associated with higher loneliness, whereas Matook et al. (2015) argued that the use of active features in the form of broadcasting was related to lower loneliness. Although Deters and Mehl (2013) showed that an experimentally induced increase in status updating activity reduced undergraduate students' feelings of loneliness, longitudinal studies investigating the impact of Facebook broadcasting or active public Facebook use on loneliness are still lacking.

Another important reason why previous studies failed to find consistent results might be because the relationships between active public Facebook and loneliness may follow different directional paths than has largely been assumed in previous research (Nowland, Necka, Cacioppo, 2018). First, it could be that increases in active public Facebook use may lower adolescents' feelings of loneliness only after a certain amount of use and up until a certain point of use. If adolescents actively use Facebook only

sporadically, they may not receive enough social cues to feel less lonely. The development of intimate attachment bonds that can reduce loneliness takes time (Bowlby, 1978). Similarly, the building of a network of peers requires personal efforts and time investments (Bowlby, 1978). These conditions may not be met when active Facebook use is rather low. As such, low levels of active Facebook use may not decrease one's feelings of loneliness, but rather be associated with high levels of loneliness. Though, when adolescents regularly use Facebook in an active modus, the quality of newly developed and previous friendships may increase and, as a result, decrease loneliness (e.g., Shaw & Gant, 2002). Grant and Schwartz (2011), however, argue that "the very strengths and virtues that positive psychology has linked to higher well-being and performance can, at high levels, undermine the outcomes they are intended to promote" (p. 66). Building on these insights, it is likely that sharing too much information on SNSs may increase one's dependence on SNSs for feedback in general, and affirmation in particular. As a result, individuals who are extensive active public Facebook users may start to feel that their use no longer satisfies their emotional and social needs. Consequently, due to this high level of sensitiveness, feelings of loneliness are no longer reduced. We even imagine that extensive active public Facebook use may increase individuals' feelings of loneliness as prior research has found positive links between SNS use and loneliness (e.g., Lou et al., 2012). As such, we assume that the relationship between active public Facebook use and loneliness may appear to be U-shaped curve, with a negative association in the left part and a positive association in the right part.

Specifically, we expect a negative relationship between active SNS use and loneliness under the condition of low to medium levels of active SNS use: The more

adolescents use social media in an active way, the less lonely they will feel. However, with high levels of active SNS use, we can expect a positive relationship between active SNS use and loneliness: The more adolescents use social media in an active way, the lonelier they will feel. We therefore expect to find a U-shape association between active public Facebook use at Time 1 and loneliness at Time 2 (i.e., Hypothesis 1).

Loneliness and Active Public Facebook Use from a Media Selection Perspective

Next to the relationships between Facebook use and loneliness, an inverse relationship is also conceivable. Uses and Gratifications (U&G) theory argues that audiences actively select and use media in response to specific personal needs (Katz, Haas, & Gurevitch, 1973). For instance, when an audience member has a need for social interaction, this member will actively select and use a particular medium to fulfill this need. Given that social media are ideal to satisfy such social interaction needs, various researchers (Sheldon, 2012; Song et al., 2014) argue, based on U&G theory, that lonely feelings may particularly lead individuals to use SNSs, such as Facebook.

In line with this reasoning, various studies found that loneliness is a positive predictor of young people's Facebook use (e.g., Blachnio, Przepiorka, Boruch, & Balakier, 2016; Kross et al., 2013). However, numerous other studies found no support for this predictive influence (Baker & Oswald, 2010; Clayton, Osborne, Miller, & Oberle, 2013; Lou et al., 2012; Skues, Williams, & Wise, 2012; Wohn & Larose, 2014).

As mentioned earlier, scholars argue that these inconsistent findings, might be, partly due to the broad measurement of Facebook use and therefore started to examine the link between loneliness and specific types of Facebook use, such as using Facebook for connecting (Clayton et al., 2013) or communicating (Jin, 2013) with others. To our knowledge, however, only two studies examined whether loneliness may predict

adolescents' active public Facebook use or presenting activities on SNSs. Jin, (2013) found that loneliness was unrelated to presenting activities on SNSs (i.e., posting messages, photos, videos on my status, sharing friends' messages) among Korean adults. Frison and Eggermont (2015) indicated that loneliness was a positive predictor of adolescents' active public Facebook use in a longitudinal study. However, these two variables were collected in the same (first) wave. As both studies were cross-sectional in nature, we still lack longitudinal evidence on the predictive influence of loneliness on adolescents' active public Facebook use.

However, this relationship between loneliness and active public Facebook use, too, may converge both negative and positive paths than has been assumed in previous studies and may thus be U-shaped.

Loneliness may *heighten* adolescents' active public Facebook use only when loneliness is high enough. Individuals who do not feel lonely at all may find it unnecessary to invest in active Facebook use, because they have alternative social activities that secure their emotional bounds with peers. Moreover, the time displacement hypothesis would suggest these individuals have less time available for using Facebook (Robinson et al., 2000). Research seems to support this reasoning showing that a high number of extracurricular activities is related to low levels of loneliness (Fredricks & Eccles, 2005). With medium levels of loneliness, though, adolescents may be motivated to turn to Facebook to gratify their social needs. Loneliness can be a strong motivational factor to seek contact with others (e.g., Parkhurst & Hopmeyer, 1999). Such contact seeking behavior is likely to include (active) Facebook use according to several studies (e.g., Blachnio, Przepiorka, Boruch, & Balakier, 2016; Kross et al., 2013). However, it could be that the positive relationship

between medium levels of lonely feelings and active public Facebook use might disappear when loneliness becomes too high, as lonely feelings may trigger the belief that a person is powerless and cannot change their situation (e.g., Heinrich & Gullone, 2006). Given that various public Facebook tools, such as sharing status updates or posting pictures, offer youth ideal ways to seek social support, loneliness may increase adolescents' active public Facebook use up until the point that a person is starting to believe that he or she is incapable to change their situation. When this point is reached, it is possible that lonely individuals give up on developing intimate ties through Facebook and thus have lower levels of active Facebook use.

As such, we expect to find a positive relationship between loneliness and active public Facebook use under the condition of low to medium levels of loneliness; however, with high levels of loneliness, we can expect a negative relationship between loneliness and active public Facebook use. We therefore expect to find an inverted U curve relationship between loneliness at Time 1 and active public Facebook use at Time 2 (i.e., Hypothesis 2).

Method

Participants and Procedure

Participants were students from fifteen high schools in Belgium. These participants took part in a large-scale longitudinal panel study on Facebook use and well-being. A total of 1 866 adolescents participated at Time 1 (October 2013). One year later (October 2014), these schools were again visited by a team of researcher and 1 577 adolescents participated. In total, 1 188 high school students participated at both time points (i.e., 64% of total). The mean age of the study's sample at Time 1 was 14.30 ($SD = 1.43$) and 55 percent were boys. After obtaining informed consent in

accordance with the customary guidelines in Belgium, paper-and-pencil questionnaires were administered during regular school hours. At the beginning of the questionnaire, participants were informed that the questions concerned their emotions and social media use. To ensure sufficient privacy of participants' answers, participants were instructed to place the questionnaire in a closed envelope after completing. Students were assured strict confidentiality of their responses. All procedures were approved by the Social and Societal Ethics Committee of the host university.

Measures

Control variables. Participants indicated whether they were a boy (= 1) or a girl (= 2), and their age. Using an 11-point Likert scale (i.e., *0 hours* (= 1); *0.5h* (= 2); *0.5h-1h* (= 3); *1h-1.5h* (= 4); *1.5h-2h* (= 5); *2h-2.5h* (= 6); *2.5h-3h* (= 7); *3h-4h* (= 8); *4h-5h* (= 9); *more than 5 hours* (= 10); *I am always logged in to Facebook (i.e., I am constantly 'online' and available for interaction)* (= 11), we also questioned how much time participants spent, on average, on Facebook on a regular weekday, Wednesday, Friday, and weekend day. As schools dismiss students at noon on Wednesday, we distinguished Wednesday from regular weekdays. The items were averaged to form the variable 'time spent on Facebook'.

Active public Facebook use. The Active Public Facebook Use Subscale of the Multidimensional Scale of Facebook Use (Frison & Eggermont, 2015) assessed the frequency of three public Facebook activities (i.e., "How often do you post a message on your own Facebook timeline", "How often do you post a photo on your own Facebook timeline", and "How often do you post something else (e.g., a picture or video) on your own Facebook timeline") using seven-point Likert scale (i.e., *never* (= 1); *less than once a week* (= 2); *once till three times a month* (= 3); *once a week* (= 4);

several times a week (= 5); *daily* (= 6); *several times a day* (= 7). To validate the hypothesized one-dimensional scale structure, principal components analyses (PCA) were run (Time 1 eigenvalue = 2.40; explained variance = 80.08; $\alpha = .87$; Time 2 eigenvalue = 2.40; explained variance = 79.91; $\alpha = .87$). Based on the average of the three items, an estimate of active public Facebook use at Time 1 and Time 2 was created.

Loneliness. The Loneliness Scale of de Jong-Gierveld and Kamphuis (1985) was used. On a five-point Likert scale (*strongly disagree* = 1 to *strongly agree* = 5), participants estimated 11 items. Six of them refer to emotional loneliness (e.g., “I miss having a really close friend”), which results from the absence of an intimate tie, and five refer to social loneliness (e.g., “There are plenty of people I can lean on when I have problems”), which stems from the lack of a network of social relationships. These five items were recoded such that higher scores indicated higher social loneliness. In line with the hypothesized two-dimensional scale structure, PCA’s revealed two factors with eigenvalues over one, both at Time 1 and 2, explaining a combined variance of 56.86% at Time 1 and 59.57% at Time 2. Internal consistency was demonstrated both at Time 1 ($\alpha_{\text{Emotional loneliness}} = .85$; $\alpha_{\text{Social loneliness}} = .78$) and Time 2 ($\alpha_{\text{Emotional loneliness}} = .88$; $\alpha_{\text{Social loneliness}} = .78$). To estimate participants’ emotional and social loneliness at Time 1 and Time 2, we calculated their mean scores.

Data-Analysis

A set of four hierarchical polynomial regression models tested the curvilinear model. Standardized values were used when creating quadratic terms to prevent multicollinearity. Models 1, 2, 3 and 4 tested respectively the relationships between active public Facebook use at Time 1 and social loneliness at Time 2 (Model 1), active

public Facebook use at Time 1 and emotional loneliness at Time 2 (Model 2), social loneliness at Time 1 and active public Facebook use at Time 2 (Model 3), and emotional loneliness at Time 1 and active public Facebook use at Time 2 (Model 4).

In all models, gender, age and overall time on Facebook at Time 1 were included as control variables in Step 1, as these variables have been shown to predict loneliness in previous research (Mahon, Yarcheski, Yarcheski, Cannella, & Hanks, 2006; Ryan & Xenos, 2011). Next, the values of the main predictor at Time 2 as well as of the dependent variable at Time 1 were entered as control variables. For instance, for Model 1, the control variables, active public Facebook use at Time 2 and social loneliness at Time 1, were entered in Step 2. In Step 3, the main predictor at Time 1 was entered. In the final Step 4, the quadratic term of the main predictor at Time 1 was included, so that we could test its curvilinear relationship with the dependent variable at Time 2. A curvilinear model is considered to be supported when the quadratic term is statistically significant. A positive quadratic term indicates a U-shaped relationship while a negative quadratic term indicates an inverted U-shaped relationship. When the quadratic term was significant, we used a figure to illustrate the U-shaped relationship.

Results

To assess whether attrition biased the sample, we examined the differences between those who participated in both waves and those who participated in one wave. Using Pillai's trace, a MANOVA with all relevant Time 1 variables revealed significant differences between those who participated once ($N = 1\,067$) and those who participated twice ($N = 1\,188$) ($V = .01$, $F(31\,501) = 6.74$, $p < .001$, $h_p^2 = .01$). Follow-up univariate analyses revealed that adolescents who participated once scored higher on emotional loneliness ($M = 2.25$; $SD = .86$), compared to those who participated twice ($M = 2.07$;

$SD = .82$), $F(11, 773) = 17.69, p < .001$. Similarly, those who participated once scored higher on social loneliness ($M = 2.21$; $SD = .72$), compared to those who participated twice ($M = 2.10$; $SD = .69$), $F(11, 788) = 11.05, p = .001$.

Table 1 presents the descriptive statistics and the correlations among the key variables. On average, adolescent Facebook users spent overall 1.5 to 2 hours per day on Facebook ($M = 5.03$; $SD = 2.88$). Participants reported to engage in active public Facebook activities once till twice per month, (Time 1 $M = 2.84$; $SD = 1.30$, Time 2 $M = 2.55$; $SD = 1.23$). Social and emotional loneliness scores were rather low in our sample (social loneliness Time 1 $M = 2.16$, $SD = .72$; Time 2 $M = 2.10$, $SD = .71$) (emotional loneliness $M = 2.16$, $SD = .86$; Time 2 $M = 2.11$, $SD = .84$). In addition, the small (and non-significant) zero-order correlations suggest that a curvilinear relationship may be relevant to consider.

Media Effect Relationships: Active Public Facebook Use at Time 1 and Social and Emotional Loneliness at Time 2

Table 2 presents the results of the hierarchical regression model on social loneliness. The coefficient of active public Facebook use at Time 1 (in Step 3) was not significant ($\beta = -.020$, 95% CI $[-.059, .019]$, $p = .311$), whereas the coefficient of its quadratic term (in Step 4) reached significance ($\beta = .041$, 95% CI $[.008, .075]$, $p < .05$). The positive coefficient of the relationship between active public Facebook use at Time 1 and social loneliness at Time 2 indicated a U-shaped curve. As illustrated in Figure. 1, the left part of the U-curve manifested a negative relationship that an increase in active public Facebook use at Time 1 (score from 1 to 3.5) was related to a decrease in social loneliness at Time 2. Whereas the right part of the U-curve indicated a positive relationship that an increase in active public Facebook use at Time 1 (score from 3.5 to

7) was associated with an increase in social loneliness at Time 2. Thus, active public Facebook use at Time 1 and social loneliness at Time 2 conformed to a U-curve relationship.

Table 3 presents the results on emotional loneliness. The coefficient of the active public Facebook use at Time 1 in Step 3 was not significant ($\beta = -.001$, 95% CI $[-.046, .044]$, $p = .969$). Whereas the coefficient of its quadratic term in step 4 reached significance ($\beta = .039$, 95% CI $[.001, .078]$, $p < .05$). The positive coefficient of quadratic term indicated a U-shaped curve relationship between active public Facebook use at Time 1 and emotional loneliness at Time 2. In line with the U-shaped curve that had been detected earlier, the current curve between active public Facebook use at Time 1 and emotional loneliness at Time 2 emerged as a similar pattern. As shown in Figure. 2, the left part of the U-curve revealed a negative relationship in which an increase in active public Facebook use at Time 1 (score from 1 to 4) corresponded to a decrease in emotional loneliness at Time 2. However, the right part of the U-curve displayed a positive relationship in which an increase in active public Facebook use at Time 1 (score from 4 to 7) was associated with an increase in emotional loneliness at Time 2.

Hence, the association between active public Facebook use at Time 1 and emotional loneliness at Time 2 conformed to a U-curve relationship rather than a linear relationship. Thus, our first hypothesis was fully supported that the relationship between active public Facebook use at Time 1 and social and emotional loneliness at Time 2 emerged as two U-shaped curves. The curve relationship remained significant after controlling for a possible linear relationship.

Media Selection Relationships: Social and Emotional Loneliness at Time 1 and Active Public Facebook Use at Time 2

Table 4 presents the results of hierarchical regression of active public Facebook use at Time 2 on social loneliness at Time 1. As shown in Table 4, the first order term of social loneliness at Time 1 in Step 3 ($\beta = .139$, 95% CI [.038, .240], $p < .01$) was significant, indicating a positive linear relationship between social loneliness at Time 1 and active public Facebook use at Time 2, whereas its quadratic term in Step 4 ($\beta = .015$, 95% CI [-.028, .058], $p = .491$) was not significant, implying that the expected inverted U-curve was not present. In short, the more adolescents experienced social loneliness at Time 1, the more they engaged in active public Facebook use at Time 2.

Table 5 presents the results of hierarchical regression of active public Facebook use at Time 2 on emotional loneliness at Time 1. The first order term of emotional loneliness at Time 1 in step 3 ($\beta = .081$, 95% CI [-.006, .167], $p = .067$) was not significant. However, its quadratic term in step 4 reached significance ($\beta = .063$, 95% CI [.013, .114], $p < .05$), indicating a U-shaped curve emerged between emotional loneliness at Time 1 and active public Facebook use at Time 2. Again, we used a figure to demonstrate the U-shaped relationship. As shown in Figure. 3, the left part of the U-curve revealed a negative relationship in which an increase in emotional loneliness at Time 1 (score from 1 to 2.5) was related to a flattening decrease in active public Facebook use at Time 2. However, the right part of the U-curve indicated a positive relationship meaning that an increase in emotional loneliness at Time 1 (score from 2.5 to 5) was associated with an increase in active public Facebook use at Time 2.

Hypothesis 2 could thus not be supported. Specifically, the association between social loneliness at Time 1 and active public Facebook use at Time 2 resembled as positive linear relationship rather than a curvilinear relationship. In addition, the association between emotional loneliness at Time 1 and active public Facebook use at

Time 2 resembled a U-shaped curve relationship, rather than the expected inverted U-curve relationship.

Discussion

Active Public Facebook Use and Loneliness from a Media Effect Perspective

We found that the relationships between active public Facebook use at Time 1 and social and emotional loneliness at Time 2 followed U-shaped curves. This means that Hypothesis 1 was confirmed and that increases in active public Facebook use are related to decreases in feelings of emotional and social loneliness over time under the condition that adolescents have rather low to moderate levels of active public Facebook use. For adolescents with rather high levels of active public Facebook use, the relationships between active public Facebook use at Time 1 and both types of loneliness at Time 2 had a different direction and appeared to be negative. The more adolescents used Facebook to update their status or the post photos or videos, the more they experienced a lack of intimate ties and missed a rich network of social relationships. Thus, for low to moderately active Facebook users, our study supports the *stimulation hypothesis* (e.g., Shaw & Gant, 2002) suggesting that social media use helps adolescents to reduce their feelings of loneliness. However, for heavy active Facebook users, the results confirm the *displacement hypothesis* (e.g., Kraut et al., 1998), suggesting that adolescents' time online displaces the time they would otherwise spend with their friends in an offline setting. Our results, together with displacement literature (e.g., Kraut et al., 1998), thus suggest that when offline social interactions are heavily replaced by online social interactions, adolescents feel more lonely and, more precisely, feel they miss intimate ties and a rich network of friends. There might be another reason for the increased loneliness among heavy Facebook users. Studies found that an upward

comparison tendency on Facebook decreases users' perceived well-being over time (e.g., life satisfaction; Frison & Eggermont, 2016). Especially the users who use Facebook for a substantial longer period of time have been described to have the highest tendencies to engage in upward social comparison processes on Facebook (Chou & Edge, 2012). As such, heavy Facebook users might feel more lonely because they are the most prone to engage in social comparison processes.

These findings also relate to older media theories on desensitization, habituation and ceiling effects suggesting extensive exposure to certain media stimuli may cause users to be no longer susceptible for particular media effects (e.g., Zillmann & Bryant, 1986). Perhaps, the dissatisfaction that comes from this lack of gratification found in the large number of active Facebook interactions may lead to even more loneliness as the individual is often confronted with his/her inability to satisfy his/her social needs on social media.

In addition, our findings on the curvilinear relationships between active public Facebook use and changes in both types of loneliness over time partly support prior studies finding positive (e.g., Lou et al., 2012) as well as negative (e.g., Pittman & Reich, 2016) relationships. It would be interesting to see whether these studies, but also research reporting null findings (e.g., Wohn & Larose, 2014), also support a curvilinear pattern when reanalyzing their prior findings. The current study is the first to report such a direction of the relationship between social media use and well-being. As such, future research is required to further confirm the suggested curvilinear pattern.

Loneliness and Active Public Facebook Use from a Media Selection Perspective

Second, we found that the relationship between social loneliness at Time 1 and active public Facebook use at Time 2 is linear, while the relationship between emotional

loneliness at Time 1 and active public Facebook use at Time 2 revealed a U-shaped curve. Regarding social loneliness, it seems that feelings of lacking a social network drive adolescents to use Facebook more actively. Such a relationship is in line with Uses and Gratifications literature (Katz et al., 1973) assuming that media are selected to satisfy certain needs. Our study suggests that such a need is the need to have (many) friends. In contrast to our hypothesis, emotional loneliness was a positive predictor of public Facebook use regardless of the level of emotional loneliness of the adolescent.

A somewhat different pattern emerged when studying emotional loneliness that was also in contrast to our hypothesis: This type of loneliness only seemed to positively drive active Facebook use when experiencing moderate to high levels of loneliness. However, when experiencing low levels of emotional loneliness, active Facebook use was not increased over time, on the contrary, it was decreased. It thus seems that a certain threshold of emotional loneliness has to be reached before adolescents turn to active Facebook use to cope with their feelings of missing an intimate tie. Among adolescents with low levels of emotional loneliness, increases in their feelings of missing a social network related to lower levels of active Facebook use. They may turn more to other strategies to cope with their feelings of loneliness, such as offline meetings with friends or investing in new social activities (e.g., enrolling in a youth movement) and thus build new social networks. More research is needed to test these explanations that suggest different coping strategies are used by adolescent with low versus moderate to high levels of emotional loneliness. Only adolescents with moderate to high levels of emotional loneliness may perceive active Facebook use as an appropriate way to decrease their emotional loneliness.

Limitations

Several limitations have to be considered when interpreting the results of this longitudinal study. First, a well-known problem with longitudinal research is attrition rate. Our MANOVA analysis showed that dropouts scored higher on emotional and social loneliness as compared to the participants in our analytical sample. Future research is warned to take measures to prevent such attrition problems. Second, only self-reported data were used to assess adolescents' Facebook use. Future studies could benefit from using other method such as monitoring software (Junco, 2013). In addition, the current study focused on (active public) Facebook use. As such, we do not know of similar curvilinear relationship curves may be found when focusing on different types of social media (e.g., Instagram, Snapchat). Also this study was the first to report curvilinear relationships; these results need to be replicated in future research.

Conclusion

In sum, the current study supports a curvilinear U-shaped relationship between (1) active public Facebook use and emotional/social loneliness and (2) between emotional loneliness and active public Facebook use. These findings stress the importance of considering possible curvilinear relationship in future research aiming to disentangle social media effects as well as social media selection patterns.

Table 1

Descriptive statistics and correlations between variables.

	M	SD	1	2	3	4	5	6	7	8
1. Gender	-	-	1	-	-	-	-	-	-	-
2. Age	14.30	1.43	-.14**	1	-	-	-	-	-	-
3. Time on FB T1	5.03	2.88	.15**	.02	1	-	-	-	-	-
4. Active FB use T1	2.84	1.30	.14**	-.12**	.44**	1	-	-	-	-
5. Active FB use T2	2.55	1.23	-.05	-.13**	.23**	.47**	1	-	-	-
6. Social loneliness T1	2.16	.72	-.11**	-.02	.01	.01	.10**	1	-	-
7. Emotional loneliness T1	2.16	.86	.06**	-.03	.10**	.08**	.11**	.46**	1	-
8. Social loneliness T2	2.10	.71	-.09**	-.01	.03	-.01	.07*	.44**	.31**	1
9. Emotional loneliness T2	2.11	.84	.01	-.02	.03	.04	.10**	.33**	.49**	.54**

Note. $N = 1\,188$. FB = Facebook; T1 = Time 1; T2 = Time 2.* $p < .05$, ** $p < .01$.

Table 2

Examining the relationships between active public Facebook use (T1) and social loneliness (T2).

Predictor	Social loneliness T2				
	<i>b</i>	<i>95%CI</i>	<i>SE</i>	<i>R</i> ²	ΔR^2
Step 1					
Gender	-.110**	[-.199, -.022]	.045	.007	.007
Age	-.015	[-.046, .017]	.016		
Time spend on FB T1	.008	[-.008, .024]	.008		
Step 2					
Social loneliness T1	.440***	[.377, .493]	.029	.188	.181***
Active public FB use T2	.007	[-.028, .043]	.018		
Step 3					
Active public FB use T1, linear effect	-.020	[-.059, .019]	.020	.189	.001
Step 4					
Active public FB use T1, quadratic effect	.041*	[.008, .075]	.017	.194	.005*

Note. *N* = 1 188. FB = Facebook; T1 = Time 1; T2 = Time 2.

* $p < .05$, ** $p < .01$, *** $p < .001$. 95% bootstrapped confidence intervals (1 000 samples).

Table 3

Examining the relationships between active public Facebook use (T1) and emotional loneliness (T2).

Predictor	Emotional loneliness T2				
	<i>b</i>	<i>95%CI</i>	<i>SE</i>	<i>R</i> ²	ΔR^2
Step 1					
Gender	.012	[-.094, .117]	.054	.005	.005
Age	-.034	[-.071, .004]	.019		
Time spend on FB	.011	[-.008, .029]	.010		
Step 2					
Emotional loneliness T1	.487***	[.432, .541]	.028	.247	.242***
Active public FB use T2	.036	[-.005, .077]	.021		
Step 3					
Active public FB use T1, linear effect	-.001	[-.046, .044]	.023	.247	.000
Step 4					
Active public FB use T1, quadratic effect	.039*	[.001, .078]	.020	.250	.003*

Note. *N* = 1 188. FB = Facebook; T1 = Time 1; T2 = Time 2.

* $p < .05$, *** $p < .001$. 95% bootstrapped confidence intervals (1 000 samples).

Table 4

Examining the relationships between social loneliness (T1) and active public Facebook use (T2).

Predictor	Active public FB use T2				
	<i>b</i>	95%CI	SE	<i>R</i> ²	ΔR^2
Step 1					
Gender	-.275***	[-.416, -.134]	.072	.080	.080***
Age	-.119***	[-.169, -.068]	.026		
Time spend on FB	.102***	[.077, .127]	.013		
Step 2				.246	.166***
Active public FB use T1	.422***	[.365, .479]	.029		
Social loneliness T2	.098	[-.008, .188]	.046		
Step 3					
Social loneliness T1, linear effect	.139**	[.038, .240]	.052	.251	.005**
Step 4					
Social loneliness T1, quadratic effect	.015	[-.028, .058]	.022	.251	.000

Note. *N* = 1 188. FB = Facebook; T1 = Time 1; T2 = Time 2.

** *p* < .01, *** *p* < .001. 95% bootstrapped confidence intervals (1 000 samples).

Table 5

Examining the relationships between emotional loneliness (T1) and active public Facebook use (T2).

Predictor	Active public FB use T2				
	<i>b</i>	95%CI	SE	<i>R</i> ²	ΔR^2
Step 1					
Gender	-.275***	[-.416, -.134]	.072	.080	.080***
Age	-.119***	[-.169, -.068]	.026		
Time spend on FB	-.102***	[.077, .127]	.013		
Step 2					
Active public FB use T1	.418***	[.362, .475]	.029	.248	.168***
Emotional loneliness T2	.109**	[.033, .184]	.038		
Step 3					
Emotional loneliness T1, linear effect	.081	[-.006, .167]	.044	.251	.003
Step 4					
Emotional loneliness T1, quadratic effect	.063*	[.013, .114]	.026	.255	.005*

Note. *N* = 1 188. FB = Facebook; T1 = Time 1; T2 = Time 2.

* $p < .05$, ** $p < .01$, *** $p < .001$. 95% bootstrapped confidence intervals (1 000 samples).

Figure 1. Relationship between active public FB use T1 and social loneliness T2

Figure 2. Relationship between active public FB use T1 and emotional loneliness T2

Figure 3. Relationship between emotional loneliness T1 and active public FB use T2

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