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RESEARCH PAPER

How and Why Social Media Affect Subjective Well-Being: Multi-Site Use and Social Comparison as Predictors of Change Across Time

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Abstract
How and why does the widespread use of social media affect happiness? The present study examined whether the three components of subjective well-being—positive affect, negative affect, and life satisfaction—were impacted by use of three of the most popular social network sites in the U.S. (Facebook, Twitter, and Instagram), using the experience sampling method. Over 10 days, greater everyday use of social media resulted in lower subjective well-being—specifically, by increasing negative affective states rather than by decreasing positive states or life satisfaction—a pattern evident across all three social network sites. In evaluating why use of social media adversely impacted subjective well-being, social comparison was a strong predictor. Specifically, the more that participants reported comparing themselves to others while using social media, the less subjective well-being they subsequently experienced. In contrast, traditional, offline social interactions exerted the opposite (beneficial) effect on happiness: increasing positive affect and decreasing negative affect. The present study therefore demonstrates that ordinary, day-to-day use of social network sites adversely impacts subjective well-being over time, and further highlights the advantages of employing independent well-being measures and assessing the use of multiple sites.

Keywords Subjective well-being · Positive affect · Negative affect · Social media · Social network sites · Experience sampling method

1 Introduction

Every day, billions of people worldwide interact with social media. Yet the widespread use of social network sites stands in sharp contrast to a comparatively small body of research on how this use impacts people's happiness, or *subjective well-being*. Understanding the

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effects of social media use on happiness is of great interest as achieving high subjective well-being is a major life goal for a majority of people (Diener 2000). Not only is the experience of subjective well-being inherently rewarding, it is also related to numerous positive outcomes—such as workplace success, mental health, prosocial behavior, and physical health and longevity (Diener et al. 2017). Thus, it is essential that researchers better understand how the ubiquitous use of social network sites impacts people's happiness. In the present study, we address this theoretical gap by examining how the construct of subjective well-being, defined by high levels of positive affect, low levels of negative affect, and the presence of life satisfaction (Diener 1984) is affected by the use of social media. We explore how the use of multiple, widely-used social network sites (Facebook, Twitter, and Instagram) affect subjective well-being and investigate social comparison as an explanation for these effects.

While the subjective well-being literature offers few specific predictions about the effects of social media use on happiness, it is possible to derive insight from research on the beneficial impacts of social relationships. Social network sites have the potential to make it easier for people to stay in touch with friends and family members, to share information and updates with acquaintances, and to facilitate social interactions—all of which, at first glance, might be expected to increase subjective well-being. Indeed, rewarding social relationships are among the most robust predictors of greater happiness (Diener and Seligman 2002; Diener et al. 2017; Rohrer et al. 2018).

On the other hand, a different prediction might be derived to the extent that social network sites create a context that is fundamentally distinct from traditional, face-to-face social interaction. While high-quality social relationships provide an enduring boost to subjective well-being, social interactions that occur via social network sites may not, for a variety of reasons, resemble traditional, offline relationships.

Social network sites, rather than serving as facilitators of face-to-face contact, tend to promote the asynchronous posting and passive consumption of information about others—an environment that encourages upward social comparison (Lee 2014; Wise et al. 2010). Online personae are subject to impression management, with users overrepresenting positive life events (Walther 2007), and exaggerating how positive these events really are (Wang et al. 2017). Indeed, positive expressions, such as joy and pride, tend to be perceived as more appropriate than negative expressions, such as sadness, anger, disappointment, and worry, across multiple different social media platforms, including Facebook, Twitter, and Instagram (Waterloo et al. 2018). Viewing images and updates that selectively portray others positively may lead social media users to underestimate how much others actually experience negative emotions (Jordan et al. 2011) and lead individuals to conclude that their own life—with its mix of positive and negative feelings—is, by comparison, not as good. Supporting this reasoning, comparing oneself to others on Facebook has been linked to negative feelings (Fox and Moreland 2015), rumination (Feinstein et al. 2013), lower life satisfaction (Frison and Eggermont 2016b), greater envy (Verduyn et al. 2015), and diminished self-esteem (Wang et al. 2017). While these findings focus on Facebook, other social network sites afford the opportunity for upward social comparison; for example, greater use of Instagram has also been associated with comparing oneself to others and to increased depressive symptoms (Nesi and Prinstein 2015; Lup et al. 2015). Given its divergence from traditional interaction and propensity for upward comparison, we hypothesize that social media use has the potential to adversely impact subjective well-being (Wang et al. 2017; Wheeler 1966).

A number of studies are consistent with the possibility that use of social network sites—rather than being a proxy for traditional, direct social interaction—undermines happiness.

Use of social network sites is associated with reduced subjective well-being in cross-sectional studies (Chen et al. 2016; Shakya and Christakis 2017), though such findings are ambiguous with regard to directionality. Nonetheless, brief longitudinal and experimental studies are consistent with the assertion that use of social network sites leads to lower well-being. For instance, participants assigned to use Facebook in a lab setting reported diminished global affect (Verduyn et al. 2015), and asking participants to quit Facebook for one week led to increases in life satisfaction and positive affect, relative to those who continued to use Facebook (Tromholt 2016). Thus, a recent review concluded that the evidence for the negative effects of social media use on well-being is generally stronger than that for the positive effects (Verduyn et al. 2017).

While the foregoing review outlines a framework for understanding how and why social media use affects happiness, a significant limitation of the existing literature is the failure to assess the full theoretical construct of subjective well-being—including positive and negative affect, as well as life satisfaction—and whether these components are differentially affected by social media use. A common practice has been to reduce the positive and negative affective dimensions to a single item rather than assessing them independently (see Diener and Emmons 1985), or to obscure their independence by combining them into an aggregate well-being score. Thus, in the present study we probe whether the use of social network sites adversely affects subjective well-being across components (i.e., decreased positive affect and life satisfaction, with increased negative affect), or whether, for example, social comparison increases negative feelings independently of positive ones.

A second limitation of existing research has been an almost exclusive focus on Facebook. Examining the effect of using additional sites on subjective well-being is essential as many social media users engage with more than one platform; testing the unique and combined effects of multi-site use within the same study is a critical theoretical gap. The present study assesses three of the most popular social network sites in the U.S.: Facebook (2.5 billion users), Instagram (1 billion users), and Twitter (386 million users; Statista 2020). By assessing use of these three sites, we aimed to capture the most likely candidates for multi-site use. Moreover, we hypothesize that they share the potential to promote the comparison of oneself to others portrayed through selectively curated images and text. As such, these sites—together and independently—offer users numerous opportunities for the upward comparison of oneself to others at their best moments, undermining subjective well-being. Indeed, the aggregate use of multiple sites—though seldom a focus within this literature—has been linked to negative states such as depression and anxiety (Primack et al. 2017), highlighting the importance of multi-site research designs. The present study is the first, to our knowledge, to study the use of these three widely used sites, together, using an experience sampling design, which records multiple measurements from individuals as they go about their ordinary, daily activities. We further probe the effects of social comparison to understand why social media use may adversely affect subjective well-being.

1.1 Overview of the Present Study

Following a typical experience sampling protocol (Scollon 2018), participants were prompted at five random times per day to respond to our questionnaire (i.e., to report on their use of Facebook, Instagram, and Twitter, along with their subjective well-being). An advantage of the experience sampling method is the ability to reduce memory distortion (Kahneman 1999), as well as to survey individuals ecologically, while they remain immersed in daily life. Our design allowed us to test whether social media use would

reduce subjective well-being (Hypothesis 1), and, if so, whether this use affected the three components of subjective well-being in parallel (i.e., diminished positive affect and life satisfaction, and increased negative affect). We additionally asked how much participants compared themselves to others while on Facebook, predicting that greater social comparison would adversely impact moment-to-moment subjective well-being (Hypothesis 2)—a possibility previously untested using the experience sampling method. Furthermore, because rewarding social interactions are a robust predictor of happiness, we sought to contrast whether the use of social network sites reduces well-being in the very same people who report increases in well-being when directly interacting with others, offline (Hypothesis 3). Finally, we tested whether life satisfaction, the cognitive component of subjective well-being, diminished across a 10-day period as a result of greater use of social network sites (Hypothesis 4)—and explored whether those results extended to self-esteem, a robust correlate of subjective well-being (Hypothesis 5).

We also explored several secondary research questions. First, we probed whether a single global measure captured the effects of social media use on subjective well-being comparably to independent measures of positive and negative affect. Second, we evaluated the causal direction of the effects by comparing whether social media use predicted changes in subjective well-being, versus whether changes in positive and negative affect predicted social media use. Third, we investigated whether feelings of loneliness—a discrete emotion reflective of social connection versus isolation—were affected by the use of social network sites.

2 Method

2.1 Participants

Eighty participants gave their informed consent for the study as one option among several to earn course credit in introductory psychology at a mid-sized public university in the southeastern U.S. Prior research (e.g., Kross et al. 2013) employed a similar sample size, suggesting this would be adequate to observe effects of comparable magnitude. Three participants were excluded due to low rates of response to the experience sampling portion of the study (responding to fewer than 5 total surveys), producing a final sample size of 77. There were no substantive differences in any of the results when these participants were included in the analyses. Demographic questions on age, gender, and ethnicity were unintentionally omitted from the baseline survey when distributed to participants. While the omission of these three demographic variables limits our ability to describe the characteristics of the sample, their omission did not impact any of the other data collected nor the results. The study was approved by the university's institutional review board.

2.2 Materials and Procedure

2.2.1 Baseline Questionnaire

The first session occurred in a university laboratory setting. A researcher explained the study procedure to participants, addressed questions, and verified that participants had the ability to receive survey links for the experience sampling phase of the study on their mobile device. After providing informed consent, participants completed the 5-item

Satisfaction with Life Scale (e.g., "*I am satisfied with my life*"; 1 = Strongly Agree, 7 = Strongly Disagree; Diener et al. 1985), and the Rosenberg Self-Esteem Scale (e.g., "*I feel that I have a number of good qualities*"; 1 = Strongly Agree, 4 = Strongly Disagree; Rosenberg 1965). As previously noted, we included self-esteem as a variable due to its strong association with subjective well-being (Diener and Diener 1995; Baumeister et al. 2003), and we expected parallel effects resulting from social media use.

2.2.2 Experience Sampling

In the experience sampling phase, participants received five surveys per day via email, between the hours of 10am and midnight, for 10 days. Each identical survey consisted of a series of questions focused on participants' emotions and use of social network sites. Specifically, participants were asked to respond to the items presented in Table 1 (in order), using a sliding scale with 1-point increments.

2.2.3 Posttest Questionnaire

Participants were provided with the link to a final "exit" survey via email after completing the experience sampling phase. The survey included the Satisfaction with Life Scale, the Rosenberg Self-Esteem Scale, and their approximate number of Facebook friends, which has been associated with a user's level of Facebook activity (Chen 2014) as well as with perceived social support (Kim and Lee 2011).

2.3 Statistical Approach

We used multilevel modeling (MLM), with observations nested within individual, to predict each participant's current rating of (a) positive affect and (b) negative affect from their reports of how much they had recently used each social network site (Facebook, Twitter, Instagram) in aggregate (i.e., the multi-site average) and independently. More specifically, when participants responded to a randomly timed survey, they were asked to report their use of each site *since the last time we asked* (i.e., since the prior survey), capturing social media use during the interval between surveys. Because participants then reported on their *current* positive and negative affect, at the time of the survey, we modeled the lagged effects of social network site use on subsequent well-being. To control for stability in affective states, we used participants' prior rating of positive or negative affect (according to the outcome being predicted) as an additional predictor. As a result, our analyses demonstrate the effect that social media use has in increasing or decreasing subjective well-being across time.[1]

[1] In the event that participants missed a survey, their most recent complete rating of positive or negative affect served as the control, as long as it was from the same day.

Table 1 Items and corresponding scales implemented during the experience sampling phase

Variable	Item	Scale
Affect	How do you feel right now?	0 = *very negative*, 100 = *very positive*
	Focusing only on positive feelings, how much are you feeling right now?	0 = *no positive feelings*, 100 = *maximum intensity of positive feelings*
	Focusing only on negative feelings, how much are you feeling right now?	0 = *no negative feelings*, 100 = *maximum intensity of negative feelings*
Loneliness	How lonely do you feel right now?	0 = *not at all*, 100 = *a lot*
Social Media Use	How much have you used Facebook since the last time we asked?	0 = *not at all*, 100 = *a lot*
	How much have you used Twitter since the last time we asked?	0 = *not at all*, 100 = *a lot*
	How much have you used Instagram since the last time we asked?	0 = *not at all*, 100 = *a lot*
Direct (Offline) Social Interaction	How much have you interacted with other people 'directly' since the last time we asked? ('Directly' means face-to-face or on the phone ONLY)	0 = *not at all*, 100 = *a lot*
Type of usage	Which of the following best describes how you've used Facebook since the last time we asked?	To check news feed; Messaging; To check World News; Posting status/picture updates
Social Comparison	How often, since the last time we asked, did you compare your life to someone else's while using Facebook?	0 = *not at all*, 100 = *a lot*

Table 2 Means, standard deviations, scale reliabilities, and correlations for baseline and posttest measures

	Baseline		Posttest	
	Life satisfaction	Self-esteem	Life satisfaction	Self-esteem
Life satisfaction (Baseline)	–	–	–	–
Self-esteem (Baseline)	.53**	–	–	–
Life satisfaction (Posttest)	.82**	.52**	–	–
Self-esteem (Posttest)	.39**	.63**	.50**	–
Cronbach's alpha	.84	.88	.88	.84
Mean	5.13	3.10	5.22	3.00
SD	1.01	0.45	1.02	0.45

*$p < .05$, **$p < .01$. Responses to the life satisfaction scale were made on a 1–7 scale; self-esteem was rated on a 1–4 scale; higher values indicate greater levels of life satisfaction and self-esteem

3 Results

Baseline and posttest questionnaire items were reverse-scored as needed, such that higher numbers indicate greater life satisfaction and self-esteem (see Table 2 for descriptive statistics and scale reliabilities). Number of Facebook friends did not significantly correlate with any outcome variables and was thus excluded from further analyses. The means, standard deviations, and correlations for the experience sampling measures are presented in Table 3. A response was considered valid ($n = 2{,}059$) if it was submitted by the participant before they received the next random survey, at which point the prior survey would be considered unreturned and participants would move on to the new survey. The number of valid responses from participants ranged from 6 to 48.

3.1 Primary Analyses

Our results are presented as *primary analyses* (addressing Hypotheses 1–5) and *secondary analyses* (addressing our secondary research questions). We begin our analyses by examining whether the self-reported frequency of social network site use was associated with participants' subsequent positive and negative affect, then move on to examining the role of social comparison, the effect of direct offline interaction, and whether social media use produces changes in life satisfaction and self-esteem over time.

Hypothesis 1 *Use of Multiple Social Network Sites Predicts Declines in Subjective Well-Being*. We examined multi-site use as a predictor of positive affect (PA) and negative affect (NA) to evaluate Hypothesis 1. As illustrated in the first row of Table 4, greater multi-site use, based on aggregate usage of Facebook, Twitter and Instagram, increased NA ($B = .16$), but had no significant effect on PA ($B = .03$).[2] We next predicted PA and NA from use of Facebook, Twitter and Instagram independently (rather than in aggregate), to probe whether this effect was consistent across the three sites. Indeed, the more that participants

[2] In other words, each one-unit increase in multi-site use predicted a .16 increase in NA, and a .03 (non-significant) change in PA.

Table 3 Within-person correlations (above diagonal), between-person correlations (below diagonal), means and standard deviations for experience-sampling variables

	Positive affect	Negative affect	Overall affect	Loneliness	Facebook use	Twitter use	Instagram use	Direct contact
Positive affect	–	−.51**	.73**	−.28**	.02	.01	.07**	.23**
Negative affect	−.57**	–	−.51**	.42**	.08**	.09**	.05**	−.09**
Overall affect	.92**	−.60**	–	−.28**	.01	.03	.10**	.24**
Loneliness	−.46**	.69**	−.46**	–	.11**	.12**	.11**	−.12**
Facebook use	−.17	.27*	−.16	.31**	–	.33**	.36**	.07**
Twitter use	−.00	.28*	−.04	.24*	.32**	–	.57**	.09**
Instagram use	−.06	.30**	−.04	.20	.23	.48**	–	.17**
Direct interaction	.40**	−.03	.41**	−.19	−.12	.13	.31**	–
Mean	65.58	26.58	68.69	26.02	20.67	27.94	36.32	62.67
SD	16.06	13.03	15.24	18.01	16.81	21.71	23.21	21.36

*$p < .05$, **$p < .01$. Means and standard deviations calculated on between-person data

Table 4 Multilevel modeling (MLM) results for the effects of social network site use, social comparison and direct social interaction on positive and negative affect

	Positive affect			Negative affect		
	B [95% CI] (SE)	*t*	*p*	*B* [95% CI] (SE)	*t*	*p*
Multi-site use	.03 [−.06, .12] (.05)	.68	.50	.16 [.05, .26] (.05)	3.04	.004
Facebook	−.02 [−.09, .05] (.03)	−.57	.58	.06 [.00, .13] (.03)	1.99	.05
Twitter	−.00 [−.06, .05] (.03)	−.12	.91	.09 [.02, .17] (.04)	2.48	.02
Instagram	.06 [−.01, .12] (.03)	1.73	.09	.08 [.01, .15] (.03)	2.26	.03
Social comparison (Facebook)	−.16 [−.25, −.07] (.05)	−3.36	.001	.21 [.11, .31] (.05)	4.36	< .001
Direct (Offline) Social Interaction	.16 [.10, .21] (.03)	6.04	< .001	−.05 [−.10, .00] (.02)	−2.13	.04

Positive coefficients (B) indicate that the more participants used social media, socially compared, or directly interacted with others, the more they experienced increases in positive or negative affect

reported using Facebook, Twitter, or Instagram in the interval between random surveys, the more NA they subsequently reported feeling ($B = .06$, .09, .08, respectively; Table 4, rows 2–4). Since participants' most recent report of NA was statistically controlled, these effects represent increases in NA over time after using any of the three sites. In terms of PA, congruent with the non-significant findings for the multi-site variable, use of each site individually was not predictive, though the effects of greater Instagram use on PA ($B = .06$) remained just outside traditional levels of significance, a finding we return to in the discussion section. Thus, our findings are clear and consistent in demonstrating that use of social network sites adversely affects subjective well-being through increasing negative affect rather than by reducing positive affect.

Hypothesis 2 *Social Comparison on Social Media Undermines Subjective Well-Being*. To further probe *why* social media use affects subjective well-being, we turned our attention to participants' ratings of how much they compared themselves to others while using Facebook. As illustrated in the fifth row of Table 4, greater social comparison increased NA ($B = .21$) while also reducing PA ($B = -.16$), controlling for the respective prior affect.[3] These results are consistent with our prediction that upwardly comparing oneself to others' carefully managed (and disproportionately positive) images and updates undermines subjective well-being. Specifically, social comparison produced both more negative affect *and* less positive affect—a robust adverse impact on the affective dimensions of their subjective well-being.

Since social media use—as well as social comparison—both predicted increases in negative affect, we next tested a model in which NA was predicted from both (a) Facebook use and (b) social comparison while using Facebook. In other words, we probed whether social comparison could, in part, explain why use of social media, such as Facebook, predicted increases in negative affect. Taking into account both Facebook use and social

[3] To keep the experience sampling survey as brief as possible, participants were asked to refer specifically to Facebook for the question of social comparison. However, social comparison on other sites similarly increases NA (Garcia et al. 2020).

Table 5 Unstandardized (B) and standardized (β) regression coefficients for the effect of social network site use on posttest life-satisfaction and self-esteem

	Life satisfaction				Self-esteem			
	B	β	*t*	*p*	*B*	β	*t*	*p*
Multi-site use	−.002	−.03	−.43	.67	−.004	−.13	−1.29	.20
Facebook	−.001	−.02	−.24	.82	−.006	−.20	−2.01	.049
Twitter	−.004	.08	−1.03	.31	−.003	−.14	−1.44	.16
Instagram	.00	.01	0.15	.88	−.00	−.003	−.03	.98
Social comparison (Facebook)	−.009	−.10	−1.42	.16	−.01	−.28	−3.13	.003

comparison as predictors, social comparison continued to predict significant increases in NA, *B* (SE) = .21 (.05), $t = 3.91$, $p < .001$, 95% CI [.10, .33]. However, there was no longer a unique effect of Facebook use on NA after taking into account social comparison, *B* (SE) = .01 (.04), $t = .35$, $p = .72$, 95% CI [−.06, .08]. Thus, these findings are consistent with the possibility that social comparison is a mechanism through which use of social network sites specifically increases negative feelings and reduces well-being.

Hypothesis 3 *Direct Interaction with Others Increases Subjective Well-Being*. Higher quality social relationships are associated with greater positive affect and diminished negative affect, and this is one of the most consistent findings in the subjective well-being literature (Diener and Seligman 2002; Diener et al. 2017). Thus, we predicted that *direct* (offline) interactions with others—defined as those occurring face-to-face or by voice—would predict greater positive affect, while inversely predicting negative affect. As illustrated in the last row of Table 4, these predictions were confirmed: direct interactions predicted greater PA ($B = .16$) while reducing NA ($B = -.05$), controlling for prior PA or NA. Interacting with others offline, therefore, enhances subjective well-being by providing a boost in PA and lowering NA, exactly the opposite of our findings for interacting with others via social network sites. Thus, even within the same group of individuals, direct social interaction is associated with very different outcomes from those resulting from social media use, suggesting that social network sites create a fundamentally different and unique form of social contact.[4]

Hypotheses 4–5 *Use of Social Network Sites Adversely Affects Life Satisfaction and Self-Esteem Across Time*. Our results show that use of multiple social network sites—as well as social comparison—led to greater negative affect. We next turned our attention to the cognitive dimension of subjective well-being—*life satisfaction* (Diener et al. 1985). While our experience sampling surveys focused exclusively on PA and NA (i.e., the affective components of subjective well-being), as emotional responses might be expected to vary moment-to-moment, we assessed life satisfaction before and after the experience sampling portion of the study, a time span of nearly 2 weeks. Life satisfaction reflects one's cognitive evaluation of life overall and prior research suggests that changes can be observed over time as a result of social media use (Kross et al. 2013; but see also Verduyn et al. 2015).

[4] Because direct interactions affected subjective well-being, we explored their effect when included as a control variable in our primary analyses. However, the results were not substantively altered.

We conducted a multiple regression analysis in which *average* multi-site use across the experience sampling portion of the study predicted posttest life satisfaction (controlling for baseline life satisfaction; see Table 5, left side). However, the results failed to demonstrate a connection between social media use and changes in life satisfaction. These findings reinforce the conclusion that in the present study, social media use influenced subjective well-being primarily through increasing negative affect.

Self-esteem, a robust correlate of subjective well-being (Diener and Diener 1995), was also assessed before and after the experience sampling phase (see Table 5, right side). Two variables emerged as significant predictors of lower posttest self-esteem, controlling for baseline self-esteem: Facebook use ($\beta = -.20$) and social comparison on Facebook ($\beta = -.28$). To examine whether Facebook use in general, or—more specifically—*social comparison* while using Facebook predicted these declines in self-esteem, we included social comparison as an additional predictor. Social comparison on Facebook continued to predict lower post-study self-esteem, $B = -.01$, $\beta = -.26$, $t\,(61) = -2.37$, $p = .02$, controlling for baseline self-esteem. In contrast, there no longer remained a unique effect of general Facebook use on post-study self-esteem, $B = -.001$, $\beta = -.05$, $t(61) = -.41$, $p = .68$. Therefore, Hypothesis 5 is partially supported, specifically for Facebook use, with social comparison on Facebook accounting for participants' reduced self-esteem.

3.2 Secondary Analyses

Our secondary analyses complement our primary objective of delineating the effects of social network use on subjective well-being. These analyses include: comparing the conclusions drawn from using a global measure of affect (versus independent measures of positive and negative affect), testing directionality of the social media to subjective well-being relation, and analyzing the impact of social network site use on loneliness.

3.2.1 Comparability of a Global Measure of Affect to Independent Measures of Positive and Negative Affect

The present study examined positive and negative affect independently—capturing the theoretical structure of subjective well-being (Diener 1984; Diener and Emmons 1985)—in contrast to the practice of using a single-item, global measure to represent happiness. However, we included a single-item measure of affect ranging from negative to positive for comparison. Thus, a secondary aim of the present study was to explore whether separate measures of PA and NA could produce different conclusions from using a single-item measure of well-being.

To evaluate this question, we used multilevel modeling with a single-item measure of overall, global affect as the outcome variable. Predicting global affect from multi-site use, Facebook use, or Twitter use revealed no significant effects, $t \leq 1.67$, $p > .10$. Thus, including only this single-item measure in the present research would have led to the erroneous conclusion that multi-site use, or use of Facebook and Twitter individually, did not significantly impact one's subjective well-being—when, in fact, such usage undermines well-being by increasing negative affect. In contrast, Instagram use predicted more favorable global affect, B (SE) = .08 (.03), $t = 2.90$, $p = .01$, 95% CI [.02, .14]. On its own, this relation between Instagram use and global affect might lead one to conclude that its use improves well-being (obscuring its tendency to also increase negative affect).

Table 6 Multilevel modeling (MLM) results for the effects of social network use, social comparison, and direct social interaction on loneliness (first column) and the reverse pathway (second column)

	Social media use → Loneliness			Loneliness → Social media use		
	B [95% CI] (SE)	*t*	*p*	*B* [95% CI] (SE)	*t*	*p*
Multi-site use	.19 [.11, .27] (.04)	4.79	< .001	.05 [.00, .09] (.02)	2.07	.04
Facebook	.17 [.08, .25] (.04)	4.14	< .001	.06 [.01, .10] (.02)	2.40	.02
Twitter	.13 [.06, .21] (.04)	3.65	.001	.03 [− .02, .08] (.03)	1.12	26
Instagram	.11 [.05, .16] (.03)	3.87	.001	.06 [− .01, .12] (.03)	1.74	.09

Therefore, outcomes for the overall global measure of affect diverge from separate measures of PA and NA, with substantively different conclusions. The undifferentiated overall affect item fails to convey the actual, multifaceted impact of social media use on subjective well-being. The high correlation between the global measure and the positive affect item ($r_{between} = .92$, $r_{within} = .73$; Table 3) suggests that participants treated the former as a proxy for the latter. These results highlight the importance of measuring positive and negative affect independently, and demonstrate that each may be uniquely responsive to different predictors (Diener and Emmons 1985; Diener et al. 2010; Kahneman and Deaton 2010).

3.2.2 Assessing Directionality via Reverse Pathways

While our results suggest that social media use predicted changes in subjective well-being, we also probed the reverse direction—in which one's affective state leads to more (or less) use of social media. Greater participant reports of negative affect at one time point did predict greater social media use at the next—only, however, for Facebook. Specifically, the reverse pathway from NA to Facebook use indicated that participants used Facebook more after experiencing negative emotions, controlling for prior Facebook use, B (SE) = .07 (.03), $t = 2.50$, $p = .01$, 95% CI [.01, .12]. As well, greater reports of positive affect at one time point predicted less use of Twitter, though the effect was weaker, B (SE) = − .06 (.03), $t = -1.82$, $p = .07$, 95% CI [− .13, .01], controlling for prior Twitter use. No other reverse pathways attained or approached significance, for either multi-site or individual site use ($t \leq 1.57$, $p \geq .12$). Therefore, whereas social media use increases NA consistently, whether use is measured in aggregate across sites or on individual sites, the evidence for the reverse pathway is weaker and sporadic (cf., Kross et al. 2013).

3.2.3 Social Isolation

We examined *loneliness* as a discrete negative emotion because—as a reflection of social isolation versus social connection—it is of particular interest in the context of social network sites. It might be argued, on one hand, that the widespread success of social media is fundamentally reflective of our need to maintain social connections. According to this perspective, time spent on social media is a form of social interaction, resulting in a feeling of social connection and reduced loneliness. Yet as the present study has demonstrated, social interaction via social network sites diverges from traditional offline interaction in its effects, predicting increases in negative affect. Therefore, we investigated whether social

media use also has the ironic effect of making people feel *lonelier*. After all, images and updates on social media may serve as reminders that a person is not (in the physical sense) with others, rather than serving as a proxy for in-person contact.

Our analyses are presented in Table 6 (first column). Multi-site use ($B = .19$), or the use of Facebook, Twitter, or Instagram separately ($B = .17$, .13, and .11, respectively) all resulted in significantly *increased* loneliness (all analyses controlling for prior loneliness).[5] These results could be viewed as compatible with the contrast effect of upward social comparison (Mussweiler et al. 2004); seeing others on social media, rather than providing a sense of connection and alleviating feelings of loneliness, might instead highlight the fact that one is not currently with those others, increasing feelings of social isolation. Consistent with this reasoning, social comparison (on Facebook) was associated with greater subsequent feelings of loneliness, B (SE) = .28 (.05), $t = 5.26$, $p < .001$, 95% CI [.18, .38].

While social media use made participants lonelier, the possibility remains that rather than anticipating this outcome, people expect the opposite—that using social media will alleviate their feelings of isolation. According to this reverse pathway, social media use is a *consequence* (rather than a cause) of loneliness. As can be observed in Table 6 (second column), loneliness predicted multi-site use ($B = .05$) and the use of Facebook, specifically ($B = .06$). The reverse paths from loneliness to use of Twitter ($B = .03$) and Instagram ($B = .06$)—while not significant—were similar in their magnitude and direction.

Together, these results are consistent across platforms in showing that social media use leads to loneliness, though the reverse (using social network sites when one is lonely) also occurs. As these pathways are not mutually exclusive, they suggest a bi-directional effect in which individuals turn to social network sites to connect with others when lonely, only to produce the contradictory outcome of heightening their sense of loneliness.

4 Discussion

How and why is subjective well-being (i.e., happiness) affected by the near-ubiquitous use of social media in daily life? We investigated how the three theoretically-based components of subjective well-being—positive affect, negative affect, and life satisfaction—were impacted by the use of multiple social network sites and by social comparison, using an experience sampling methodology that allowed us to assess these variables in situ and across time. The three social network sites examined (Facebook, Twitter and Instagram) yielded remarkably convergent findings. The more respondents had recently used these sites, either in aggregate or individually, the more *negative affect* they reported when they responded to our randomly-timed surveys over a 10-day period. As we controlled for consistency in participants' affective states, these results indicate downward changes in their subjective well-being. In contrast, neither aggregate multi-site use nor usage of any one site consistently predicted changes in positive affect or life satisfaction over the course of the study. Social media use, in the present study, undermined subjective well-being exclusively by increasing negative feelings.

The relationship between social media use and subjective well-being, via increased negative affect, is arguably paradoxical given that social media sites offer users a potential

[5] In contrast, direct, offline social interactions *reduced* loneliness, B (SE) = −0.08 (.03), $t = -2.58$, $p = .01$, 95% CI [−.15, −.02].

means to socially connect with others. Quality social relationships are generally a hallmark of subjective well-being, and are likely necessary to attain high levels of happiness (Diener and Seligman 2002). In a representative sample of more than 51,000 people worldwide, gathered through the Gallup World Poll, virtually all (94%) of those who fell in the "extremely happy" category felt there were others they could rely upon (Diener et al. 2018). Because the present study included ratings of direct, offline interactions with others (i.e., face-to-face or voice), we were able to demonstrate that—consistent with this body of work—offline social interaction had precisely the opposite effect of using social media, strongly enhancing affective well-being (c.f., Shakya and Christakis 2017). The use of social media, thus, differs from traditional offline social interaction in important ways—with divergent effects on subjective well-being.

One of the aspects of social network sites that increases negative feelings is the widespread availability of upward targets for social comparison. Because people tend to differentially post personal images and updates that convey a favorable impression, individuals may reach the false conclusion that others' lives consist largely of positive experiences—unlike one's own life, which inevitably has both positive *and* negative moments (Jordan et al. 2011).[6] According to the selective accessibility model (Mussweiler et al. 2004), social comparison produces a contrast effect when individuals focus on differences between themselves and the target of comparison. Given that the amount and degree of positive experiences shared by others on social media is likely not realistic, and quite different from one's personal experience, comparisons on social media are likely to create a contrasting effect, ultimately resulting in a more negative evaluation of oneself and one's life. Consistent with this assertion, the more that participants in the present study reported having compared themselves to others on Facebook in the interval between surveys, the more negative affect—and less positive affect—they subsequently experienced. Social comparison on Facebook appeared to account, at least in part, for the relation between Facebook use and negative affect, in that once social comparison was controlled, no independent effect of Facebook use on negative affect remained. Social comparison also accounted for the adverse effect of Facebook use on self-esteem over the course of the study.

Some forms of social media use may preferentially encourage social comparison and reduce subjective well-being. Using Facebook passively—in which one does not interact synchronously with others—predicts declines in subjective well-being, while active usage—involving direct online communication with others—does not (Verduyn et al. 2015; see also Clark et al. 2018). If active social media use most closely resembles traditional, face-to-face communication, passive use (for example, scrolling through others' posts and updates) involves little person-to-person reciprocal interaction while providing ample opportunity for upward comparison. We queried participants about their use of four specific functions of Facebook—checking one's news feed, messaging, checking world news, and posting status/picture updates—throughout the present study. The most frequently used function was passively checking one's news feed ($M = 27.3$), followed by posting updates ($M = 15.6$), messaging ($M = 11.2$) and reading world news ($M = 8.9$), with

[6] The phenomenon of *assortative mixing* (i.e., individuals preferentially connecting with similar others via social media) has been observed among Twitter users on the basis of subjective well-being. An interesting possibility, therefore, is that social media users may come to post content that affectively matches the content of those with whom they are connected. When those in one's social network post largely positive content, the homogeneity of this content among connected users may only increase over time, augmenting misperceptions about the uniform positivity of others' lives (Bollen et al. 2011).

all items assessed on a 100-point scale. Thus, participants in the present study primarily used Facebook asynchronously, and the negative effects on subjective well-being were consistent with this form of use.[7]

While we largely observed consistency in the effects of social media use across sites on positive and negative affect, some unique variation occurred. The tendency for Instagram to increase overall global affect while also promoting negative affect may, at first glance, appear contradictory. However, we suspect that divergent impacts on positive and negative affect may result from unique predictors. For example, use may provide entertainment and informational value and allow for the up-regulation of one's positive emotions through capitalization while simultaneously promoting social comparison—and these processes may impact different aspects of subjective well-being. In other words, the multifaceted ways in which individuals use social network sites may moderate specific affective outcomes. The site-specific features (such as the degree to which direct interaction between persons is facilitated) that drive unique well-being outcomes (i.e., positive versus negative affect) are deserving of further research, and highlight the importance of measuring well-being according to its theoretical structure, with independent measures of positive and negative affect.

4.1 Limitations and Future Directions

The present study found support for the role of social comparison in explaining why social media use decreases subjective well-being, yet other factors may also operate. Understanding when particular predictor variables become focal and how they might interact with social comparison processes demand further attention, such as: perceived online social support (Frison and Eggermont 2016a; Park et al. 2016; Seo et al. 2016; Shensa et al. 2016), reassurance seeking (Nesi and Prinstein 2015), positive and negative emotions while browsing (Lin and Utz 2015), fear of missing out (Beyens et al. 2016; Oberst et al. 2017), interpersonal competence (Chan 2014), and self-objectification (Hanna et al. 2017). On the other hand, increased feelings of social closeness, when obtained from use of social media, can lead to positive outcomes (Neubaum and Kramer 2015). That is, social media may help some individuals satisfy their belongingness needs and increase social connectedness and social capital (Tobin et al. 2015; Verduyn et al. 2017; Liu et al. 2016), outcomes which could be expected to benefit subjective well-being. Further research is needed to understand when social media use leads to these beneficial outcomes—by examining, for example, whether social network sites that promote relatively greater direct social interaction can increase well-being.

Another limitation of the present study stems from the inherent difficulty in gauging social media use via self-report. While our approach allowed us to establish a record of use over time that is arguably less reliant on memory than retrospective cross-sectional surveys, we note that participants self-reporting their recent use still invokes recollection—albeit over a relatively short time, not exceeding three hours between prompts. A related point is that while we received over 2,000 responses from our participants (nearly 27 reports, on average, per participant), surveying individuals every few hours means that participants were not always able to respond to a survey prior to receipt of the next.

[7] However, none of these uses of Facebook significantly predicted subjective well-being outcomes in our data.

Last, how prior experiences with particular social media sites (which could further correlate with the age of the site and the user) affect the relationship between use and subjective well-being could be investigated further. Yet, we also find the consistency in the effects of social media use on negative affect across sites noteworthy in this regard; despite differences in the age and function of the sites, for example, we find largely comparable effects. Additionally, the selection of a university sample and the generalizability of the results beyond this demographic is an area for further inquiry, as it is possible that social network sites could produce unique effects among those of different ages; for example, a parent who observes a son or daughter's successes shared via social media might derive a sense of joy or pride resulting from use, rather than engaging in social comparison.

5 Conclusion

Social network sites are an integral part of everyday life for many individuals around the world—the total number of users for the three sites examined in the present study exceeds 3 billion people—making it important to understand how and why this use impacts subjective well-being. Social media use may undermine happiness due to its tendency, specifically, to increase negative affect. Furthermore, the more individuals compared themselves to others, the more negative affect—and diminished self-esteem—they experienced. While these findings generally support the conclusion that social media use diminishes subjective well-being, they also point toward how these adverse effects could be mitigated. To the extent that social media users limit engaging in social comparison or use social network sites to facilitate direct interactions and social connectedness, the negative impact of social media use could be reduced—if not reversed. In other words, *how* we use social media has the potential to shape the effects on our day-to-day happiness.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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