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Alone and Online: Understanding the Relationships Between Social Media, Solitude, and Psychological Adjustment

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Emerging adults are heavy users of smartphones and social media, a behavioral trend that may disrupt the experience of solitude and decrease the corresponding benefits for mood regulation and identity development. This study used the experience sampling method to assess the associations between solitude, social media use, and psychological adjustment in the everyday lives of 69 college students and to investigate whether individual differences in extraversion and the preference for solitude influenced these associations. Cluster analyses showed that high-functioning introverts with high identity development and low loneliness were more likely than extraverts and low-functioning introverts to spend time truly alone without using social media, and they exhibited the lowest social media use in general. Analyses using covariance pattern modeling indicated that, contrary to expectations, participants were happier when on their devices, particularly when they were alone but preferred to be with people. These findings illustrate both the appeals and pitfalls of social media and device use. Although our moods may improve from using social media during solitude, chronic device use when alone may inhibit identity development and other psychosocial developmental tasks.

Public Policy Relevance Statement
An experience sampling study showed that the use of social media during solitude has a paradoxical relationship to psychological adjustment; although it elevates one's current mood state, it is also linked to low identity development and high trait loneliness. Social media use may be a form of mood regulation when one does not wish to be alone. Individuals who consistently spend time on their devices when alone may bypass important psychosocial developmental processes gained through solitude.

Keywords: emerging adulthood, smartphones, social media, solitude

Engaging in solitude by choice confers multiple benefits, from creativity and emotional renewal to self-reflection and identity development (for a review, see Goossens, 2014; Larson, 1990; Storr, 1988). However, people of all ages, and emerging adults in particular (Manago, Taylor, & Greenfield, 2012), are increasingly heavy users of smartphones and social media. Turkle (2011) posited that being physically alone with one's device, especially while engaging in other-directed activities such as social media, does not meet the criteria for psychological solitude, which is fundamentally inner directed. She theorized that ubiquitous smartphone use has led us to abandon solitude and weakened our capacity to be by ourselves in stillness; the implication is that we subsequently face the loss of solitude's benefits. Our study attempts to shed some empirical light on these claims.

The Benefits of Solitude

The most substantive body of research on solitude has been conducted with adolescents, when the desire to be alone increases (Larson, 1997), but studies with emerging adults—approximately 18–29 years of age—have shown that solitude also appears to be constructive at this developmental stage (Goossens & Marcoen, 1999; Long & Averill, 2003; Thomas & Azmitia, 2019). Arguably the two most robust findings from the literature on the benefits of solitude concern mood regulation and identity development. For example, researchers have found that for adolescents, moods typically lower during alone time but then rebound to higher than normal levels upon exiting solitude; the implication is that solitude

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offers a "renewing effect on people's mood state" (Larson, Csikszentmihalyi, & Graef, 1982, p. 48). Adolescents tend to accrue benefits from solitude but still report feeling lonelier and less happy when alone compared with when they are interacting with others (Larson, 1997). In contrast, emerging adults tend to report more positive than negative experiences with being alone (Long & Averill, 2003). In studies with college students, the opportunity to be alone affords time for introspection and identity development (Goossens & Marcoen, 1999), experiences of enlightenment and freedom (Averill & Sundararajan, 2014) and is associated with increases in self-awareness (Franzoi & Brewer, 1984), and psychological well-being (Thomas & Azmitia, 2019). Thus, emerging adults appear to be well positioned to reap the benefits of solitude—if they take the opportunity to be alone.

Smartphone Use in Emerging Adulthood

Emerging adulthood is increasingly a period of high smartphone and social media usage. According to the PEW Research Center, 96% of emerging adults in the United States own a smartphone (PEW Research Center, 2019a), and a majority of these users report that they visit social media sites daily; for example, 68% of Snapchat users between the ages of 18 and 29 years visit the site multiple times per day (PEW Research Center, 2019b). As they text, tweet, and update their statuses on social media, the paradox is that emerging adults are spending more time physically alone but not psychologically alone (Turkle, 2011), which potentially disrupts the experience of solitude and inhibits its corresponding benefits.

This hypothesis is consistent with evidence demonstrating the use of TV as a parasocial activity, one that is used as a distraction for people who are uncomfortable with the unstructured time of solitude (Greenwood & Long, 2009; Kubey, 1986); indeed, Long, Seburn, Averill, and More (2003) noted the tendency for university students to distract themselves with the Internet or TV when they were alone and felt lonely. The principal goals of the present study were to assess the associations between solitude, social media use, and psychological adjustment in the everyday lives of college-going emerging adults and to investigate whether the individual differences of introversion and the preference for solitude influenced these relationships.

Social Media and Psychological Adjustment

A spate of research has investigated social media's effects on psychological adjustment. Results reveal a complex picture. On the one hand, social networking sites can and do serve valuable psychological needs, such as the drive to belong, maintain relationships, and receive social support (for a review, see Burke & Kraut, 2016). Clark, Algoe, and Green (2018) argued that social networking sites can enhance well-being when they are used to make meaningful social connections. Consistent with this idea, self-disclosure on social media has been found to increase well-being by increasing perceived social support (Lee, Noh, & Koo, 2013). Moreno and colleagues (2011) found that Facebook provides a place for college students to express genuine self-disclosure around depressive symptoms, and this may alleviate stigma around mental health. Thus, different types of interactions on social media appear to make a crucial difference for well-being outcomes; targeted communication from close friends, rather than viewing broadcast status updates, is tied to increases in well-being (Burke & Kraut, 2016).

On the other hand, recent research challenges these benign conclusions. Heavy social media use has been associated with poor mental health (Sampasa-Kanyinga & Lewis, 2015), stress (Samaha & Hawi, 2016), and loneliness (Skues, Williams, & Wise, 2012) for both adolescents and emerging adults. In studies with college students, loneliness and social anxiety predicted Facebook use and an emotional attachment to Facebook, respectively (Clayton, Osborne, Miller, & Oberie, 2013). Furthermore, studies on college students' Facebook use over a 2-week period showed that Facebook use led to subsequent declines in subjective well-being (Kross et al., 2013), and college students who spend more time on Facebook—especially those who passively use the site—exhibit significantly more symptoms of social anxiety than their peers (Shaw, Timpano, Tran, & Joormann, 2015).

Given that emerging adulthood is a time of intense self-focus and identity exploration (Arnett, 2004), social media platforms become important arenas for experimentation with self-presentation. For example, in samples of college students, Facebook provided a forum to experiment with socially desirable possible selves (Taber & Whittaker, 2018; Zhao, Grasmuck, & Martin, 2008), and those emerging adults with more coherent identities tended to present their real selves on Facebook more than their ideal or false selves (Michikyan, Dennis, & Subrahmanyam, 2015). Yet, social media use also intensifies social comparison and can invite negative feedback, which has been shown to trigger depressive symptoms and decreases in self-esteem, especially for adolescents (Chua & Chang, 2016; Nesi & Prinstein, 2015; Valkenburg, Peter, & Schouten, 2006).

This brief foray into the increasing body of work devoted to understanding how social media and smartphones affect us demonstrates the complex relationship we have with our devices. Still, social media's effects on the task of identity development, a process that involves both inner-directed and outer-directed exploration (Erikson, 1968), are understudied. The smartphone is an inherently social tool that acts as a gateway to 24-hr access for communication with others. Srivastava (2005) has argued that the mobile phone has become more of a "key 'social object'" (p. 111) than a technological object, given that it serves fundamental social needs (e.g., belonging, relationship building). But such chronic outer-directed smartphone and social media use may mean that an important dimension of identity development risks being unattended to—the privacy and alone time required to observe, process, and resolve thoughts and feelings about oneself, one's future, and one's relationships. If emerging adults are increasingly spending their solitary time on social media platforms and smartphones, these developmental benefits of solitude may be compromised.

Individual Differences in Device Use

Extraversion

One's use of social media and smartphones may vary with individual differences in personality, and in particular extraversion. People who are extraverted seek out social stimulation and interaction more frequently and intensely than do introverts, and these differences may be a factor in social media use. Some researchers have found that both introverts and extraverts use the

Internet and social media to experiment with self-presentation and social interaction strategies (Valkenburg, Schouten, & Peter, 2005), but others have found that extraversion is positively correlated with high social media usage for people of all ages (Correa, Hinsley, & de Zuniga, 2010). Among college students, extraversion is positively correlated with cell phone use (Lepp, Li, Barkley, & Salehi-Esfahani, 2015), Facebook use (Gosling, Augustine, Vazire, Holtzman, & Gaddis, 2011), and what researchers have dubbed cell phone "addiction" (Roberts, Pullig, & Manolis, 2015). Thus, it appears that extraversion may influence smartphone users' behaviors. Because of the correlation between solitude and introversion (Burger, 1995), introverts may experience alone time as less threatening than extraverts, and, therefore, may not feel as much need to use social media as an escape route from solitude.

This line of thinking is consistent with recent empirical work with college students that used cluster analysis to reveal the following pattern: Although extraversion generally correlated positively with cell phone use, the cluster that had the highest cell phone use was only moderately extraverted, compared with a highly extraverted cluster whose cell phone use was lower. The most introverted cluster reported the lowest cell phone usage (Lepp et al., 2015). Given that the trait of extraversion was not uniformly linked with cell phone use in this cluster analysis, other dispositional factors likely have an influence. We suspect two such factors are one's preference for solitude and one's motivation for solitude.

Preference and Motivation for Solitude

A distinct but related concept to introversion is the preference for solitude. This is described by Burger (1995) as the extent to which individuals "prefer solitude over social interaction" (p. 105). However, a preference for solitude is also correlated with negative outcomes, such as loneliness (Burger, 1995; Cramer & Lake, 1998), and thus, subsequent research has aimed to clarify this relationship. One's *motivation* for being alone appears to correlate with psychological outcomes more than simply a preference for solitude; specifically, self-determined motivation for solitude (SDS), in which an individual seeks out alone time for constructive purposes, avoids the loneliness that is experienced by individuals who seek solitude for not–self-determined reasons such as anxiety and discomfort around others (Thomas & Azmitia, 2019). Therefore, in the context of social media usage, we would expect that individuals who prefer solitude, and in particular those who are motivated to be alone for self-determined reasons, would not be drawn to using social media during their periods of intentional solitude. Using social media would in fact distract them from inner-directed pursuits.

Previous Research on Solitude and Social Media

A few studies have investigated social media usage in the context of solitude. Most recently, when young adults were surveyed about their smartphone use, researchers found a general tendency for participants to use smartphones during alone time, and a negative correlation between a preference for solitude and smartphone usage (Diefenbach & Borrmann, 2019). Another team of researchers found that when participants were in solitude, their social media use increased, although the effects were larger for other media, such as TV, radio, and magazines (Wang, Tchernev, & Solloway, 2012). Finally, Leung (2015) found a positive relationship between the desire to be alone and the use of social media. In this study, the desire to be alone increased participants' belief that using a tablet in solitude would be stress relieving, in particular for social-oriented activities (e.g., using social media). Taken together, this research suggests that social media use during solitude may serve a mood-regulating function.

Although these studies do begin to chart the territory of solitude and smartphone usage, they are limited in two ways. First, they did not investigate the corresponding effects of such solitary use on psychological adjustment outcomes, and second, they did not track the *volition* or *valence* of the solitude experience during which participants engaged with social media, both of which are critical for predicting whether a person will benefit from time alone (Larson, 1997; Thomas & Azmitia, 2019). Second, with the exception of Wang and colleagues (2012), these studies used self-report surveys, in which participants were asked to estimate the amount of time they spent alone on their devices. It is well-established that self-report surveys are limited for a variety of reasons, from inaccuracies in recall to the bias of social desirability. Our study design addresses both of these limitations, first by examining participants' mood during solitude and their preference for being alone at that moment in time, and second by using the experience sampling method (ESM) to collect data (Csikszentmihalyi & Larson, 1987). ESM avoids the pitfalls of self-report surveys by allowing researchers to capture behaviors and moods as they occur, in vivo, and over time.

The Present Study

Our study aims to fill in a missing piece of the puzzle in the literature on social media use and psychological adjustment by including the dimension of solitude, and our goal is to increase the ecological validity of the results by using the ESM. Does using social media during alone time interrupt two key benefits of solitude: mood regulation and identity development? The literature reveals an inconsistent picture of how social media and smartphone use relate to well-being, but using these technologies clearly seems to have an impact on mood, whether alleviating or exacerbating loneliness, anxiety, and other negative emotions. Diefenbach and Borrmann (2019) have theorized that the smartphone has become an attachment object, similar to a pacifier in infancy, which alternately soothes us and causes anxiety when we are separated from it. If the smartphone is indeed serving as an attachment object, it may be changing solitude's role in mood regulation. When people feel anxious or unhappy, they may turn to their phones to feel better. When they are in solitude—by choice or not—and they feel bored or lonely, they also may turn to their phones to alleviate such states.

We focused on other-directed online behaviors, specifically posting and messaging on social media sites as well as texting, given that these activities fall under the umbrella of computer-mediated communication; however, we excluded other Internet use (e.g., browsing, using Wikipedia, watching videos, and so on) because these activities are not inherently other directed (Burke & Kraut, 2016). We also excluded phone calls and video chats from our research questions because these mimic face-to-face interactions more closely and differ qualitatively from text-based formats

of social media communication. Thus, we operationally defined *social media use* as any activity on social media sites such as Facebook, Snapchat, and Instagram, as well as texting and instant messaging. Following Turkle's (2011) distinction between being physically alone and psychologically alone, we distinguished between various alone states in our study. We operationalized *truly alone* as a state of solitude absent of communication with others, including any type of computer-mediated communication such as texting or messaging on social media. In contrast, we operationalized *on device alone* as the state of being physically alone but using one's device to engage in one of the aforementioned types of social media. Finally, when considering one's preference for solitude, we distinguished between the trait-based conception of preferring solitude in general, as measured by the Preference for Solitude Scale (PSS; Burger, 1995), versus a state-based experience of solitude, as measured by one's reported preference for solitude in the current situation and moment in time.

Hypotheses for Individual Differences

We expected that high introversion, PSS, and SDS would predict higher frequencies of being *truly alone* (Hypothesis 1). In addition, we expected that scores on these three individual difference measures would also predict lower rates of social media use in general, that is, *social media use* (Hypothesis 2a), and social media use in particular during solitude, that is, *on device alone* (Hypothesis 2b).

Hypotheses for Psychological Adjustment

We predicted a negative relationship between identity development and social media use in general, that is, *social media use* (Hypothesis 3a), and social media use during solitude, that is, *on device alone* (Hypothesis 3b). In contrast, we predicted a positive relationship between trait loneliness and social media use in general, that is, *social media use* (Hypothesis 4a), and social media use during solitude, that is, *on device alone* (Hypothesis 4b). Finally, we expected negative mood states to be elevated when using social media during solitude, that is, *on device alone* (Hypothesis 5), and that this effect would be greater when participants' state preference was to be social (Hypothesis 6).

Method

Participants

Seventy-eight college students were recruited from undergraduate courses in psychology at a public university in northern California. The study was approved by the university's institutional review board, and each participant read and signed a statement of informed consent before beginning the study. Of the recruited sample, nine did not complete the ESM phase of the study, resulting in an analytic sample of 69 participants. Each of these participants received course credit after completing the study. The majority ($n = 64$) were between 18 and 25 years of age, and the remaining five were between 26 and 35 years of age. The sample was ethnically diverse; they self-identified as Latino/Hispanic (39.1%), White (24.6%), Asian American/Pacific Islander (20.3%), Asian Indian (7.2%), or Black/African American (1.4%), and 7.2% indicated they belonged to more than one ethnic category or identified with an "other" ethnicity not listed on the survey. The majority ($n = 45$) identified as single, and the rest of the sample identified as either currently in a long-term committed relationship ($n = 22$) or married ($n = 2$). Approximately half ($n = 34$) of the sample lived with three or more people, and more than half ($n = 39$) had no access to a private room in their current living situation.

Procedure

This mixed-methods study gathered survey (quantitative) and interview (qualitative) data. The study consisted of three phases. First, participants completed a survey that included a battery of psychological measures, described in the following text. Second, ESM was used to prompt participants with a survey about their current mood, social media usage, and status of being alone or with others. The survey alerts prompted participants seven times per day, at random times, for 7 consecutive days via an Android application on their smartphones (see Thomas & Azmitia, 2016, for a full description of the development of the Android app and implementation of the ESM method). Third, after completing the ESM phase of the study, participants met with the researcher in a university laboratory to complete a semistructured verbal interview about their use of social media and experiences with solitude. Results from the qualitative analysis conducted with the interview data are reported elsewhere (Thomas, 2020).

Initial Survey Measures

Before participating in the ESM portion of the study, each participant completed an initial survey on a computer located in a university research lab. In addition to collecting demographic information, the survey included questionnaires for seven psychological adjustment and personality measures, described in the following text. The initial survey took ~20–30 min to complete. To enable comparison of effect sizes across constructs with different scales, we converted all survey measures to *z* scores.

Preference for Solitude Scale. This measure consisted of 12 forced-choice statements (Burger, 1995). A sample item was "I enjoy being around people / I enjoy being by myself." The statements that reflected a preference for solitude were scored a "1," and the statements indicating a preference for being social were scored a "0"; thus, high scores indicated a trait preference for solitude over being social. The PSS showed high reliability ($\alpha = .78$).

Motivation for Solitude Scale–Short Form. The Motivation for Solitude Scale–Short Form is a 14-item questionnaire with two subscales measuring SDS and not self-determined motivation for solitude (NSDS; Thomas & Azmitia, 2019). The questionnaire provided participants with the prompt: "When I spend time alone, I do so because . . ." and then instructed them to rate statements on a 4-point scale ranging from 1 (*not at all important*) to 4 (*very important*). A sample item of the SDS subscale was "I can engage in activities that really interest me." A sample item of the NSDS subscale was "I feel anxious when I'm with others." Cronbach's αs for the eight SDS items and six NSDS items were .79 and .88, respectively.

Big Five Personality Questionnaire. We used the short form of the extraversion portion of this scale (John, Donahue, & Kentle,

1991; John, Naumann, & Soto, 2008). The measure consisted of eight statements, which participants rated on a 5-point scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). Sample items included "I am someone who is talkative" and "I am someone who is sometimes shy, inhibited" (reverse coded). The eight items of the Extraversion subscale showed high reliability ($\alpha = .86$).

Identity subscale of the Erikson Psychosocial Inventory Scale. The Identity subscale contained 12 items that participants rated on a 5-point scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree* ; Rosenthal, Gurney, & Moore, 1981). A sample item was "I've got a clear idea of what I want to be." The Identity subscale was found to be highly reliable ($\alpha = .88$).

UCLA Loneliness Scale, Short Form. This scale measured the extent to which one feels lonely in daily life by having participants rate eight statements on a 4-point scale ranging from 0 (*never*) to 3 (*always*; Hays & DiMatteo, 1987; Russell, Peplau, & Ferguson, 1978). A sample item was "I feel left out." The eight items of this short form showed high reliability ($\alpha = .87$).

Psychological Well-Being Scales. This study used two of the six subscales: Autonomy and Positive Relations With Others (Ryff, 1989; Ryff & Keyes, 1995). Each subscale asks participants to rate nine statements on a 6-point scale ranging from 0 (*strongly disagree*) to 5 (*strongly agree*). A sample item from the Autonomy subscale is "Being happy with myself is more important to me than having others approve of me." A sample item from the Positive Relations With Others subscale is "Most people see me as loving and affectionate." Cronbach's αs for the Autonomy and Positive Relations With Others subscales were .82 and .81, respectively.

ESM Survey Questions

After completing the initial survey, the participant installed an Android app designed by the researchers onto their smartphone and completed a short in-person training on how to use the app. The app was programmed to deliver seven surveys per day, for 7 consecutive days, at random times during a 16-hr window (i.e., when the participant was not sleeping) to collect daily experience data on the variables of interest. The Android app survey consisted of 20 questions and took ~2 min to complete each time. Only the survey questions relevant to the present study are provided here (mood, alone status, and social media use); the remaining survey questions pertaining to solitude satisfaction and volition are analyzed and reported elsewhere (Thomas & Balzer Carr, 2020).

Mood. The survey inquired about participants' current mood on a Likert scale for seven mood pairs (adapted from Larson et al., 1982). For example, participants responded to the question "Describe how happy or sad you feel right now," with one of the following response options: *very happy*, *somewhat happy*, *neither happy nor sad*, *somewhat sad*, *or very sad*. The other six mood pairs were *calm/anxious*, *excited/bored*, *sociable/reserved*, *cheerful/irritable*, *relaxed/tense*, and *lonely/connected*.

Alone status and preference. Arguably the most crucial element of the survey was operationalizing what it meant to be "alone"; thus, the survey provided five response choices indicating various states of being alone or with others. Participants were asked to select one of the following responses that best described their current situation: were they (a) physically alone and not communicating with anyone (*truly alone*), (b) physically alone but also communicating with someone (*on device alone*), (c) around people but not interacting with them (*around others*), (d) around people and interacting with them (*social*), or (e) around people and also communicating with someone who was not physically present (*social while on device*). Because alone time has both physical and psychological implications (Turkle, 2011), it was important to distinguish between these states. Following this alone status question, participants were asked an alone preference question: "Right now would you prefer to be alone or with others?" This question provided data on participants' *state* preference for solitude over the course of the 7-day study, versus their *trait* preference for solitude, which was measured in the initial survey with the PSS (Burger, 1995).

Social media usage. If participants were communicating or interacting with others during the survey alert, they were asked to report what method of communication they had been using. Response options included face-to-face, phone, letter, video (e.g., Skype), text, instant message, or social media platform (e.g., Facebook, Twitter, Instagram, and Snapchat). Finally, they were asked whether they had been using their phone for any purpose at the moment the survey alerted them.

Analysis

Beyond simple frequency counts, analyses of variance, and correlation coefficients, analysis consisted of two advanced analytic techniques: cluster analysis and CPM. Cluster analysis identified which participants were similar to each other (i.e., clustered together) on the survey measures during Phase 1 of the study and compared those clusters' social media use, mood, and solitude behaviors. Thus, cluster analysis enabled us to holistically identify multivariate associations without eliminating shared variance from the model—as with regression—and provided the novel utility of distinguishing and then comparing subgroups of participants. A two-step cluster analysis was used, which relied on an SPSS algorithm that combined two traditional clustering techniques (*k*-means and hierarchical clustering). First, participants were preclustered using *k*-means: Each participant's score on every clustering variable was subtracted from the mean of that variable, and participants with similar difference scores were iteratively grouped together using a cluster feature tree (as described in Zhang, Ramakrishnon, & Livny, 1996). Second, each of these initial clusters was consecutively compared with each of the others and grouped into a set number (specified by the analyst) of larger clusters. This method identified homogeneous subgroups of participants from the larger more heterogeneous sample. Two-, three-, and four-cluster solutions were attempted, but ultimately a three-cluster solution was selected because it had the highest silhouette measure of cohesion and separation (0.3, a measure of model fit; Bacher, Wenzig, & Vogler, 2004) and was the most theoretically interpretable. To validate the cluster analysis, one-way analyses of variance were conducted with cluster membership predicting each survey scale; Tukey's post hoc tests revealed that at least two clusters significantly differed across all cluster variables except for the Self-Determined Solitude subscale of the Motivation for Solitude Scale–Short Form. Because cluster analysis is an iterative technique, it can be biased by the ordering of cases in a data set, so the data were randomly sorted three times, which consistently yielded the same cluster solution.

CPM was used to test all time-varying ESM hypotheses. Because the total number of completed surveys varied by participant, traditional repeated measures analyses that require a fixed number of time points would not suffice. CPM allowed for independently modeling within-participant variance (i.e., individual differences) and then testing how individual's scores on a time-varying dependent (e.g., mood) differed at one or another level of a time-variant (e.g., being on one's device) or time-invariant (e.g., identity development) independent variable. To do this, the data analyst had to define a covariance structure, which imposed assumptions on how participants' repeated measures would correlate with each other (e.g., the relationship between an individual's mood at different time points). The analyst used an autoregressive covariance structure because they assumed that moods and other variables would be correlated across time points but these covariances would decay exponentially. Other covariance structures (e.g., Toeplitz) were attempted, but autoregressive covariance consistently yielded better Akaike and Bayesian information criteria, suggesting that an autoregressive covariance structure was the most appropriate.

Results

Descriptive Statistics

Participants completed an average of 27.6 surveys ($SD = 8.7$) during the study period. They spent most of their waking hours being social (48%), followed by being truly alone (19%), around others (17%), on their devices alone (9%), and being social while on their device (4%). By wide margins, the most frequent forms of communication were face-to-face (40%) and texting (13%). When alerted by the app, participants were using social media 17% of the time and already on their phones 26% of the time. Our findings suggest that emerging adults spend most of their time being social in person, but they are still frequent users of social media and computer-mediated communication. In our analysis, we operationally defined *social media use* as any activity on social media sites as well as texting and instant messaging, given that we were interested in other-directed online communication behaviors in general, not strictly activities on social networking sites.

Individual Differences

To gain an understanding for how individual differences predicted social media use and solitude, we conducted a cluster analysis of all survey scales. Our initial two-cluster solution grouped participants into extraverts and introverts and had poor model fit, but as we increased the cluster solutions to three and four, the introvert cluster split into two and then three (with the extravert cluster staying intact), so introverts appear to be relatively heterogeneous. Our cluster analysis yielded the best model fit for a three-group typology: extraverts ($n = 18$), high-functioning introverts ($n = 29$), and low-functioning introverts ($n = 22$). We labeled this third group *low-functioning introverts* because compared with the other two clusters, the low-functioning introvert cluster was significantly higher on trait loneliness and not self-determined solitude, and significantly lower on identity development, autonomy, and positive relationship (all $p < .05$). In contrast, the *high-functioning introverts*, although not differing in level of extraversion from the low-functioning introverts, had a significantly more well-adjusted psychological profile, similar to the extravert cluster (see Table 1). Regarding solitude, a significant characteristic of the high-functioning introverts was that they displayed the highest preference for solitude, and the low-functioning introverts had the highest NSDS, which is a marker for negative outcomes (both $p < .05$). Overall, extraverts were homogenous and had high psychosocial functioning, but introverts fell into two groups: one with the highest loneliness and lowest identity development and autonomy (i.e., low functioning), and another with the highest preference for solitude and high levels of identity development and autonomy (i.e., high functioning).

We expected that introversion, preference for solitude, and SDS would predict higher frequency of being truly alone (Hypothesis 1). Whereas correlational analyses showed no significant relationships between these variables (see Table 2), cluster analysis indi-

Table 1
Cluster Analysis Results

Variables	Extraverts	HF introverts	LF introverts	All Ps
Identity development	4.0[a] [0.4]	3.9[a] [0.5]	2.7[b] [0.5]	3.5 [0.7]
Extraversion	3.9[a] [0.6]	2.7[b] [0.5]	2.8[b] [0.6]	3.0 [0.8]
Autonomy	40.4[a] [6.8]	41.5[a] [5.4]	34.5[b] [5.1]	39.0 [6.4]
Positive relationships	47.8[a] [3.6]	40.8[b] [5.3]	33.9[c] [5.8]	40.4 [7.3]
Loneliness	11.2[a] [1.8]	17.0[b] [3.6]	21.9[c] [4.0]	17.0 [5.3]
Preference for solitude	3.9[a] [2.0]	8.7[b] [2.2]	6.0[c] [2.4]	6.6 [3.0]
SD solitude	3.0[a] [0.7]	2.9[a] [0.5]	2.8[a] [0.5]	2.9 [0.6]
NSD solitude	1.3[a] [0.3]	1.6[a] [0.4]	2.2[b] [0.8]	1.7 [0.6]
Truly alone	13%[a] [7%]	24%[b] [15%]	18%[a,b] [10%]	19% [13%]
On device alone	8%[a] [10%]	8%[a] [7%]	13%[a] [12%]	9% [10%]
Social	57%[a] [13%]	46%[b] [15%]	44%[b] [13%]	48% [15%]
Around people	17%[a] [12%]	18%[a] [13%]	17%[a] [16%]	17% [14%]
Social on device	4%[a] [6%]	3%[a] [5%]	5%[a] [8%]	4% [6%]
Any social media	16%[a,b] [15%]	13%[a] [12%]	23%[b] [16%]	17% [18%]
On phone when alerted	27%[a] [14%]	24%[a] [15%]	28%[a] [17%]	26% [16%]

Note. HF = high-functioning; LF = low-functioning; Ps = participants; SD = self-determined; NSD = not self-determined. Standard deviations are reported in square brackets.
[a–c] Clusters with nonmatching letters differ significantly ($p < .05$).

Table 2
Bivariate Correlation Coefficients

Variables	ID	Ex	Au	PR	Lo	PSS	SDS	NSDS	TA	ODA	So	AP	SoD	ASM
Identity development	—													
Extraversion	.16	—												
Autonomy	.37**	.19	—											
Positive relationships	.62**	.53**	.24*	—										
Loneliness	−.59**	−.54**	−.26*	−.81**	—									
Preference for solitude	.07	−.57**	.09	−.23	.12	—								
Self-determined solitude	.11	.15	.02	.10	−.12	.05	—							
Not self-determined solitude	−.38**	−.35**	−.35**	−.60**	.59**	.18	.25*	—						
Truly alone	.07	−.22	.11	−.01	.22	.19	−.04	.08	—					
On device alone	−.19	−.14	.11	−.11	.13	.07	.01	−.11	−.00	—				
Social	.13	.40**	.13	.20	−.36**	−.31*	−.16	−.37**	−.51**	−.19	—			
Around people	−.01	−.13	−.26*	−.12	.05	.10	.24*	.34**	−.31**	−.42**	−.35**	—		
Social on device	−.12	−.02	−.06	−.03	.08	.02	−.15	.05	−.04	−.10	−.23	−.12	—	
Any social media	−.26*	−.02	.01	−.14	.19	−.12	.11	.03	−.15	.58**	−.19	−.27*	.42**	—
On phone when alerted	−.19	−.04	.08	−.06	.07	−.11	.07	−.17	−.18	.21	.02	−.16	.34**	.55**

Note. ID = identity development; Ex = extraversion; Au = autonomy; PR = positive relationships; Lo = loneliness; PSS = Preference for Solitude Scale; SDS = self-determined solitude; NSDS = not self-determined solitude; TA = truly alone; ODA = on device alone; So = social; AP = around people; SoD = social on device; ASM = any social media.
* $p < .05$. ** $p < .01$.

cated some support for this hypothesis. The extravert cluster was less likely to be truly alone (13%) than high-functioning introverts (24%, $p < .05$) but not less likely than the low-functioning introverts (18%, *ns*). This difference in introvert behavior can be explained by greater preference for solitude among high-functioning introverts and greater not self-determined solitude among low-functioning introverts. In other words, the cluster who spent the most time truly alone (i.e., without using social media or any other form of communication during solitude) was introverted, expressed high psychosocial functioning, and had a high preference for solitude and a low negative motivation for solitude.

We expected that these same three variables—introversion, preference for solitude, and motivation for solitude—would predict lower rates of social media use (Hypothesis 2a), in particular during solitude, *on device alone* (Hypothesis 2b). Partially supporting Hypothesis 2a, a significant difference was found between both introvert clusters: In general, high-functioning introverts were less likely to use any social media in general (13%) than low-functioning introverts (23%, $p < .05$), but extraverts' social media use (16%) did not differ significantly from either introvert cluster. Overall, cluster analysis provided mixed support for Hypothesis 2. The two introverted clusters were either the lowest or highest when it came to using social media, in general or during solitude, which suggests that contrary to Hypothesis 2, introverts do not uniformly engage in social media at lower rates. Consistent with Hypothesis 1, it appears that preference for solitude, which is highest among high-functioning introverts, is a stronger predictor than introversion when it comes to using social media less frequently.

Psychological Adjustment

We had anticipated that social media use in general, and in particular during solitude, would correlate negatively with identity development (Hypothesis 3) and positively with trait loneliness (Hypothesis 4). As shown in Table 2, correlational analyses yielded a significant relationship only between social media use and identity development, $r = -.26$, $p < .05$, thus supporting Hypothesis 3, but not with trait loneliness (Hypothesis 4). To improve our statistical power, we used CPM to analyze these effects in a repeated measures framework. CPM assessed the effect of survey scale responses on participants' chances of using social media in general when alerted (*any social media*) and in particular engaging in social media while alone (*on device alone*). Here we found stronger support for both Hypothesis 3 (identity) and Hypothesis 4 (loneliness).

Identity development. Converging with the cross-sectional analyses, CPM analyses showed that identity development significantly predicted reduced odds of social media use ($\beta = -0.24$, $p < .01$). Participants at the mean of identity development had a 17% chance of using social media, whereas participants at 1 *SD* above the mean had a 14% chance of using social media. Although only marginally significant, identity development also predicted reduced odds of being on one's device alone ($\beta = -.18$, $p < .10$), with participants at the mean having a 35% chance of being on their device alone and those at 1 *SD* above the mean having a 31% chance. Experience sampling enabled us to infer from these probabilities rough approximations of total amount of time spent in one or another solitude and device use state. Assuming that participants were awake and responding to survey alerts during the scheduled 16 hr a day, the effects of a 3%–4% increase amount to about an additional half hour of social media and solitary device use every day.

Loneliness. Unlike our cross-sectional analyses, CPM analyses indicated that loneliness significantly predicted social media use in general ($\beta = 0.14$, $p < .05$), which supports Hypothesis 4. When at the mean on trait loneliness, participants had a 17% chance of being on social media, and a standard deviation increase corresponded with a 19% chance of being on social media. There was a marginally significant relationship with a smaller effect between trait loneliness and being on one's device alone ($\beta = -.07$, $p < .10$).

Mood. We expected participants' negative mood states to be elevated when on their device alone (Hypothesis 5) and that this effect would be greater when participants would rather be social (Hypothesis 6). Table 3 provides descriptive statistics for participants' moods during the study. We again used CPM to assess the

Table 3
Mood Descriptive Statistics

Mood	Time 1	Time *j*	Correlation across time
Happy	3.8 [0.9]	3.6 [0.9]	.34
Anxious	2.4 [1.3]	2.6 [1.1]	.36
Bored	2.8 [0.9]	3.0 [1.1]	.20
Sociable	3.5 [1.1]	3.0 [1.2]	.23
Cheerful	3.6 [1.0]	3.3 [1.0]	.32
Tense	2.5 [1.2]	2.7 [1.1]	.37
Lonely	2.5 [0.9]	2.7 [0.8]	.28

Note. Correlations across time are covariance parameters from autoregressive covariance pattern models, and they represent how correlated individuals' scores on variables were across their repeated surveys. Time *j* is the participants' final survey. Standard deviations are reported in square brackets.

relationship between mood and social media or phone use in vivo. Contrary to Hypothesis 5, participants were consistently in better moods when on their devices alone. As compared with being truly alone, participants were happier when on their devices alone by a quarter of a standard deviation ($\beta = 0.25$, $p < .01$). Participants were likewise less bored ($\beta = -0.36$, $p < .001$) and lonely ($\beta = -0.37$, $p < .001$) when on their devices alone but not any more or less anxious ($\beta = 0.02$, *ns*). Cohen (1988) argued that effects within this range should be considered of medium size.

We introduced interaction effects to assess if current state preference for solitude (i.e., preferring to be with others, preferring to be alone, or no preference, when alerted, as opposed to trait-level preference for solitude as measured by the PSS) moderated the relationship between device use and mood. Interestingly, the relationship between device use and happiness appeared to be entirely driven by the interaction of a state preference for being with others. The interaction between preferring others and being on one's device alone was significant ($\beta = 0.37$, $p < .05$), and the main effect of preferring to be alone and being on one's device alone was not significant ($\beta = 0.00$, *ns*). In other words, participants were just as happy when on their devices alone as when truly alone as long as they *preferred* to be alone. But if they would rather be with others, then participants were much happier when on their devices alone than when they were truly alone. When estimating happiness at each level of our predictors, we found that participants had a score of 3.31 happiness when truly alone and preferring to be alone, 3.31 (i.e., no change) when on one's device alone and preferring to be alone, and 3.86 when on one's device alone but preferring to be with others. After converting to *z* scores, this amounted to nearly half a standard deviation increase (0.38). Thus, the increases in happiness associated with device use were only true when participants wanted to be with others (i.e., not when they wanted to be alone), and the effect of that difference was large.

Discussion

This study investigated how engaging in social media, in general or when alone, relates to emerging adults' psychological adjustment. Our results showed that psychosocial functioning, more than individual differences in personality, predicted social media use and solitary behaviors. Most strikingly, individuals with the lowest psychosocial functioning, specifically low identity development and high loneliness, were the ones most likely to be high social media users, even during solitude. These individuals were also more introverted, and we labeled them *low-functioning introverts*. This cluster was the loneliest and spent significantly less time truly alone compared with their high-functioning introverted peers. Perhaps this was owing to the fact that their motivation for solitude was significantly less self-determined than the high-functioning introverts, indicating that they were choosing to be alone owing to negative reasons such as social anxiety or lack of close friends, rather than for positive reasons such as creative expression or self-reflection. Regardless, the low-functioning introverts spent the most time on social media, significantly more than the high-functioning introverts or the extraverts. These results are consistent with previous findings showing a positive correlation between loneliness and social media usage among college students in particular (Clayton et al., 2013; Skues et al., 2012; Yao & Zhong, 2014).

In contrast, their introverted peers with high psychosocial functioning, including markedly higher identity development, were much more likely to spend time truly alone, that is, in solitude without using their devices. This group we labeled *high-functioning introverts*, given that they also exhibited less trait loneliness and higher levels of well-being as measured by autonomy and positive relationships. This cluster also exhibited the highest preference for solitude, which appears to have contributed to their high frequency of being *truly alone* during the course of the study. These results suggest that the constructive use of solitude depends somewhat on psychosocial factors; this is consistent with recent literature showing similar solitary behavior and adjustment profiles of early adolescents (Corsano, Grazia, & Molinari, 2019) and emerging adults (Thomas & Azmitia, 2019). To underscore this finding, extraverts who had similar psychological adjustment as the high-functioning introverts also spent significantly less time on social media than the low-functioning introverts. These results are consistent with previous findings by Lepp and colleagues (2015), who found that extraversion was not uniformly linked with smartphone usage. However, our study goes further by demonstrating that although personality is not the most reliable indicator of social media use, psychological adjustment is a more potent predictor. In particular, high levels of identity development may buffer against the need to do impression management on social media, and high levels of autonomy may protect against a dependence on social media for social comparisons and feedback for determining self-worth.

Although one could infer from these findings that poor psychological adjustment drives social media usage and inhibits solitude, it may be that a reciprocal relationship exists between these variables. For example, emerging adults who exhibit low identity development may subsequently avoid solitude or not know how to constructively use time alone when given the opportunity. This chronic avoidance of solitude might then further inhibit the developmental affordances that come with volitional time alone, namely, identity development and mood regulation. Moreover, although some literature has suggested that the self-presentation and impression management behaviors involved in social media usage can stimulate identity exploration (Zhao et al., 2008), high social media usage may undermine the more inner-directed processes of identity development, which theorists have argued re-

quire a sufficient amount of privacy and solitude to make possible (Erikson, 1968; Modell, 1992).

Finally, contrary to our expectation that negative moods, especially during solitude, would be associated with social media use, these emerging adults actually had more positive mood overall when using their devices alone. As with the relationship between identity development and social media use, we could not ascertain whether mood was driving solitude and device use or whether there was some other causal path. We found that participants' happiness was higher when on their devices alone, specifically when they did not want to be alone, but we cannot determine the cause and effect from these data. It could be that device use increases happiness, or that happiness leads to device use. Still, the relationship between device use and happiness was driven by the interaction of preferring to be with others. Device use, therefore, may have served as a means for these participants to be happier when they were alone but would rather be with others.

Drawing on Diefenbach and Borrmann's (2019) concept of smartphones as attachment objects, social media use may serve as a form of self-soothing when one is alone and feeling out of sorts. However, emerging adults who consistently spend time on their devices when alone may bypass the important process of mood regulation during solitude, which seem to require an inner-directed focus rather than outer-directed attention (Modell, 1992). Solitude experiences typically involve lowered moods, but during time alone these initial negative emotions get reflected on and resolved, so that moods rebound to higher than normal levels upon exiting solitude (Larson & Csikszentmihalyi, 1978). Thus, negative moods on the surface may mask important processes such as self-reflection and emotional release, processes that are well suited to the environment of solitude (Koch, 1994).

Limitations and Future Research

Although our study advances our understanding of the complex relationships between solitude, social media use, and psychological adjustment, the findings are limited in terms of population and study design. Our sample, although diverse in gender and ethnicity, was still somewhat homogenous, given that they were all college-going emerging adults attending the same public university in northern California. It would be important to understand whether our findings replicate with other populations more diverse in age (e.g., adolescents, older adults), life situation, social class, and psychosocial functioning (e.g., clinical samples, at-risk populations).

Furthermore, although our analyses allowed us to understand solitude, device use, and mood in vivo, as opposed to self-report data, we still could not ascertain cause and effect regarding the relationships between psychological adjustment and device use, and between mood and device use. When we conducted CPMs with a lag score, such that mood predicted device use during the subsequent time point or device use predicted mood during the subsequent time point, we found no statistically significant effects. This may be because mood and device use do not predict later mood or device use, or the experience sampling was too irregular or far apart in time to detect an effect. Future researchers may want to analyze solitude, device use, and mood using ESM in a fashion that would increase participant compliance to their survey regimen, and perhaps future studies could explore these relationships more definitively by using an experimental design that systematically tracks effects over time. Overall, our results are consistent with the growing corpus of studies and meta-analyses that show a small but negative correlation between digital technology use and well-being, but that stop short of ascertaining causal relationship (Orben & Przybylski, 2019).

Conclusions

Our study indicates that psychosocial functioning is a more potent predictor of social media use and solitary behaviors than personality variables; in particular, low identity development is associated with high social media use. Additionally, findings suggest that interacting on social media when alone is correlated with positive mood states, but this is largely only true when people do not want to be alone. Thus, social media use may be a way to cope with unwanted solitude. Although moods may improve from using social media during solitude when one does not wish to be alone, such device use may inhibit identity development and other psychosocial growth processes (e.g., introspection, autonomy, and mood regulation) in the long run. In short, our findings lend support to Turkle's (2011) concerns about the psychological cost of social media use and suggest that emerging adults who spend their solitude mostly or totally on social media rather than periodically being *truly alone* are not reaping all of the benefits of solitude.

References

Arnett, J. (2004). *Emerging adulthood*. New York, NY: Oxford University Press.

Averill, J. R., & Sundararajan, L. (2014). Experiences of solitude: Issues of assessment, theory, and culture. In R. J. Coplan & J. C. Bowker (Eds.), *The handbook of solitude: Psychological perspectives on social isolation, social withdrawal, and being alone* (pp. 90–108). Chichester, United Kingdom: Wiley.

Bacher, J., Wenzig, K., & Vogler, M. (2004). *SPSS two-step cluster—A first evaluation*. RC33 sixth international conference on social science methodology: Recent developments and applications in social research methodology, Amsterdam, the Netherlands. Retrieved from https://nbn-resolving.org/urn:nbn:de:0168-ssoar-327153

Burger, J. (1995). Individual differences in preference for solitude. *Journal of Research in Personality, 29,* 85–108. http://dx.doi.org/10.1006/jrpe.1995.1005

Burke, M., & Kraut, R. (2016). The relationship between Facebook use and well-being depends on communication type and tie strength. *Journal of Computer-Mediated Communication, 21,* 265–281. http://dx.doi.org/10.1111/jcc4.12162

Chua, T. H. H., & Chang, L. (2016). Follow me and like my beautiful selfies: Singapore teenage girls' engagement in self-presentation and peer comparison on social media. *Computers in Human Behavior, 55,* 190–197. http://dx.doi.org/10.1016/j.chb.2015.09.011

Clark, J. L., Algoe, S. B., & Green, M. C. (2018). Social network sites and well-being: The role of social connection. *Current Directions in Psychological Science, 27,* 32–37. http://dx.doi.org/10.1177/0963721417730833

Clayton, R. B., Osborne, R. E., Miller, B. K., & Oberie, C. D. (2013). Loneliness, anxiousness, and substance use as predictors of Facebook use. *Computers in Human Behavior, 29,* 687–693. http://dx.doi.org/10.1016/j.chb.2012.12.002

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Correa, T., Hinsley, A. W., & de Zuniga, H. G. (2010). Who interacts on the Web? The intersection of users' personality and social media use. *Computers in Human Behavior, 26,* 247–253. http://dx.doi.org/10.1016/j.chb.2009.09.003

Corsano, P., Grazia, V., & Molinari, L. (2019). Solitude and loneliness profiles in early adolescents: A person-centred approach. *Journal of Child and Family Studies, 28,* 3374–3384. http://dx.doi.org/10.1007/s10826-019-01518-1

Cramer, K. M., & Lake, R. P. (1998). The Preference for Solitude Scale: Psychometric properties and factor structure. *Personality and Individual Differences, 24,* 193–199. http://dx.doi.org/10.1016/S0191-8869(97)00167-0

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the experience-sampling method. *Journal of Nervous and Mental Disease, 175,* 526–536. http://dx.doi.org/10.1097/00005053-198709000-00004

Diefenbach, S., & Borrmann, K. (2019, May 4–9). *The smartphone as a pacifier and its consequences: Young adults' smartphone usage in moments of solitude and correlations to self-reflection*. 2019 CHI conference on human factors in computing systems proceedings, Glasgow, Scotland. http://dx.doi.org/10.1145/32906053300536

Erikson, E. H. (1968). *Identity: Youth and crisis*. New York, NY: Norton.

Franzoi, S. L., & Brewer, L. C. (1984). The experience of self-awareness and its relation to level of self-consciousness: An experiential sampling study. *Journal of Research in Personality, 18,* 522–540. http://dx.doi.org/10.1016/0092-6566(84)90010-2

Goossens, L. (2014). Affinity for aloneness in adolescence and preference for solitude in childhood. In R. J. Coplan & J. C. Bowker (Eds.), *The handbook of solitude: Psychological perspectives on social isolation, social withdrawal, and being alone* (pp. 150–166). Chichester, United Kingdom: Wiley.

Goossens, L., & Marcoen, A. (1999). Adolescent loneliness, self-reflection, and identity: From individual differences to developmental processes. In K. J. Rotenberg & S. Hymel (Eds.), *Loneliness in childhood and adolescence* (pp. 225–243). Cambridge, United Kingdom: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511551888.011

Gosling, S. D., Augustine, A. A., Vazire, S., Holtzman, N., & Gaddis, S. (2011). Manifestations of personality in online social networks: Self-reported Facebook-related behaviors and observable profile information. *Cyberpsychology, Behavior, and Social Networking, 14,* 483–488. http://dx.doi.org/10.1089/cyber.2010.0087

Greenwood, D. N., & Long, C. R. (2009). Psychological predictors of media involvement: Solitude experiences and the need to belong. *Communication Research, 36,* 637–654. http://dx.doi.org/10.1177/0093650209338906

Hays, R. D., & DiMatteo, M. R. (1987). A short-form measure of loneliness. *Journal of Personality Assessment, 51,* 69–81. http://dx.doi.org/10.1207/s15327752jpa5101_6

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory—Versions 4a and 54*. Berkeley: University of California, Berkeley, Institute of Personality and Social Research.

John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative Big Five trait taxonomy: History, measurement, and conceptual issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 114–158). New York, NY: Guilford Press.

Koch, P. (1994). *Solitude: A philosophical encounter*. Peru, IL: Open Court Publishing.

Kross, E., Verduyn, P., Demiralp, E., Park, J., Lee, D. S., Lin, N., . . . Ybarra, O. (2013). Facebook use predicts declines in subjective well-being in young adults. *PLoS ONE, 8,* e69841. http://dx.doi.org/10.1371/journal.pone.0069841

Kubey, R. W. (1986). Television use in everyday life: Coping with unstructured time. *Journal of Communication, 36,* 108–123. http://dx.doi.org/10.1111/j.1460-2466.1986.tb01441.x

Larson, R. (1990). The solitary side of life: An examination of the time people spend alone from childhood to old age. *Developmental Review, 10,* 155–183. http://dx.doi.org/10.1016/0273-2297(90)90008-R

Larson, R., & Csikszentmihalyi, M. (1978). Experiential correlates of time alone. *Journal of Personality, 46,* 677–693. http://dx.doi.org/10.1111/j.1467-6494.1978.tb00191.x

Larson, R., Csikszentmihalyi, M., & Graef, R. (1982). Time alone in daily experience: Loneliness or renewal? In L. Peplau & D. Perlman (Eds.), *Loneliness: A sourcebook of current theory, research and therapy* (pp. 40–53). New York, NY: Wiley.

Larson, R. W. (1997). The emergence of solitude as a constructive domain of experience in early adolescence. *Child Development, 68,* 80–93. http://dx.doi.org/10.2307/1131927

Lee, K.-T., Noh, M.-J., & Koo, D.-M. (2013). Lonely people are no longer lonely on social networking sites: The mediating role of self-disclosure and social support. *Cyberpsychology, Behavior, and Social Networking, 16,* 413–418. http://dx.doi.org/10.1089/cyber.2012.0553

Lepp, A., Li, J., Barkley, J. E., & Salehi-Esfahani, S. (2015). Exploring the relationships between college students' cell phone use, personality and leisure. *Computers in Human Behavior, 43,* 210–219. http://dx.doi.org/10.1016/j.chb.2014.11.006

Leung, L. (2015). Using tablet in solitude for stress reduction: An examination of desire for aloneness, leisure boredom, tablet activities, and location of use. *Computers in Human Behavior, 48,* 382–391. http://dx.doi.org/10.1016/j.chb.2015.01.068

Long, C. R., & Averill, J. R. (2003). Solitude: An exploration of the benefits of being alone. *Journal for the Theory of Social Behaviour, 33,* 21–44. http://dx.doi.org/10.1111/1468-5914.00204

Long, C. R., Seburn, M., Averill, J. R., & More, T. A. (2003). Solitude experiences: Varieties, settings, and individual differences. *Personality and Social Psychology Bulletin, 29,* 578–583. http://dx.doi.org/10.1177/0146167203029005003

Manago, A. M., Taylor, T., & Greenfield, P. M. (2012). Me and my 400 friends: The anatomy of college students' Facebook networks, their communication patterns, and well-being. *Developmental Psychology, 48,* 369–380. http://dx.doi.org/10.1037/a0026338

Michikyan, M., Dennis, J., & Subrahmanyam, K. (2015). Can you guess who I am? Real, ideal, and false self-presentation on Facebook among emerging adults. *Emerging Adulthood, 3,* 55–64. http://dx.doi.org/10.1177/2167696814532442

Modell, A. H. (1992). The private self and private space. *The Annual of Psychoanalysis, 20,* 1–14.

Moreno, M. A., Jelenchick, L. A., Egan, K. G., Cox, E., Young, H., Gannon, K. E., & Becker, T. (2011). Feeling bad on Facebook: Depression disclosures by college students on a social networking site. *Depression and Anxiety, 28,* 447–455. http://dx.doi.org/10.1002/da.20805

Nesi, J., & Prinstein, M. J. (2015). Using social media for social comparison and feedback-seeking: Gender and popularity moderate associations with depressive symptoms. *Journal of Abnormal Child Psychology, 43,* 1427–1438. http://dx.doi.org/10.1007/s10802-015-0020-0

Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour, 3,* 173–182. http://dx.doi.org/10.1038/s41562-018-0506-1

PEW Research Center. (2019a). *Mobile fact sheet*. Retrieved from https://www.pewresearch.org/internet/fact-sheet/mobile/

PEW Research Center. (2019b). *Share of U.S. adults using social media, including Facebook, is mostly unchanged since 2018*. Retrieved from https://www.pewresearch.org/fact-tank/2019/04/10/share-of-u-s-adults-using-social-media-including-facebook-is-mostly-unchanged-since-2018/

Roberts, J. A., Pullig, C., & Manolis, C. (2015). I need my smartphone: A hierarchical model of personality and cell-phone addiction. *Personality*

and Individual Differences, 79, 13–19. http://dx.doi.org/10.1016/j.paid.2015.01.049

Rosenthal, D. A., Gurney, R. M., & Moore, S. M. (1981). From trust on intimacy: A new inventory for examining Erikson's stages of psychosocial development. *Journal of Youth and Adolescence, 10,* 525–537. http://dx.doi.org/10.1007/BF02087944

Russell, D., Peplau, L. A., & Ferguson, M. L. (1978). Developing a measure of loneliness. *Journal of Personality Assessment, 42,* 290–294. http://dx.doi.org/10.1207/s15327752jpa4203_11

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology, 57,* 1069–1081. http://dx.doi.org/10.1037/0022-3514.57.6.1069

Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology, 69,* 719–727. http://dx.doi.org/10.1037/0022-3514.69.4.719

Samaha, M., & Hawi, N. S. (2016). Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Computers in Human Behavior, 57,* 321–325. http://dx.doi.org/10.1016/j.chb.2015.12.045

Sampasa-Kanyinga, H., & Lewis, R. F. (2015). Frequent use of social networking sites is associated with poor psychological functioning among children and adolescents. *Cyberpsychology, Behavior, and Social Networking, 18,* 380–385. http://dx.doi.org/10.1089/cyber.2015.0055

Shaw, A. M., Timpano, K. R., Tran, T. B., & Joormann, J. (2015). Correlates of Facebook usage patterns: The relationship between passive Facebook use, social anxiety symptoms, and brooding. *Computers in Human Behavior, 48,* 575–580. http://dx.doi.org/10.1016/j.chb.2015.02.003

Skues, J. L., Williams, B., & Wise, L. (2012). The effects of personality traits, self-esteem, loneliness, and narcissism on Facebook use among university students. *Computers in Human Behavior, 28,* 2414–2419. http://dx.doi.org/10.1016/j.chb.2012.07.012

Srivastava, L. (2005). Mobile phones and the evolution of social behaviour. *Behaviour and Information Technology, 24,* 111–129. http://dx.doi.org/10.1080/01449290512331321910

Storr, A. (1988). *Solitude: A return to the self*. New York, NY: Free Press.

Taber, L., & Whittaker, S. (2018, April 21–26). *Personality depends on the medium: Differences in self-perception on Snapchat, Facebook, and offline*. 2018 CHI Conference on human factors in computing systems proceedings, Montreal, Quebec, Canada. http://dx.doi.org/10.1145/3173574.3174181

Thomas, V. (2020). *The self-regulating and self-generative functions of solitude in emerging adulthood*. Manuscript submitted for publication.

Thomas, V., & Azmitia, M. (2016). Tapping into the app: Updating the experience sampling method for the 21st century. *Emerging Adulthood, 4,* 60–67. http://dx.doi.org/10.1177/2167696815618489

Thomas, V., & Azmitia, M. (2019). Motivation matters: Development and validation of the Motivation for Solitude Scale—Short Form (MSS-SF). *Journal of Adolescence, 70,* 33–42. http://dx.doi.org/10.1016/j.adolescence.2018.11.004

Thomas, V., & Balzer Carr, B. (2020, February). What predicts satisfaction with solitude? Paper presented in T. Nguyen (Chair), *Finding solitude in the modern world*. Symposium conducted at the annual convention of the Society for Personality and Social Psychology (SPSP), New Orleans, LA.

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other*. New York, NY: Basic Books.

Valkenburg, P. M., Peter, J., & Schouten, A. P. (2006). Friend networking sites and their relationship to adolescents' well-being and social self-esteem. *Cyberpsychology and Behavior, 9,* 584–590. http://dx.doi.org/10.1089/cpb.2006.9.584

Valkenburg, P. M., Schouten, A. P., & Peter, J. (2005). Adolescents' identity experiments on the Internet. *New Media and Society, 7,* 383–402. http://dx.doi.org/10.1177/1461444805052282

Wang, Z., Tchernev, J. M., & Solloway, T. (2012). A dynamic longitudinal examination of social media use, needs, and gratifications among college students. *Computers in Human Behavior, 28,* 1829–1839. http://dx.doi.org/10.1016/j.chb.2012.05.001

Yao, M. Z., & Zhong, Z. (2014). Loneliness, social contacts and Internet addiction: A cross-lagged panel study. *Computers in Human Behavior, 30,* 164–170. http://dx.doi.org/10.1016/j.chb.2013.08.007

Zhang, T., Ramakrishnon, R., & Livny, M. (1996, June). *BIRCH: An efficient data clustering method for very large databases*. Paper presented at ACM SIGMOD Record, Montreal, Québec, Canada. http://dx.doi.org/10.1145/235968.233324

Zhao, S., Grasmuck, S., & Martin, J. (2008). Identity construction on Facebook: Digital empowerment in anchored relationships. *Computers in Human Behavior, 24,* 1816–1836. http://dx.doi.org/10.1016/j.chb.2008.02.012

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