

Social Media, Social Support and Solitude among College Student

Honors Research Thesis

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by

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Abstract

Social support gained through social network and social media has been proposed to be a plausible buffer protecting college students from mental health problems. However, contradictory evidence has been found questioning whether social media indeed can help gratify college students' social needs and cultivate social support for them. The current study reconciles existing findings by examining the role of solitude in this process. Through a longitudinal 4-week experience sampling study and dynamic panel models, the study revealed that the nature of solitude (loneliness and voluntariness) moderated the use and effects of social media. More specifically, an increase of social needs boosted social media use; but this effect was stronger when a person was lonelier during the solitude and when the solitude was non-voluntary. The effect of social media use on social gratification was moderated by solitude as well. For those who were voluntarily to select to be alone and did not feel high levels of loneliness, social gratification was higher and an increase of social media use slightly increased social gratification. In comparison, for those who were non-voluntarily to be alone and felt lonelier, social gratification was lower and an increase of social media use decreased social gratification. The implications for how to better use social media to improve college students' social support and mental health is discussed.

Mental health issues, such as stress, depression, and fear of loneliness are prevalent on college campus. A growing body of evidence shows that one in four young adults between the ages of 18 and 24 have a diagnosable mental illness (National Institute on Mental Health, 2005) and more than 25 percent of college students have been diagnosed or treated by a professional for a mental health condition within the past year (Substance Abuse and Mental Health Services Administration, 2013). Being away from families and friend circles, facing new and unfamiliar environment, and peer pressures and fear for uncertainty all contribute to the problem (National Alliance on Mental Illness, 2012). In addition, Hefner and Eisenberg (2009) indicated that the characteristics of those students who are at greater risk of social isolations differ from most other students, such as they are more likely to be associated with minority race or ethnicity, international status, and low socioeconomic status. Nowadays college students face an entirely new social environment when they attend to college life and they are facing with greater freedom and less adult supervision environment (Lefkowitz, 2005). However, in such situation, they are frequently reported as home-sickness, friend-sickness, a sense of isolation, and increased inter-personal conflict (Buote, V., Pancer, S., Pratt, M., Adams, G., & Birnie-Lefcovitch, S., 2007). College students are not only facing with more mental health challenges but also facing with life-transition challenges (Eklund, K., Dowdy, E., Jones, C., & Furlong, M., 2011). According to National Alliance on Mental Illness (2012), 40 percent of students overall with diagnosable mental health conditions did not seek help and 57 percent of them did not request accommodations from their school.

Naturally, social support gained through social network has been proposed to be a plausible buffer protecting college students from mental illness (Menagi, F. S., Harrell, Z. A.

T., & June, L. N., 2008). Social support has been playing an important role in mental health problem, which may influence emotional health and well being (Kawachi & Berkman, 2001). There is a strong relationship between higher perceived quality of social support and lower likelihood of mental illness problem, such as depression, anxiety, suicide and eating disorder, independent of frequency of social contacts and other individual characteristics (Hefner & Eisenberg, 2009). Moreover, emotional assistance which is commonly referred as social support, can be provided by friends, family, and significant others (House, Umberson, & Landis, 1988) and will have positive affects on individuals' self-esteem and self-efficacy while helping reduce stress (Thoits, 1995). In terms of college students, positive social support may buffer against mental illness problem such as suicide risk for college students, which indicates promotion of supportive relationships may be an important mental illness prevention strategy (Hirsch, & Barton, 2011). In addition to previous findings, social support system exerted significant, positive influence with each and with resilience especially friend support may moderate the academic stress (Wilks & Spivey, 2010).

Social Media Use and Social Support

Social media—websites and software that serve a primary function of allowing users to connect, communicate, and interact with each other, often by posting, sharing, or co-producing information, is becoming an important part of people's life (Wang, Tchernev, & Solloway, 2012). According to Madden & Zicuhur (2011), as of 2011, two thirds (65%) of adult Internet users engage in social media and young adults users have been raised to 72% (Lenhart, A., Purcell, K., Smith, A., & Zickuhr, K., 2010). Fully 72% of online 18-29 year olds use social networking websites and adults are increasingly fragmenting their social

networking experience as a majority of those who use social networking sites (Lenhart et al., 2010). Some other studies showed specifically that bloggers produce content for the admiration of others to increase their social capital (Branthwaite, & Patterson 2011)

There has been evidence supporting that social media can increase social capital, in particular, social support (Steinfeld, C., Ellison, N. B., & Lampe, C., 2008). Online tools such as social network sites provide users with a powerful context for accessing the resources inherent in their social networks. The ability to quickly access one's network through the site's communication features, as well as the embedded level of trust associated with a network of known others, encouraged many participants to use Facebook to seek advice and information (Vitak & Ellison, 2012).

Features of computer-mediated communication within online communities, such as Facebook, Twitter, Skype and MySpace, appear to provide users with more social support, such as emotional support and better subjective well-being (Constant, Sproull, & Kiesler, 1996; Walther & Boyd, 2002; Wellman & Gulia, 1999; Kim & Lee, 2011). Initial research on social networking sites suggests that these online communities help individuals build social capital, which refers to the idea that one derives benefits—i.e., advice, information, or social support—through their network of relationships (Portes, 1998). There are more previous study showed that greater Internet use resulted in higher levels of perceived social support (Cody, M. J., Dunn, D., Hoppin, S., & Wendt, P., 1999) and another study showed that increasing social networking use towards decreased loneliness (White, H., McConnell, E., Clipp, E., Bynum, L., Teague, C., Navas, L., et al., 1999).

However, recent studies questioned whether social media indeed can help gratify college students' social needs and cultivate social support over time for them. A recent longitudinal study using experience-sampling methods over four weeks found that college students' social needs are not satisfied by social media use (Wang et al., 2012). Similarly, according to Krasnova, Wenninger, Widjaja, and Buxmann (2013), 36.9% of Facebook users in their study reported common experience of unpleasant social comparison and feeling jealousy when using Facebook. Some other problems were pointed out to be associated with growing social media usage, including negative word-of-mouth information proliferation across networks due to isolated events, as well as mistrust and reduction of social capital (Wasko, & Faraj 2005). More specifically, the social networking act—unfriending—has been shown to relate to strong negative emotional responses among users (Bevan et al., 2012). A study of American university students found that increasing use of Facebook strongly predicts increased loneliness (Lou et al., 2012). Furthermore, a recent research found that those college students who reported having Facebook friends experienced lower emotional adjustment to college life, which indicated that those who spend more time on social media networking tend to be more likely to be depressed and to have low self-esteem in their college life (Kalpidou et al., 2011). This study aims to reconcile the existing findings by examining the moderation effects of solitude, especially the nature of the solitude (whether it is associated with loneliness and whether it is voluntary), on social media use and effects.

Solitude and Social Media Use

Scholars have distinguished two aspects of being alone—loneliness and solitude (Tillich, 1963). Solitude can be intrinsic desire and time to reflect, rest, question and discover who we

are while loneliness can be deeply distressing (Ruiz-casares, 2012). For example, Long and Averill (2003) found that people experience self-release, self-discovery, and become more creative and can develop spiritual communication with themselves during the time when they are alone. According to their study, it is important to differentiate voluntary vs. non-voluntary solitude. Voluntary solitude can be mentally and spiritually beneficial, while non-voluntary solitude (loneliness) can stimulate fear of aloneness and sense of losing oneself. Furthermore, Wang et al. (2012) suggest that solitude can increase social media use. However, Wang et al. (2012) only measured the time spent alone (solitude) and did not measure whether participants felt lonely during the solitude and whether the solitude is voluntary. Hence, extending the study by Wang et al. (2012), this study will further explore the moderation effects of solitude on the use and effects of social media by specifying the nature of solitude. Figure 1 is adopted from Wang et al. (2012), and it illustrates the proposed relationship between the concepts. On the one hand, social needs will increase social media use as found by Wang et al., but this effect should be moderated by solitude (*Hypothesis 1*). On the other hand, as reviewed, previous research has found mixed results on whether social medias use can increase social gratification or not. Here we propose that social media can increase social gratification, but this effect is, again moderated by solitude (*Hypothesis 2*). Specifically, solitude is more specially measure by whether the person feels lonely at the time (solitude-lonely) and whether it is voluntary or not (solitude-voluntary).

[Insert Figure 1 here.]

Method

Participants and Procedures

Undergraduate students at the Ohio State University (N = 17) participated in this study in exchange of monetary compensation. An increasing amount of compensation and a final raffle were offered to encourage participants' continuities of this study. The study closely followed the study by Wang et al. (2012), but focused on differentiating voluntary solitude vs. loneliness on social media use. In order to use experience sampling method (Kubey, Larson, & Csikszentmihalyi, 1996, Wang et al., 2012), the participants submitted reports at regular time intervals throughout the day: before lunch and around noon, before dinner and around 6pm, and right before they went to bed. Each interval lasted around 5-6 hours if we assume roughly 7-8 hours of sleep in a day. Participants' reports detailed activities they engaged in over the past several hours since last reporting, including social media, other media, and non-media activities. Each person's experience was sampled for 28 consecutive days, resulting in 84 reports per person.

To ensure data reporting efficiency and consistency, each participant was trained to become familiar with the reporting method. To avoid contaminating media use behavior, each participant was provided with a tablet to report their activities using an online survey. The device was configured by the researchers and could only be used to respond to the survey. On the home page of the device, reminders of reporting time intervals were indicated. Every participant was trained to use the device and the reporting protocol for several hours and all of them successfully passed follow-up testing trails. In addition, every participant was given four reporting entries to practice before actual data collection began.

Experience Sampling Method

Neisser (1976) suggested that researchers must try to understand behaviors that occur in the ordinary environment and in the context of natural purposeful activity. In order to get such real life data of college students, experience sampling method was used in this study. Experience sampling method is a “ quasi-naturalistic method that involves signaling research subjects at random times throughout the day, often for a week or longer; and asking them to report on the nature and quality of their experience” (Kubey, Larson, & Csikszentmihalyi, 1996). Researchers can obtain detailed data about important subjective elements of participant’s lives and by designing the self-report form to a particular research problem, many topics can be researched and analyzed such as emotional experience (Diener, Larson, & Emmons, 1984). According to Kubey et al., (1996), participants are given electronic paging devices (a tablet in this study) and a small booklet of self-report forms in most studies. The self-report forms typically take less than two minutes to complete, thereby keeping the intrusion into the respondents’ activities to a minimum (Kubey et al., 1996). However, as the technology developed, the experience sampling method is transformed into a digital format. In this study, digital experience sampling method was used to obtain detailed data of participants’ daily lives.

Measures

Social Media (SM) use: SM use included blogs, email, Facebook, IN, LinkedIn, MySpace, Skype, Twitter, Wikis, YouTube and other social media.

Other Media (OM) use: OM use included media use aside from social media, such as television, radio, print media (magazine, newspaper) and computer use that was not related to social media.

For each SM or OM activity, the participants reported its duration (in minutes) and the following information:

Solitude: Whether he or she was physically alone during the activity. In addition, 1-9 point Likert scales were used to measure whether the person felt lonely while being alone (*Solitude-lonely*); and whether the person wanted to be alone (*Solitude-voluntary*). These two measures help quantify whether the solitude was voluntary or not.

Needs and gratifications: What needs were sought and how much they were gratified. Those needs are fun/entertainment, to relax/kill time, information, studying/work, personal, professional, and habits/background noise. More than one need could be reported for each activity. For each need reported, the participant rated its strength using a scale of 1-a teeny tiny need to 100-an extremely strong need. It was also gratified by the activity: 1-a teeny tiny satisfied to 100-very satisfied.

Before the four weeks of experience sampling reporting, the participants completed Interpersonal Support Evaluation (ISEL) (Cohen & Hoberman, 1983; Cohen, Mermelstein, Kamarck, & Hoberman, 1985). ISEL measures functional components of social support. ISEL provides four subscales: appraisal, belonging, tangible, and self-esteem support. Items are rated on a four-point scale with anchors ranging from “definitely true” to “definitely false.” ISEL has shown good internal consistency and test-retest reliability (Cohen et al., 1985) and was used to test, compare and analyses the levels of perceived interpersonal support in the current study. Higher scores indicate higher perceived interpersonal support, and the highest possible score is 48.

Data reduction, time series data set, and dynamic panel models

The method for data reduction follows the same way as in Wang et.al (2012). The reporting interval of each person is computed to analysis data. The reporting interval is computed by using the total duration of SM activities divided by the total duration of all activities during that interval. This is the portion of time that participant spent on social media use during that certain time and was ranged from 0 to 1 (0% to 100%). Solitude time was also computed in the same way to indicate time spent when solitude during that certain interval. In terms of social needs and social gratifications for each person during each interval, they are computed by averaging participant's needs and gratification levels reported in that interval. Since each individual reported three times a day for 28 days, time series of 84-observations were used to analyses time spent on social media use, solitude, social needs and social gratifications for each experience sampling reporting interval.

Since there are variations over time within each individual's data as well as variations across individuals, dynamic panel models were used to simultaneously examine both levels of variation while accounting for unobserved individual heterogeneity (Baltagi, 2008). Unobserved individual heterogeneity refers to all the individual differences which were not measured in the data set—in other words, the uniqueness of each individual beyond what was (or even can be) measured numerically.

The generalized method of moments (GMM) was used to fit the models using the `xtdpdsys` command in Stata/SE 11.0 software (Arellano & Bover, 1995; Blundell & Bond, 1998). Based upon the Wald χ^2 test (Engle, 1984; Busemeyer & Deiderich, 2010), the preferred models were selected for SM use, OM use, needs, and gratifications. They passed the Sargan test for over-identifying restrictions (Arellano & Bond, 1991).

Results

To test the hypotheses, two dynamic panel models were estimated using the time series data. The models and results are summarized in Table 1 and Table 2. Both models closely followed the models tested by Wang et al. (2012), but with the additional terms added to test the hypothesized moderation effects of solitude-lonely and solitude-voluntary on social media use and social gratification. These additional terms were marked in gray in Tables 1-2. The full model predicts the SM use of an individual i at a time point t (i.e., $SM_{i,t}$) using: (1) the autoregressive lag1, lag2, and lag3 feedback effects of SM use (i.e., $SM_{i,t-1}$, $SM_{i,t-2}$, and $SM_{i,t-3}$), (2) the autoregressive lag1, lag2, and lag3 feedback effects of OM use (i.e., $OM_{i,t-1}$, $OM_{i,t-2}$, and $OM_{i,t-3}$), (3) the four categories of needs at time t , (4) their interactions with solitude at time t , and (5) the interpersonal support of the individual i . Gender and race are entered as control variables.

The Nature of Solitude Moderated the Effects of Social Needs on Social Media Use

As summarized in Table 1, following the model of social media use as tested by Wang et al. (2012), social media use for any person at any time ($SM_{i,t}$) is predicted by its lag 1, lag 2, and lag 3 terms, and also the person's needs (Emotional Need $_{i,t}$, Cognitive Need $_{i,t}$, Social Need $_{i,t}$, and Habitual Need $_{i,t}$), as well as solitude, interpersonal support, and their two-way interactions with the four needs. To test *Hypothesis 1* that the loneliness and voluntary nature of solitude (Solitude-Lonely $_{i,t}$ and Solitude-Voluntary $_{i,t}$) would moderate the effects of social needs on social media use, the proposed two-way interactions, Social Need $_{i,t} \times$ Solitude-Lonely $_{i,t}$ and Social Need $_{i,t} \times$ Solitude-Voluntary $_{i,t}$, were added to the Wang et al. (2012) model. So were the lower order main effects of Solitude-Lonely $_{i,t}$ and

Solitude-Voluntary_{*i,t*}. These four additional terms are marked in grey in Table 1. Supporting *Hypothesis 1*, the two two-way interaction terms indeed were significant (see Table 1), and their effects are illustrated in Figure 2.

As shown in the upper panel of Figure 2, when social needs increased, social media use increased. However, solitude-lonely moderated the increasing rate. When solitude-lonely is higher, the increasing rate is greater. The bottom panel of Figure 2 shows the moderation effect of solitude-voluntary on the increasing effects of social needs on social media use. The lower solitude-voluntary levels, the greater the increasing rate. Taken together, an increase of social needs boosted social media use; this effect was stronger when a person felt lonelier during the solitude and when the solitude was more likely to be non-voluntary.

Solitude-Loneliness Moderated the Effects of Social Media Use on Social Gratification, and Solitude-Voluntary Increased Social Gratification

As summarized in Table 2, following the model of social gratification tested by Wang et al. (2012), social gratification for any person at any time (social gratification_{*i,t*}) is predicted by its lag 1, lag 2, and lag 3 terms, and also the person's social needs (Social Need_{*i,t*}), as well as social media use (SM_{*i,t*}), other media use (OM_{*i,t*}), and their two-way interactions with social needs at the time (SM_{*i,t*} × Social Need_{*i,t*} and OM_{*i,t*} × Social Need_{*i,t*}). To test our *Hypothesis 2* that the loneliness and voluntary nature of solitude would moderate the effects of social media use on social gratification, the proposed two-way interactions, SM_{*i,t*} × Solitude-Lonely_{*i,t*} and SM_{*i,t*} × Solitude-Voluntary_{*i,t*}, were added to the Wang et al. (2012) model. Again, so were the lower order main effects of Solitude-Lonely_{*i,t*} and Solitude-Voluntary_{*i,t*}. These four additional terms are marked in grey in Table 2. Partially

supporting *Hypothesis 2*, the two-way interaction of $SM_{i,t} \times \text{Solitude-Lonely}_{i,t}$ was significant; but $SM_{i,t} \times \text{Solitude-Voluntary}_{i,t}$ was not, and instead, $\text{Solitude-Voluntary}_{i,t}$ showed a significant main effect on social gratification (see Table 2).

As shown in the upper panel of Figure 3, when solitude-loneliness was low (such as when it was zero or at the mean level of the sample, the thick navy and green solid lines), an increase of social media use slightly increased social gratification. However, when solitude-loneliness was high (such as when it was the mean level of the sample plus SD or 2SD, the thin green solid or dotted lines), an increase of social media use decreased social gratification. The bottom panel of Figure 3 shows the main effect of solitude-voluntary on social gratification. The more likely the solitude is voluntary, the greater social gratification. Taken together, for those who were voluntarily to select to be alone and did not feel high levels of loneliness, social gratification was higher and an increase of social media use slightly increased social gratification. In comparison, for those who were non-voluntarily to be alone and felt lonelier, social gratification was lower and an increase of social media use decreased social gratification.

Discussion

Whether social media indeed can help gratify college students' social needs and cultivate social support for them has been questioned. For example, Nansen, B., Chakraborty, K., & Gibbs, L. et al. (2012) suggested the importance of social participation as a focus of health-based interventions. A study from Japan indicated young people who used the Internet social platform more frequently had increased social support (Takahira, M., Ando, R., & Sankmoto, A., 2012). However, there are an increasing amount of contradictory evidence

suggesting the negative effects of social media on social support and mental health problems (Takahira et al., 2012). The current study reconciled existing contradictory findings by examining the role of solitude in social media use. Specifically, this study examined how the nature of solitude (loneliness and voluntariness) cause different results in social media use and its effects on gratifying social needs.

This study extends Wang et al. (2012) study of the dynamic longitudinal examination of social media use, needs, and gratifications. First, this study replicated the results of the dynamics uses and gratifications of SM daily lives of college students, as well as their self-sustaining feedback effects. Those effects and models would help more accurately estimate the influences on SM use across time. Dynamic panel models employed in this study afford simultaneous examination of how the individual differences in interpersonal support and momentary state differences in solitude affect the dynamics of SM use. Second, this study differentiated the nature of solitude (voluntary and non-voluntary, perceived loneliness), and specified their influences on SM use and effects. This helps reconcile conflicting findings in the literature in terms of the effects of SM use on social gratifications and social support.

Consistent with earlier findings (Wang et al., 2012), an increase of social needs boosted social media use. However, this effect was stronger when a person felt lonelier during the solitude and when the solitude was more likely to be non-voluntary solitude. It is interesting to note that in general, solitude would have a positive effect on modifying the relationship between social needs and social media use, the more lonelier the person felt, social media use would increase more based on same social needs. However, if the individual chooses to be alone (voluntary solitude), although social needs increase will increase SM use,

but the increased amount could be much less if the individual did not choose to be alone. As suggested in Wang et al. (2012) study, it is possible that during voluntary solitude, he/she may be more likely to select media activities that he/she has full control of such as readings and listening to music. In addition, if the individual wants to be alone to use this period time to refresh himself or herself and has self-communion, this individual is less likely to engage in synchronized interaction such as SM.

In terms of the effect of social media use and social gratification, solitude has interesting modification effects on their relationship. For those who were voluntarily to select to be alone and did not feel high levels of loneliness, social gratification was higher and an increase of social media use slightly increased social gratification. In comparison, for those who were non-voluntarily to be alone and felt lonelier, social gratification was lower and an increase of social media use decreased social gratification. This result explained the contradictory findings in literature in terms of the effects of social media use on social support and social gratifications. An implication of this finding is that we need to consider the mental state of people to be able to better use and evaluate the effects of social media on social networking and social support. Likely for those who suffer from loneliness, isolation, and depression, increasing use of social media would not help with but instead, may be harmful to their social needs. This suggests that health and communication interventions for students who may already suffer from mental illness may need to come up with more proactive and creative approaches to reach them instead of relying on naturalistic use of social media in daily life.

One thing to note is that in this study, being alone was defined by physically being alone, which means being in a public place will be analyzed as not being alone or video chatting with others will be analyzed as being alone. However, people might feel lonely even in a crowded public surrounding. A follow up study could be conducted with asking participants whether they feel lonely first and then asking whether they were physically alone to evaluate participants' sense of loneness. Further more, a psychological test should be conducted for every participant to determine their mental health statement in order to collect and analyze data specifically from students who already been through mental illness problems. Besides the implication for those students, results for this study could also enrich findings of solitude statement among general college students population.

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Table 1. The model predicting social media use.

	SM _{<i>i,t</i>}
	<i>M (SE)</i>
Intercept	.23(.05)*
SM _{<i>i,t-1</i>}	.04(.02)*
SM _{<i>i,t-2</i>}	.06(.02)*
SM _{<i>i,t-3</i>}	.18(.02)*
Emotional Need _{<i>i,t</i>}	- .003(.001) [†]
Cognitive Need _{<i>i,t</i>}	- .03(.004)*
Social Need _{<i>i,t</i>}	.01(.004)*
Habitual Need _{<i>i,t</i>}	- .003(.001)*
Solitude _{<i>i,t</i>}	.00002(.00002)
Solitude _{<i>i,t</i>} × Emotional Need _{<i>i,t</i>}	-.00001(.000002)*
Solitude _{<i>i,t</i>} × Cognitive Need _{<i>i,t</i>}	.000008(.000003)*
Solitude _{<i>i,t</i>} × Social Need _{<i>i,t</i>}	-.00001(.000003)*
Solitude _{<i>i,t</i>} × Habitual Need _{<i>i,t</i>}	.00001 (.000001)*
Interpersonal Support _{<i>i</i>}	- .003(.0004)*
Interpersonal Support _{<i>i</i>} × Emotional Need _{<i>i,t</i>}	.00009(.00002)*
Interpersonal Support _{<i>i</i>} × Cognitive Need _{<i>i,t</i>}	.0003(.00005)*
Interpersonal Support _{<i>i</i>} × Social Need _{<i>i,t</i>}	-.00007(.00004) [†]
Interpersonal Support _{<i>i</i>} × Habitual Need _{<i>i,t</i>}	.00004(.00002)*
Solitude-Lonely _{<i>i,t</i>}	-.0003(.0002) [†]
Solitude-Voluntary _{<i>i,t</i>}	.0004(.00007)*
Social Need _{<i>i,t</i>} × Solitude-Lonely _{<i>i,t</i>}	.0001(.00001)*
Social Need _{<i>i,t</i>} × Solitude-Voluntary _{<i>i,t</i>}	-.00002(.000004)*
Gender _{<i>i</i>}	.03(.02) [†]
Race _{<i>i</i>}	- .02(.01)*
Wald χ^2	1859.74*

* $p < .05$, [†] $p < .10$

Table 2. The model predicting social gratification.

	Social Gratification _{<i>i,t</i>}
	<i>M (SE)</i>
Intercept	-.09(.16)
Social Gratification _{<i>i,t-1</i>}	.05(.007)*
Social Gratification _{<i>i,t-2</i>}	-.02(.007)*
Social Gratification _{<i>i,t-3</i>}	.04(.008)*
Social Need _{<i>i,t</i>}	.99(.03)*
SM _{<i>i,t</i>}	3.68(1.28)*
OM _{<i>i,t</i>}	.29(.33)
SM _{<i>i,t</i>} × Social Need _{<i>i,t</i>}	.07(.06)
OM _{<i>i,t</i>} × Social Need _{<i>i,t</i>}	-.05(.05)
Solitude-Lonely _{<i>i,t</i>}	.03(.01)*
Solitude-Voluntary _{<i>i,t</i>}	.01(.004)*
SM _{<i>i,t</i>} × Solitude-Lonely _{<i>i,t</i>}	-.11(.05)*
SM _{<i>i,t</i>} × Solitude-Voluntary _{<i>i,t</i>}	-.005(.01)
Wald χ^2	14866.52*

* $p < .05$, † $p < .10$

Figure 1. The proposed causality between social needs, social media use, social gratification, and how they are moderated by solitude and interpersonal support.

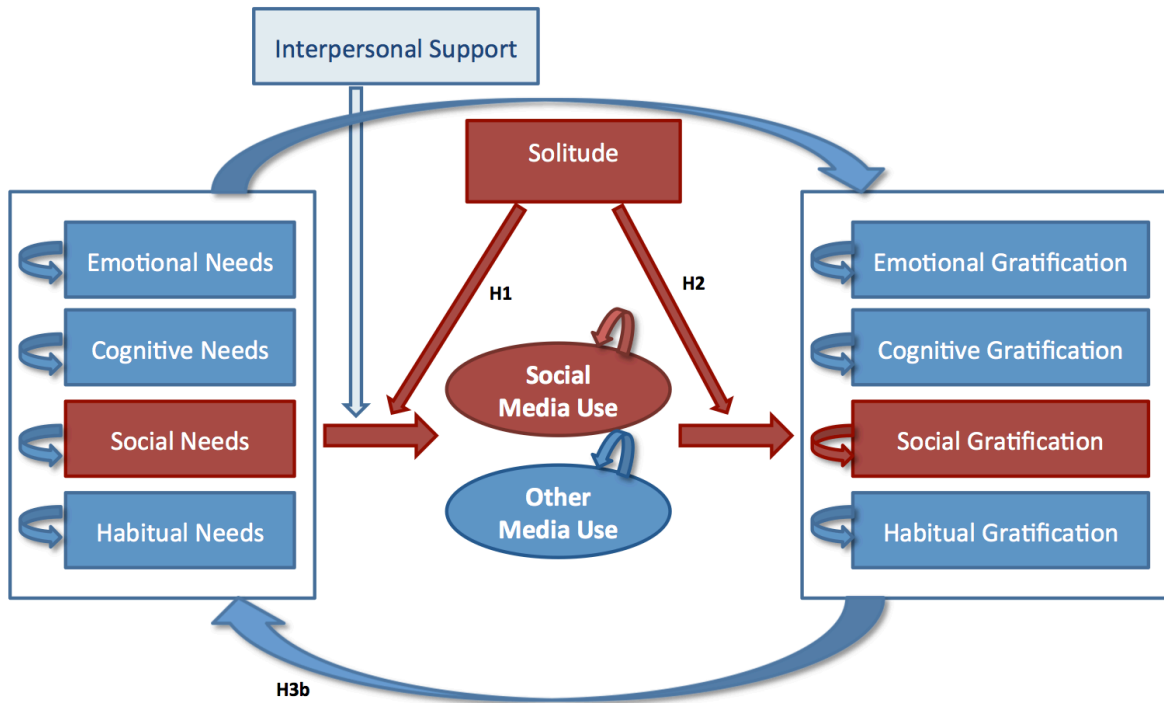


Figure 2. The Nature of Solitude (Solitude-Lonely, Upper Panel; Solitude-Voluntary, Bottom Panel) Moderated the Increasing Effects of Social Needs on Social Media Use.

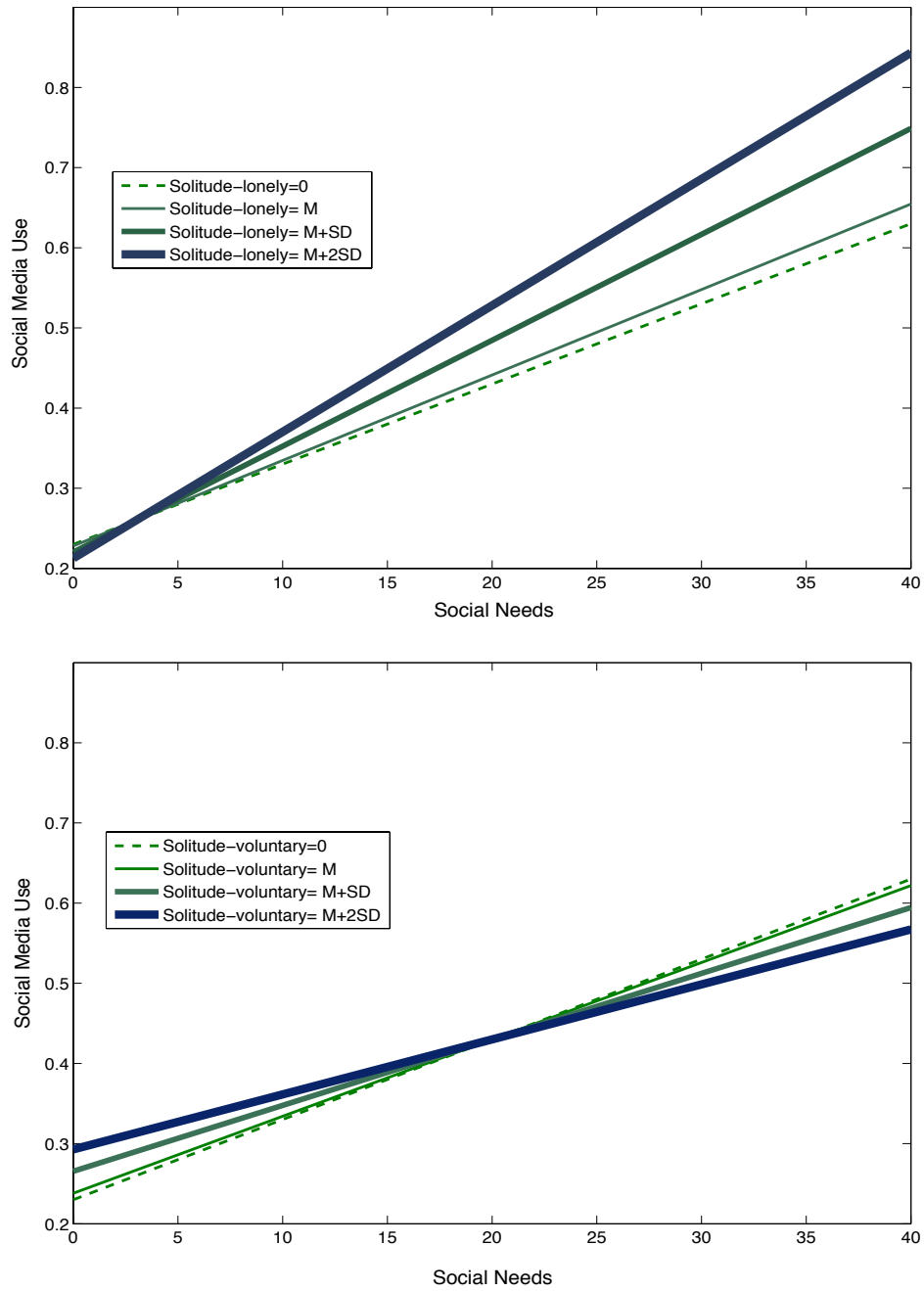


Figure 3. Solitude-Lonely Moderated the Increasing Effects of Social Media Use on Social Gratification (Upper Panel), but Solitude-Voluntary Had a Main Effect on Social Gratification (Bottom Panel).

