Digital Social Multitasking (DSMT), Digital Stress, and Socioemotional Wellbeing Among Adolescents

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Abstract

Phone use during face-to-face interactions has become increasingly common in adolescents' social lives, but the mechanisms through which the behavior is associated with adolescents' socioemotional wellbeing remain understudied. Drawing on the frameworks of digital social multitasking (DSMT) and digital stress, this study examined whether and how three types of digital stress (availability stress, connection overload, and fear of missing out) mediated the association between phone use in friendships and socioemotional wellbeing (depressive symptoms and friendship quality) among adolescents. A sample of 517 adolescents (M_{age} = 14.83, SD = 1.93) completed an online survey. Results showed that phone use during face-to-face interactions with a friend (i.e., DSMT) had an indirect relationship with greater depressive symptoms through all three types of digital stress. It also had an indirect relationship with better friendship quality via fear of missing out. The paths involving connection overload was moderated by the seriousness of the face-to-face interactions—in more serious interactions, DSMT had an indirect relationship with depressive symptoms, but not friendship quality; in less serious interactions, DSMT had an indirect relationship with friendship quality, but not depressive symptoms. Theoretical and practical implications are discussed.

Keywords: digital social multitasking; digital stress; co-present phone use; availability stress; connection overload; FOMO

Introduction

Mobile communication has become an integral part of adolescents' lives. A Pew Research report showed that 95% of the adolescents in the United States had access to a smartphone, and 45% of the teens were almost always online (Anderson & Jiang, 2018). The high adoption rate suggests that phone use can be ubiquitous in adolescents' daily lives, including when they have face-to-face interactions with others. Phone use during face-to-face interactions can compromise the quality of a relationship and one's socioemotional wellbeing (McDaniel & Coyne, 2016; Roberts & David, 2016; X. Wang et al., 2017), although the impacts may be indirect and conditioned by contextual factors (Kelly et al., 2019; Vanden Abeele et al., 2019; Yang & Christofferson, 2020). Because phone use during face-to-face interactions has not been theorized and studied until relatively recently, much remains unknown about how the behavior associates with young people's wellbeing and how the associations would differ as a function of the contexts of the interactions. Drawing on the frameworks of digital social multitasking (DSMT; Yang & Christofferson, 2020) and digital stress (Steele et al., 2020), this study explored (1) how DSMT was

associated with adolescents' depressive symptoms and friendship quality through various types of digital stress, and (2) how the associations were moderated by (a) whether the phone-based activities were shared between the communication partners and (b) how serious the face-to-face interactions were.

Digital Social Multitasking (DSMT)

DSMT refers to multitasking on a digital device during an in-person or virtual social interaction (Yang & Christofferson, 2020). Examples of DSMT include, but are not limited to, browsing social media during a video call, working on a tablet during a message chat, and using a phone during a face-to-face interaction. Among the various forms of DSMT, phone use during an in-person conversation has drawn the most attention among researchers (e.g., Bai et al., 2020; Stockdale et al., 2018; Yang et al., 2021). This behavior has also been studied under the frameworks of co-present phone use (e.g., Vanden Abeele et al., 2016), technoference (McDaniel & Coyne, 2016), and phubbing (Roberts & David, 2016)[1].

DSMT is a common practice in adolescent peer interaction (Yang et al., 2021). Although it has the benefits of making teens feel more connected with people and more efficient in completing multiple tasks, which, in turn, contributes to better friendship quality and satisfaction of the basic psychological needs (Yang et al., 2021), less promising socioemotional associations have also been identified. For example, scholars have voiced concerns that using technologies during a conversation with friends would transform adolescent friendship processes by compromising the quality of the conversation (Nesi et al., 2018). In particular, texting and phone use may distract young people from in-person interactions and have been associated with increased feelings of insignificance in co-present partners (Turkle, 2015). These negative perceptions of DSMT are deleterious to teens' friendship quality and the relatedness need satisfaction (Yang et al., 2021).

A few gaps exist in the current literature. First, despite the prevalence of DSMT in adolescent peer interaction, there is limited literature on this topic. Most studies have focused on adults' romantic/couple relationships (e.g., Kelly et al., 2017; McDaniel et al., 2021; Roberts & David, 2016; X. Wang et al., 2017) or adolescents' parent-child relationships (e.g., Bai et al., 2020; Stockdale et al., 2018). This gap is surprising considering the developmental significance of friendships in adolescence (Cuadros & Berger, 2016; Narr et al., 2019). Given the unique functions served by adolescent friendships (Hunter & Youniss, 1982) and the different norms of phone etiquette and use in different age groups (Forgays et al., 2014), findings of DSMT from other age groups and relationships may not be fully applicable to adolescent friendships, which necessitates the research of DSMT in adolescent friendships.

Second, earlier research mostly focused on how co-present phone use negatively impacts a person when their communication partner uses the phone (e.g., McDaniel & Coyne, 2016; Roberts & David, 2016). Although later research starts differentiating the scenarios in which one engages in DSMT versus when one's communication partner performs DSMT (e.g., McDaniel et al., 2021; Vanden Abeele et al., 2019; Yang & Christofferson, 2020), much remains unknown about the challenges unique to the phone users (i.e., the multitaskers) themselves. This void is especially noticeable in the investigation of the mechanisms through which DSMT associates with wellbeing—most studies focus on interpersonal processes, such as conflicts with the communication partner (McDaniel & Coyne, 2016; McDaniel et al., 2021; Roberts & David, 2016), satisfaction with the leisure time spent together (McDaniel et al., 2021), and sense of belonging (Chotpitayasunondh & Douglas, 2018). These mechanisms were explored with the assumption that DSMT would distract the multitaskers from the face-to-face interactions and hurt the communication partner's feelings. In the meantime, personal processes that may uniquely impact the multitaskers themselves are understudied. For example, DSMT may lead to a sense of being overwhelmed as the multitaskers juggle the multiple stimuli both online and offline. Digital stress, defined as the stress induced by constant use of information and communication technologies (Steele et al., 2020), thus, may be a major mechanism, although this possibility has not been empirically examined. Finally, the relationship between DSMT and socioemotional wellbeing has been theorized to be moderated by contextual factors concerning the nature of the multitasked activities (Yang & Christofferson, 2020), although little empirical evidence is available.

To bridge these gaps, we aim to answer the following questions: (1) When adolescents perform DSMT in friendships as the multitasker, how would this behavior associate with their socioemotional wellbeing via digital stress? (2) How might the associations described in the question above be moderated by contextual factors? In the following sections, we review the literature of two wellbeing indicators (depression and friendship quality in adolescence), digital stress, and two contextual moderators (shared phone use and seriousness of the interaction during DSMT).

Depression and Friendship Quality in Relation to DSMT

Adolescent depression and friendship quality both have major developmental implications. Adolescent depression is associated with diminished academic performance (Riglin et al., 2014) and increased suicidal ideation (Kang et al., 2021). It also predicts depression recurrence, poor physical health, and low social support during emerging adulthood (Naicker et al., 2013). Friendship quality during adolescence has the short-term benefit of mitigating the negative impacts of peer victimization on adolescent socioemotional wellbeing (Cuadros & Berger, 2016) as well as the long-term impacts for mental wellbeing into adulthood (Narr et al., 2019).

Depression is among the most extensively studied emotional outcomes within the DSMT context. College students who constantly use their phone during social interactions are more depressed (Ivanova et al., 2020). Similarly, adolescents who snub their parents in favor of the technologies at hand also report greater depressive symptoms, in addition to other undesirable socioemotional and behavioral outcomes (Bai et al., 2020; Stockdale et al., 2018). While the mechanisms underlying DSMT and depressive symptoms remain underexplored, research on depression in general has suggested that stress is a contributor to adolescent depression (Shapero et al., 2013). Specifically, interpersonal stress plays a salient role in adolescent depression (Hamilton et al., 2015; Shih et al., 2006), likely because such stress induces or reflects the frustration of basic human needs of belongingness and acceptance (Vrshek-Schallhorn et al., 2015). Digital stress, conceptualized as not having enough coping resources when one uses technologies in social and relational contexts (Steele et al., 2020), appear to be a reasonable mediator explaining how DSMT may impede adolescents' emotional wellbeing when they multitask on the phone during interactions with friends.

The perceived quality of social interactions and relationships has been of particular interest within the realm of DSMT. For example, the perceived quality of adults' romantic relationship is compromised when oneself uses the phone during an interaction (McDaniel et al., 2021). Similarly, the perceived quality of friendship interactions has been found to diminish as adolescents and emerging adults spend more time on the phone during their interaction with friends (Brown et al., 2016; Yang et al., 2021). Remaining engaged with the co-present person while being on one's phone (and facing the expectations to be connected to the digital world) appears challenging and can induce digital stress (Steele et al., 2020). When such stress makes the multitasker feel entrapped by the high expectations for constant and instant responses and hinders one from fully engaging in the face-to-face interaction, friendship satisfaction declines (Hall & Baym, 2012; Yang & Christofferson, 2020). These studies suggest the possibility that digital stress may be a mediator between DSMT and compromised friendship quality.

Digital Stress as Mediators

Steele et al. (2020) conceptualized digital stress as the subjective experience of not having sufficient resources to cope with the technology-induced stressors in one's social and relational contexts. They theorized digital stress as a mediator between technology use and youth's psychosocial functioning. Our study focused on three types of digital stress proposed by Steele et al.: availability stress, connection overload, and fear of missing out (FOMO).

Availability stress stems from the beliefs that one must fulfill other people's expectations of being constantly available and responsive through digital devices (Steele et al., 2020). It has also been referred to as *entrapment* (Hall, 2017; Hall & Baym, 2012) and *perceived social pressure to be responsive via communication technologies* (Halfmann & Rieger, 2019; Yang, 2021). The amount or frequency of general mobile phone use and, in particular, texting, are associated with a greater sense of entrapment (Hall, 2017; Hall & Baym, 2012). Availability stress, in turn, has been found to be directly or indirectly associated with lower subjective wellbeing (Hall, 2017), affective wellbeing (Halfmann & Rieger, 2019), and friendship satisfaction (Hall & Baym, 2012). It was thus hypothesized that during DSMT when adolescents must attend to both the face-to-face interaction and the social demands from the phone, availability stress would emerge, which would then induce depressive symptoms (**H1a**) and compromise friendship quality (**H1b**).

Connection overload refers to the distress resulting from the perception of receiving an overwhelming amount of input from digital sources, such as messages, posts, "likes," and notifications (Steele et al., 2020). It is also frequently referred to as information overload (Matthes et al., 2020; Misra & Stokols, 2012). Using social media on mobile phones predicts information overload, likely because this activity is often part of media multitasking (i.e., simultaneous use of multiple media or engagement in various media activities), and media multitasking requires constant reallocation of cognitive resources as one directs attention back and forth among the different activities

(Matthes et al., 2020). Digital connection overload has been found to predict more depressive symptoms (Matthes et al., 2020). Among adolescents in particular, connection overload is correlated with higher levels of anxiety, depression, and fatigue (Hall et al., 2021). Furthermore, when individuals are preoccupied with online posts and interactions, they are in a state of mind-wandering (Freytag et al., 2021), suggesting they are unlikely to give their co-present communication partner due attention and can appear disengaged from the current interaction, which should be detrimental to one's social relationships. Thus, we hypothesized that DSMT would induce connection overload, which, in turn, would be associated with more depressive symptoms (**H1c**) and poorer friendship quality (**H1d**).

FOMO is "a pervasive apprehension that others might be having rewarding experiences from which one is absent" (Przybylski et al., 2013, p. 1841). Individuals feel distressed when they experience, perceive, or anticipate negative social consequences resulting from missing out on these events (Steele et al., 2020). When adolescents engage in DSMT, they can easily become aware of the social events they miss out on through notifications and friends' social media posts, which should generate the distress of FOMO. Because FOMO is apprehensive in nature, it is not surprising that FOMO is associated with poor emotional wellbeing, such as anxiety, depression (Hall et al., 2021), increased negative affect over time (Elhai et al., 2020), and more emotional symptoms (Fabris et al., 2020). The association between FOMO and social wellbeing is less conclusive. Although FOMO is negatively related to social relationships (Hall et al., 2021) and satisfaction with personal relationships (Stead & Bibby, 2017), it also drives people to use social media more (Beyens et al., 2016; Przybylski et al., 2013), which, in turn, contributes to a greater sense of social connection (Roberts & David, 2020). It was thus hypothesized that DSMT would associate with greater FOMO, which would relate to higher levels of depressive symptoms (**H1e**), although its association with friendship quality would await exploration (**RQ1**).

Contextual Factors as Moderators: Phone Sharing and Seriousness of the Interactions

Recently, a few scholars have noted the importance of contextual factors in moderating the associations between DSMT and users' socioemotional wellbeing (Kelly et al., 2019; Yang & Christofferson, 2020). Two such factors have been repeatedly discussed: whether the phone-based activities are shared between the communication parties and how serious the potentially interrupted interaction is.

Research of co-present phone use in couple relationships has revealed that when romantic partners spend time together, they often show one another what they see and do on the phone, and such shared phone use is viewed as a positive experience (Kelly et al., 2017). Although McDaniel et al. (2021) noted that the positive relational implications of shared technology use were not robust, Drouin and McDaniel (2021) found consistent positive associations between shared technology use and various forms of satisfaction in couple relationships. Benefits have also been identified in adolescent friendships—using computers with friends predicts better friendship quality, likely because it provides opportunities for social exchanges and self-disclosure (Desjarlais & Willoughby, 2010). Although we hypothesized that DSMT would be associated with poorer socioemotional wellbeing via digital stress, adolescents may not feel as overwhelmed when they engage their co-present friends in phone-based activities. When the phone-based activities are shared between friends, the online and offline worlds are integrated rather than divided. In this case, teens likely deal with the demands from the phone with the co-present friends rather than struggle to allocate attention to two competing social realms. Thus, we hypothesized that shared phone use would moderate the relationship between DSMT and socioemotional wellbeing, such that the negative associations between DSMT and socioemotional wellbeing via digital stress would be weaker when the level of shared phone use was high (**H2a**).

Co-present phone use is considered especially inappropriate when the conversation is serious or important in nature (Baron, 2008). The significance of seriousness has been identified in multiple relational contexts. In couple relationships, undivided attention is expected during formal interactions; phone use during these times is thus less acceptable (Miller-Ott & Kelly, 2015). When two people were randomly assigned in an experiment to have a conversation, the presence of a phone reduced relationship quality, partner trust, and perceived partner empathy during a discussion of personally meaningful topics (Przybylski & Weinstein, 2013). Similarly, in the scenarios where their friend used a phone during a serious conversation, people reported decreased basic needs satisfaction, increased pain, enhanced feelings of ostracism (Hales et al., 2018), and poorer friendship quality due to stronger negative perceptions of the friend's phone use (Yang & Christofferson, 2020). It is plausible that DSMT during a serious interaction where full attention is expected would be particularly overwhelming and harmful. We thus hypothesized that seriousness would moderate the relationship between DSMT and socioemotional

wellbeing, such that the negative associations between DSMT and socioemotional wellbeing via digital stress would be stronger in more serious interactions (**H2b**).

Methods

Participants and Procedure

We recruited participants through the Qualtrics survey panel service in October, 2020. We specified the desired sample size (at least 500 adolescents between the ages of 12 and 18) and characteristics (nationally representative gender and racial/ethnic distribution and a roughly equal age split). The Qualtrics representative distributed the survey to participants in their pool on our behalf. A total of 517 adolescents completed our online survey (M_{age} = 14.83, SD = 1.93). See Table 1 for the demographic distribution of the sample. All participants passed at least two of the three attention checks embedded in the survey. These were questions asking participants to select a particular response (e.g., *strongly disagree* or a color from a list of options) to show that they were paying attention. Parental consent and adolescent assent were obtained before the adolescents started participating in the IRB-approved study. Compensation was provided based on the agreement between each participant and Qualtrics. There was no missing data.

Table 1. *Sample Characteristics.*

Demographics	*n*	%
Age		
12	78	15.1
13	78	15.1
14	79	15.3
15	76	14.7
16	78	15.1
17	79	15.3
18	49	9.5
Gender		
Female	259	50.1
Male	258	49.9
Race/Ethnicity		
Asian/Asian American	29	5.6
Black/African American	69	13.3
Latinx/Hispanic/Mexican American	88	17.0
Native American/Alaska Native	6	1.2
Native Hawaiian/Pacific Islander	1	0.2
White/European American	358	69.2
Other	6	1.2

Measures

Digital Social Multitasking

The questions were adapted from or designed based on Yang and Christofferson (2020). Participants were instructed to think of one particular friend with whom they had frequent face-to-face interactions. Participants then responded to three prompts: *In general, when you have face-to-face interactions with this friend, how often do YOU do something else on the phone (e.g., texting, browsing, etc.)?* (1 = Rarely, 2 = Sometimes, 3 = Often, 4 = A lot), In general, when you or the friend uses the phone during face-to-face interactions with each other, how often are both of you involved in the phone-based activity (e.g., Do you share what you see on the phone with one another? Are you both in the same text conversation with a mutual friend?)? (1 = Rarely, 2 = Sometimes, 3 = Often, 4 = A lot), and In general, when you or the friend uses the phone during face-to-face interactions with each other, how serious are those*

interactions? (1 = *Not serious,* 2 = *A little serious,* 3 = *Serious,* 4 = *Very serious*). The three items reflected the participant's level of DSMT, shared phone use during DSMT, and seriousness of the potentially disrupted face-to-face interactions, respectively.

Availability Stress

We used five items from Hall and Baym's (2012) scale of Entrapment (α = .94) to measure the construct on a 5-point Likert scale (1 = *Strongly disagree,* 5 = *Strongly agree*). Sample items included *I am pressured to respond quickly to calls or texts from my friends* and *I feel pressured to call or text to keep in touch with my friends*. A higher mean score reflected a higher level of stress resulting from perceived expectations to be responsive and available through digital communication.

Connection Overload

We used five adapted items from Misra and Stokols's (2012) Perceived Information Overload Scale (α = .94) to measure connection overload. On a 5-point Likert scale (1 = *Never,* 5 = *Very often*), participants indicated the frequency of feeling distressed because of the subjective experience of receiving too much input from digital communication. Sample items included *receive more phone calls than you can handle* and *receive more text or private messages than you can handle*. A higher mean score reflected a higher level of connection overload.

Fear of Missing Out

FOMO was measured with six items from Przybylski et al.'s (2013) Fear of Missing Out Scale (α = .93). On a 5-point Likert scale (1 = *Not at all true to me,* 5 = *Extremely true to me*), participants reported how well the scale items described their general experience. Sample items included *I fear others have more rewarding experiences than me* and *I get worried when I find out my friends are having fun without me*. A higher mean score reflected a higher level of apprehension that oneself was not involved in a rewarding experience.

Depressive Symptoms

The level of depressive symptoms was measured using the seven-item Center for Epidemiologic Studies Depression Scale Short Form (CES-D-SF; Levine, 2013; α = .94) on a 4-point Likert scale (1 = *Strongly disagree,* 4 = *Strongly agree*). Sample items included *I feel depressed* and *I have trouble keeping my mind on what I am doing*. A higher mean score reflected higher levels of depressive symptoms.

Friendship Quality

Five items from the Relationship Assessment Scale (Hendrick, 1988) were included in the survey. The original scale was designed to measure the quality of romantic relationships. We followed other scholars (e.g., Hall & Baym, 2012), revising the items to measure friendship quality (α = .86). Participants responded to items such as *In general, I'm satisfied with this friendship* and *For the most part, this friendship has met my original expectations* (1 = *Strongly disagree,* 5 = *Strongly agree*). A higher mean score reflected better friendship quality with the aforementioned friend.

Plan for Analysis

We started with confirmatory factor analysis (CFA) of the three scales measuring the various types of digital stress, ensuring they should be treated as different variables. After the CFA, we examined the hypothesized path model, in which depressive symptoms and friendship quality were regressed on the three types of digital stress, which, in turn, were regressed on the level of DSMT. Depressive symptoms and friendship quality were also regressed on the level of DSMT to examine the direct associations. The control variables included gender, age, and the amount of phone use in a typical day (which participants indicated through a pull-down menu, where the responses ranged from *0 to 1 hour* to *More than 12 hours*). The mediators were allowed to correlate, and so were the outcome variables.

Multi-group analyses were conducted to examine the moderation effects of shared phone use and seriousness. Low shared phone use/seriousness included participants who selected 1 or 2 for the given question, whereas high shared phone use/seriousness included participants who selected 3 or 4 for the given question. If the Sattora-Bentler Scaled Chi-Square difference test suggested a difference between the constrained and unconstrained models, we performed path-by-path comparisons to identify which path or paths differed between the two groups. In the path-by-path comparisons, we released one path constraint at a time, starting with the path with the greatest coefficient difference. We compared the two models' Sattora-Bentler Scaled Chi-Square coefficients. If the chi-square test was significant, we concluded that releasing the given constraint significantly improved model fit, suggesting that the given path differed between the two groups. We then continued to release the path with the second greatest coefficient difference and performed another chi-square difference test. We repeated the comparisons until the release no longer improved model fit.

All analyses were performed using Mplus 7, with maximum likelihood robust (MLR) being the estimator. Model fit was considered acceptable when the comparative fit index (CFI) and the Tucker-Lewis index (TLI) were close to or greater than .95, and the root mean square error of approximation (RMSEA) was smaller than .08. For CFA, factor loadings were expected to be close to or greater than .70 (Hair et al., 2011).

Results

Confirmatory Factor Analysis of the Digital Stress Scales

The presumed 3-factor structure of the digital stress scales was supported: $\chi^2(101) = 382.45$, $p < .001$; RMSEA = .073, 90% CI [.066, .081]; CFI = .949; TLI = .939. All factor loadings were above .70, ranging from .77 to .91. See scale means, standard deviations, and correlations in Table 2[2].

Table 2. *Descriptive Statistics and Correlations.*

		M (SD)	1.	2.	3.	4	5.	6.	7.
1.	Level of DSMT (4-pt)	2.77 (0.96)							
2.	Availability Stress (5-pt)	3.00 (1.33)	.26***						
3.	Connection Overload (5-pt)	2.90 (1.27)	.35***	.75***					
4.	FOMO (5-pt)	3.01 (1.26)	.28***	.69***	.75***				
5.	Depressive Symptoms (4-pt)	2.33 (0.94)	.22***	.62***	.61***	.67***			
6.	Friendship Quality (5-pt)	4.36 (0.65)	.11*	−.02	.04	.09*	−.00ᵃ		
7.	Shared Phone Use (4-pt)	2.79 (0.96)	.61***	.20***	.31***	.27***	.25***	.22***	
8.	Seriousness (4-pt)	2.47 (1.07)	.44***	.39***	.51***	.43***	.29***	.21***	.42***

Note. DSMT = digital social multitasking, FOMO = fear of missing out. *p < .05, **p < .01, ***p < .001, ᵃr = −.002.

Path Analyses of Socioemotional Implications of DSMT

The hypothesized path model fit well: $\chi^2(9) = 20.03$, $p = .018$; RMSEA = .049, 90% CI [.019, .078]; CFI = .990; TLI = .967. DSMT was associated with higher availability stress (β = .26, $p < .001$), connection overload (β = .35, $p < .001$), and FOMO (β = .28, $p < .001$), all of which were, in turn, associated with greater depressive symptoms (β$_{availability\ stress}$ = .25, $p < .001$; β$_{connection\ overload}$ = .13, $p = .032$; β$_{FOMO}$ = .40, $p < .001$). Availability stress (β = −.14, $p = .063$) and connection overload (β = −.05, $p = .476$) were not associated with friendship quality, but FOMO was related to better friendship quality (β = .18, $p = .003$). The direct relationship between DSMT and depressive symptoms (β = .00, $p = .927$) and friendship quality (β = .07, $p = .154$) were non-significant. See Table 3 for unstandardized coefficients for the direct paths. The following indirect paths were significant: DSMT → availability stress → depressive symptoms (β = .06, 95% CI [.027, .101], $p = .001$); DSMT → connection overload → depressive symptoms (β = .05, 95% CI [.003, .089], $p = .039$); DSMT → FOMO → depressive symptoms (β = .11, 95% CI [.066, .156], $p < .001$); DSMT → FOMO → friendship quality (β = .05, 95% CI [.014, .088], $p = .007$). Amount of phone use was associated with better friendship quality (β = .14, $p < .001$); no other controlled paths were significant. See Figure 1.

Table 3. *Unstandardized Coefficients for the Path Models.*

Paths of Interest	b	SE	p
Overall Sample			
DSMT → Availability Stress	0.35	0.06	< .001
DSMT → Connection Overload	0.47	0.06	< .001
DSMT → FOMO	0.37	0.06	< .001
DSMT → Depressive Symptoms	0.00	0.03	.927
DSMT → Friendship Quality	0.05	0.03	.154
Availability Stress → Depressive Symptoms	0.18	0.04	< .001
Connection Overload → Depressive Symptoms	0.10	0.05	.032
FOMO → Depressive Symptoms	0.30	0.04	< .001
Availability Stress → Friendship Quality	−0.07	0.04	.069
Connection Overload → Friendship Quality	−0.03	0.04	.473
FOMO → Friendship Quality	0.09	0.03	.003
Coefficients Varying Between Groups			
Connection Overload → Depressive Symptoms			
Low Seriousness	−0.01	0.05	.878
High Seriousness	0.22	0.05	< .001
Connection Overload → Friendship Quality			
Low Seriousness	−0.15	0.05	.001
High Seriousness	0.04	0.04	.253

Note. DSMT = digital social multitasking. FOMO = fear of missing out.

Figure 1. *Associations Between DSMT, Digital Stress, and Wellbeing (Overall Sample).*
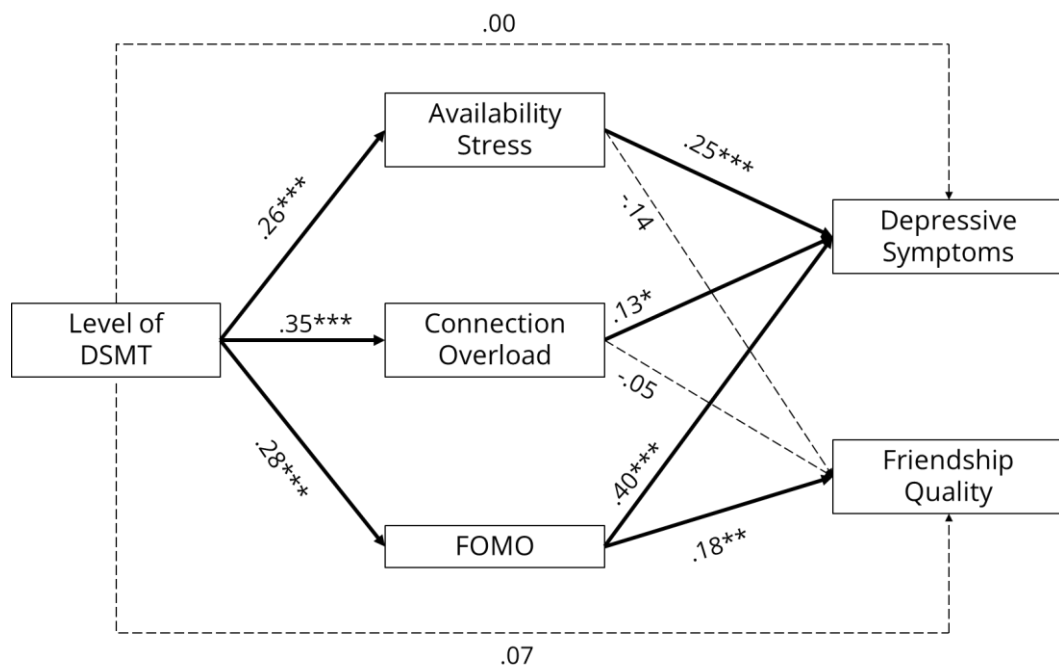
Note. Numbers are standardized coefficients. DSMT = digital social multitasking. FOMO = fear of missing out. The bold lines represent significant indirect paths. The dotted lines represent non-significant direct paths. For clarity of presentation, controlled paths are not presented. $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Multi-Group Analyses

The multi-group analysis of phone sharing showed that the unconstrained model had a better fit than the constrained model: Sattora-Bentler Scaled Chi-Square Difference = 36.96, Δdf = 21, p = .017. We then performed the path-by-path comparison, starting by releasing the constraint involving the greatest coefficient difference

(availability stress to friendship quality, standardized path coefficient difference = .25). The release did not lead to a significant change in model fit: Sattora-Bentler Scaled Chi-Square Difference = 2.18, Δ*df* = 1, *p* = .140. No further comparisons were made. The path-by-path comparison suggested that there were no path-level differences between the two models. In other words, whether the participants and their friends shared the phone-based activity did not moderate the results ($N_{low\ sharing}$ = 205, $N_{high\ sharing}$ = 312).

The multi-group analysis of seriousness showed that the unconstrained model had a better fit than the constrained model: Sattora-Bentler Scaled Chi-Square Difference = 63.75, Δ*df* = 21, *p* < .001. We then performed the path-by-path comparisons. Releasing the path from connection overload to depressive symptoms (standardized path coefficient difference = .268) led to a significant change in model fit: Sattora-Bentler Scaled Chi-Square Difference = 18.71, Δ*df* = 1, *p* < .001, and so did further releasing the path from connection overload to friendship quality (standardized path coefficient difference = .261): Sattora-Bentler Scaled Chi-Square Difference = 12.98, Δ*df* = 1, *p* < .001. Releasing the additional path from DSMT level to friendship quality (standardized path coefficient difference = .205) did not change model fit: Sattora-Bentler Scaled Chi-Square Difference = 2.29, Δ*df* = 1, *p* = .130, and thus no further comparisons were made. In the final model, the paths from connection overload to depressive symptoms and friendship quality varied between the low seriousness (*N* = 277) and high seriousness (*N* = 240) groups: $\chi^2(37)$ = 50.09, *p* = .074; RMSEA = .037, 90% CI [.000, .061]; CFI = .986; TLI = .977. Specifically, connection overload was associated with greater depressive symptoms only in the high seriousness group (β = .26, *p* < .001) but not the low seriousness group (β = −.01, *p* = .878). In contrast, connection overload was associated with lower friendship quality only in the low seriousness group (β = −.24, *p* = .001) but not the high seriousness group (β = .10, *p* = .248). See Table 3 for unstandardized coefficients for these direct paths. Due to these differences, DSMT was indirectly associated with depressive symptoms via connection overload in the high seriousness group (β = .06, 95% CI [.024, .094], *p* = .001) but not the low seriousness group (β = −.003, 95% CI [−.038, .032], *p* = .878). Conversely, DSMT was indirectly associated with lower friendship quality via connection overload only in the low seriousness group (β = −.06, 95% CI [−.098, −.016], *p* = .006) but not the high seriousness group (β = .02, 95% CI [−.017, .061], *p* = .262). See Figures 2 and 3.

Figure 2. *Seriousness Moderating the Associations Between DSMT, Digital Stress, and Wellbeing: Low Seriousness Model.*
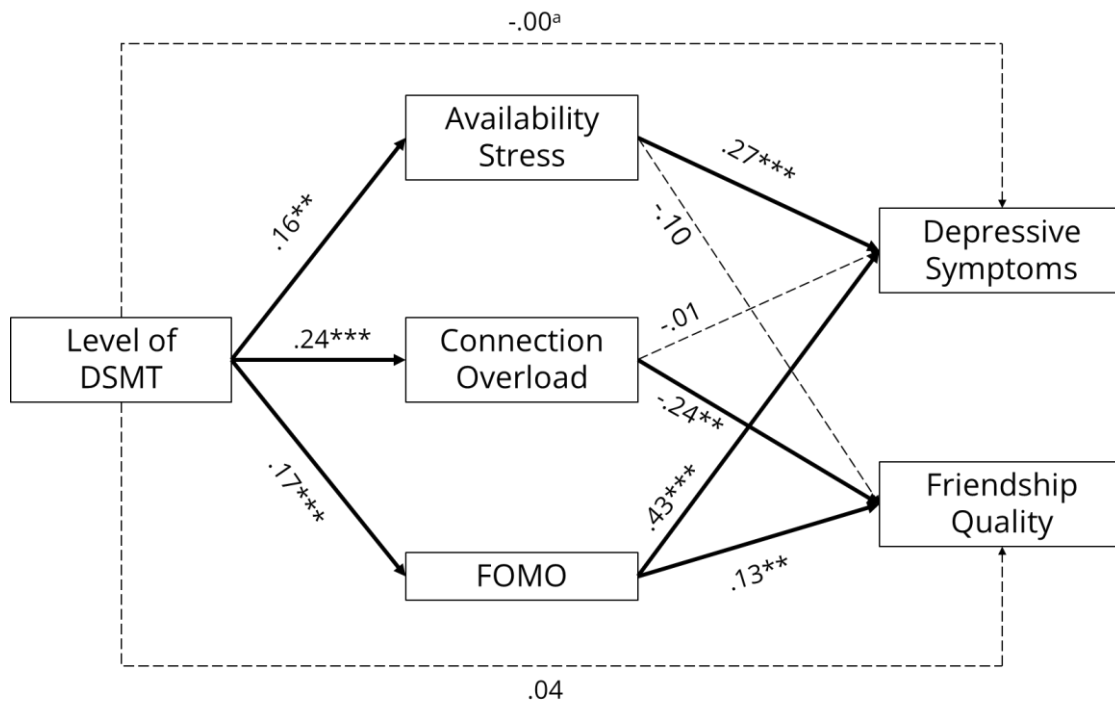
Note. Numbers are standardized coefficients. DSMT = digital social multitasking. FOMO = fear of missing out. The bold lines represent significant indirect paths. The dotted lines represent non-significant direct paths. For clarity of presentation, controlled paths are not presented. * *p* < .05, ** *p* < .01, *** *p* < .001, ª β = -.002.

Figure 3. *Seriousness Moderating the Associations Between DSMT, Digital Stress, and Wellbeing: High Seriousness Model.*
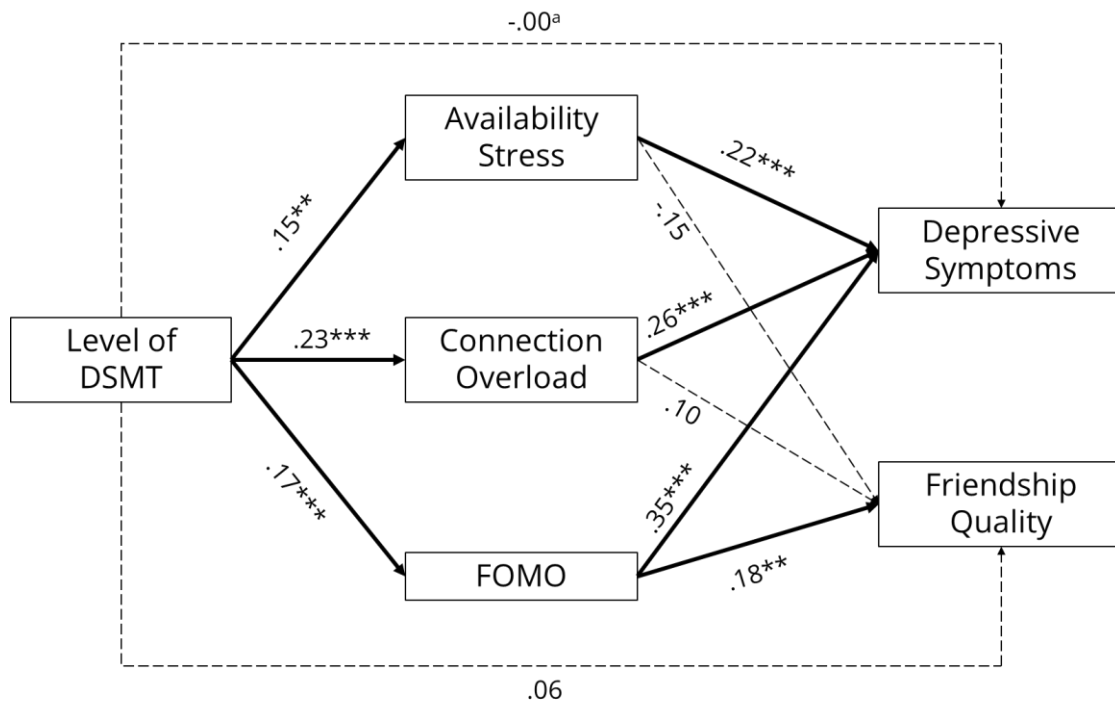
Note. Numbers are standardized coefficients. DSMT = digital social multitasking. FOMO = fear of missing out. The bold lines represent significant indirect paths. The dotted lines represent non-significant direct paths. For clarity of presentation, controlled paths are not presented. $^*p < .05$, $^{**} p < .01$, $^{***} p < .001$, $^a\beta = -.002$.

Discussion

Drawing on the frameworks of digital social multitasking (DSMT; Yang & Christofferson, 2020) and digital stress (Steele et al., 2020), this study explored the socioemotional implications of phone use during face-to-face interactions with a friend among adolescents. Our study showed that the extent to which adolescents performed DSMT was not directly associated with depressive symptoms and friendship quality. This result is consistent with the recent literature suggesting that DSMT does not necessarily have a simple, direct relationship with lower relational intimacy and poor socioemotional wellbeing (Kelly et al., 2019; Vanden Abeele et al., 2019; Yang & Christofferson, 2020). Instead, DSMT was indirectly associated with depressive symptoms and friendship quality through various types of digital stress. Furthermore, the relationships were moderated by the serious level of the face-to-face interactions but not whether the phone-based activities were shared between the participant and the friend. Overall, DSMT was consistently associated with poor emotional wellbeing (depressive symptoms) via the three types of digital stress, especially during serious face-to-face interactions, whereas the indirect relationships between DSMT and socio-relational wellbeing (friendship quality) via digital stress were less consistent.

The more adolescents engaged in DSMT, the greater availability stress they perceived, and thus the more depressive symptoms they reported (supporting H1a). When youth engage in DSMT, they often use their phone for texting and social media (Yang & Christofferson, 2020), but texting and some social media activities have been found to be associated with greater availability stress (Hall, 2017; Yang, 2021). As theorized by Steele et al. (2020), digital stress can impede optimal psychosocial functioning. Indeed, availability stress deprives people of a sense of autonomy and competence and thus contributes to poorer affective wellbeing (Halfmann & Rieger, 2019). Our finding resonates with this line of research. Surprisingly, availability stress did not mediate the relationship between DSMT and friendship quality (negating H1b). The result contradicts Hall and Baym's (2012) study showing that entrapment was related to lower friendship satisfaction. A difference between our model and Hall and Baym's is that we simultaneously considered various types of digital stress. It appears that when multiple types of stress are considered, other types of digital stress play a more central role than availability stress in adolescents' friendship quality.

For the overall sample, our hypotheses involving connection overload were partially supported. Engagement in DSMT was associated with greater connection overload, which, in turn, was related to more depressive symptoms

(supporting H1c). As suggested by earlier studies, multitasking can induce stress and thus dampen wellbeing by depleting users' cognitive resources (Hall et al., 2021; Matthes et al., 2020). Social media, texting, and watching YouTube videos are among the activities youth perform during DSMT (Yang & Christofferson, 2020). Matthes et al. (2020) found that using these apps on the phone, YouTube and WhatsApp specifically, predicted information overload, which predicted greater depressive symptoms and poorer wellbeing over time. They argued that these mobile phone apps were detrimental likely because they were information-dense and required immediate attention from the users. Although Matthes et al. concluded that multitasking was especially challenging for older adults, their study did not include adolescents. Our results showed that these young participants also suffered from multitasking, likely because adolescence is characterized by poorer inhibitory control and goal-directed attention relative to adulthood (Baumgartner & Sumter, 2017; Ernst et al., 2011). On the other hand, contrary to our hypothesis (H1d), connection overload was not related to friendship quality in the overall sample.

Notably, the role of connection overload varied by the seriousness of face-to-face interactions, and the moderating role of seriousness was more sophisticated than we had hypothesized (H2b). When adolescents viewed the face-to-face interactions as generally serious, the results were consistent with those found from the overall sample (i.e., connection overload was related to depressive symptoms but not friendship quality). In contrast, among the adolescents who rated their face-to-face interactions as generally less serious, connection overload was a mediator for poor friendship quality but not depressive symptoms. Phone use or presence during a conversation is deemed particularly disruptive and inappropriate when the conversation is serious in nature (Baron, 2008; Przybylski & Weinstein, 2013). In romantic couple relationships, phone use during formal interactions violates expectations as it suggests to the communication partner one's lack of interest (Miller-Ott & Kelly, 2015), and the same expectations and norms may exist in adolescents' friendships. It is possible that when adolescents engage in a serious interaction while being on the phone and experiencing connection overload, they still remind themselves to direct sufficient attention to the co-present friend to avoid offending or upsetting them. This approach likely prevents them from disengaging from the in-person conversation and appearing indifferent to the friend, which averts damage to the friendship. However, the approach may consume voluminous cognitive resources, which creates more stress, leading to greater depressive symptoms (Matthes et al., 2020). Conversely, divided attention is usually expected and more acceptable in casual or less formal interactions (Miller-Ott & Kelly, 2015). Thus, adolescents, who already feel overwhelmed by connection overload, may feel permitted to stay focused on the phone and detach from the in-person interaction. Although such distraction is associated with poorer friendship quality (Yang et al., 2021), the fact that adolescents likely do not force themselves to extract more cognitive resources in this condition appears to protect them from an emotional toll.

As hypothesized in H1e, DSMT was related to greater FOMO, which was associated with higher levels of depressive symptoms. The negative emotional implications of FOMO have been well-documented (Elhai et al., 2020; Fabris et al., 2020; Hall et al., 2021). When people engage in DSMT, the notifications and new information they receive on the phone may induce FOMO. This type of digital stress often drives users to use social media more intensely (Beyens et al., 2016; Przybylski et al., 2013), which provides more opportunities for upward or negative social comparison and thus contributes to low self-esteem (Vogel et al., 2014), poor affective wellbeing (Weinstein, 2017), and more depressive symptoms (Feinstein et al., 2013). In fact, FOMO per se can be viewed as a manifestation of social comparison (e.g., *compared with my peers, I'm missing out on rewarding social experiences*). Although social comparison was not included in our model, this is a plausible mediator between FOMO and wellbeing that could be investigated in the future.

Interestingly, the path from DSMT to friendship quality via FOMO was positive (RQ1). Although several studies have noted the negative association between FOMO and social wellbeing (Hall et al., 2021; Stead & Bibby, 2017), at least one study has shown that FOMO contributes to a greater sense of social connection via increased use of social media (Roberts & David, 2020). It is possible that adolescents who multitask and experience greater FOMO are more eager to find social information from social media (Beyens et al., 2016; Przybylski et al., 2013). Because young people often share the information gleaned from the phone with the co-present partner during DSMT (Kelly et al., 2017; Yang & Christofferson, 2020), DSMT actually makes adolescents feel more connected to their social network and thus report better friendship quality (Yang et al., 2021). Furthermore, social relationships seem especially important to adolescents who score high on FOMO—they have a higher need to belong and for popularity (Beyens et al., 2016). Perhaps the FOMO induced by DSMT brings to the forefront the importance of friendship, and helps adolescents become more appreciative of the relationship with the co-present friend. It is also noteworthy that FOMO was the only stress consistently associated with both depressive symptoms and

friendship quality across conditions of seriousness. This type of digital stress thus warrants particular attention in future research of the socioemotional implications of DSMT and digital stress.

Implications and Contributions

At the theoretical level, the study has three major contributions. First, it is one of the few studies looking into the implications of DSMT in the context of adolescent friendships. It complements existing research on co-present phone use in adults' romantic relationships (McDaniel et al., 2021; X. Wang et al., 2017) and adolescents' relationships with parents (Bai et al., 2020; Stockdale et al., 2018). Second, by integrating the frameworks of DSMT and digital stress, the study illuminates important pathways through which DSMT can be associated with adolescents' emotional and socio-relational wellbeing. Non-relational mediators that may uniquely impact multitaskers themselves have long been overlooked in the literature of co-present phone use (cf. McDaniel et al., 2021; Roberts & David, 2016). The significant paths identified in this study should provide additional ways for future scholars to conceptualize the relationship between DSMT and wellbeing. Third, the study responds to the growing calls for contextualizing the associations between co-present mobile communication and wellbeing (e.g., Kelly et al., 2019; Yang & Christofferson, 2020). The moderating role of seriousness allows us to draw more nuanced conclusions regarding when DSMT and digital stress would be harmful to which type of wellbeing.

At the practical level, findings from the study can inform adolescents of how DSMT is associated with their own depressive symptoms and friendship quality. Suggestions derived from earlier research of phubbing and technoference, which emphasized that one's DSMT would make one's communication partner feel ignored and unimportant (e.g., Roberts & David, 2016; Turkle, 2015), would discourage adolescents from DSMT by asking them to think about how their friends may feel if they do not give the co-present friend full attention. Our results offer an additional route for adolescents to consider the implications of DSMT—the behavior does not only influence the co-present friend; it also creates greater digital stress for the multitaskers themselves. Helping adolescents understand how themselves (rather than just their friends) may be impacted by DSMT is important, because adolescents often hold positive views of DSMT—they appreciate how DSMT allows them to access the information they need, complete tasks efficiently, seek entertainment, and connect with others (Yang et al., 2021). For adolescents to make informed decisions about how to approach the phone in their friendships, it appears critical for them to recognize both the benefits and detriments associated with DSMT.

Limitations and Conclusions

The study has several limitations. The first set of limitations concern the design and analyses. Specifically, the cross-sectional survey design does not warrant causal or directional conclusions. For example, given that individuals may use mobile devices to compensate for poor socioemotional states (e.g., Chen et al., 2021; Y. Wang et al., 2022), it was possible that adolescents who scored higher on depressive symptoms and lower on friendship quality engaged in a higher level of DSMT, which induced greater digital stress. Although this alternative model did not fit well: $\chi^2(3) = 34.86$, $p < .001$; RMSEA = .143, 90% CI [.103, .188]; CFI = .971; TLI = .746, suggesting that our hypothesized directionality was among the more reasonable ones, experimental and longitudinal studies are still needed to provide stronger evidence. Furthermore, we measured three types of digital stress using the scales recommended by Steele et al. (2020). Although the scales appeared to operate well (e.g., good reliability), Steele and colleagues recently developed the Multidimensional Digital Stress Scale (Hall et al., 2021). These scales should reflect digital stress even more faithfully and are recommended to scholars who intend to study digital stress in the future. Relatedly, our study only concerned three types of digital stress, leaving out approval anxiety and online vigilance (Hall et al., 2021; Steele et al., 2020). Approval anxiety was excluded because we did not find strong measurements for it; online vigilance was a new type of digital stress identified in Hall et al. (2021), after we completed data collection. The new Multidimensional Digital Stress Scale makes it possible to explore the relationships between these digital stresses and DSMT in the future. Finally, our moderation tests were exploratory in nature. Although it would have been ideal if we had specified which path or paths would be moderated by shared phone use and seriousness, we were unable to do so prior to approaching the data. Both DSMT (Yang & Christofferson, 2020) and digital stress (Steele et al., 2020) are relatively new theories, and our study is among the first connecting the two. While Yang and Christofferson (2020) noted the importance of contextual factors in shaping DSMT's implications, there were insufficient theoretical underpinnings and empirical data to pinpoint exactly which paths would be moderated (e.g., from DSMT level to digital stresses, from the stresses to wellbeing, or both). Therefore, we decided to perform multi-group analyses, followed by the path-by-path

comparisons. This approach has the limitation of turning the continuous variables into categorical variables, leading to the loss of variance. It was a compromise we had to make. By presenting these preliminary and exploratory findings, we hope future scholars would be able to more clearly describe and predict the roles of these contextual factors in adolescents' mobile communication.

The second set of limitations concern the sample. According to the results of Monte Carlo tests (Muthén & Muthén, 2002), a sample of 600 participants was recommended to ensure at least 80% of power for all the paths with an anticipated effect size of .15. Due to the limited financial resources we had, our sample was slightly smaller. With the current sample size, most paths still achieved at least 80% of power, with the four paths from availability stress and connection overload to depression and friendship quality being exceptions (74.5% to 76.6%). The readers are advised to consider this information when they interpret the findings. In addition, although our sample had a nationally representative distribution of gender and race/ethnicity, we would still caution the readers when they intend to generalize the findings, especially to adolescents outside of the United States.

Phone use during face-to-face interactions has become a common behavior in adolescents' social lives. Drawing on the frameworks of DSMT and digital stress, our study clarified how DSMT would associate with adolescents' emotional and socio-relational wellbeing via three types of digital stress, and how the paths were moderated by the seriousness of the face-to-face interactions. The implications of DSMT are complex. As our results showed, DSMT did not have a simple, direct relationship with adolescents' depressive symptoms and friendship quality, and it was not always detrimental to teens' wellbeing. Adolescents' DSMT appeared more harmful to emotional wellbeing than socio-relational wellbeing, especially when the face-to-face interactions were serious. At the same time, DSMT was associated with better friendship quality through FOMO. More studies aiming to unravel the multi-faceted roles of DSMT are needed to more accurately describe, explain, and predict adolescents' peer interactions and wellbeing in the digital age.

Footnotes

[1] There is a subtle difference between DSMT, co-present phone use, technoference, and phubbing: Under the frameworks of technoference and phubbing, phone use during social interactions is viewed as an interference ("technoference") or a snub ("phubbing"), which is inherently deleterious. In contrast, DSMT and co-present phone use describe the behavior without assuming it to be beneficial or detrimental. Given that a growing number of scholars have noted that phone use during face-to-face interactions is not necessarily harmful (Kelly et al., 2019; Vanden Abeele et al., 2019; Yang & Christofferson, 2020), we prioritized the terms of DSMT and co-present phone use in our writing, although we also included research of technoference and phubbing when relevant.

[2] The three types of digital stress had a correlation close to or greater than .70. Thus, additional CFAs were performed to examine whether the scales should be combined. The one-factor and two-factor models all had poor fit: χ^2(103 to 104) = 821.65 to 1359.21, ps < .001; RMSEAs = .116 to .153, 90% CIs [.109 to .146, .124 to .160]; CFIs = .773 to .870; TLIs = .738 to .848. Therefore, we retained the 3-factor structure for the following analyses.

Conflict of Interests

The authors have no conflict of interests to declare.

Authors' Contribution

Chia-chen Yang: conceptualization, formal analysis, funding acquisition, investigation, methodology, project administration, supervision, visualization, writing—original draft, writing—review & editing. **Christina Smith:** writing—original draft, writing—review & editing. **Thomas Pham:** writing—original draft, writing—review & editing. **Jati Ariati:** writing—original draft, writing—review & editing.

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