

THE RELATIONSHIP BETWEEN ADOLESCENT TECHNOLOGY USE AND
DEPRESSIVE SYMPTOMS: AN INTEGRATIVE MODEL OF OFFLINE AND
TECHNOLOGY-BASED RISK FACTORS

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ABSTRACT

Jacqueline Nesi: The Relationship Between Adolescent Technology Use and Depressive Symptoms: An Integrative Model of Offline and Technology-Based Risk Factors
(Under the direction of Mitchell Prinstein)

This study examined the role that specific technology-based behaviors (social comparison and interpersonal feedback-seeking) and offline individual characteristics play in the relationship between technology use and depressive symptoms among adolescents. A total of 702 students (57% female) completed self-report questionnaires at two time points. Adolescents reported on depressive symptoms at baseline, and one year later on depressive symptoms, frequency of technology use, excessive reassurance-seeking, technology-based social comparison and feedback-seeking, and popularity. Path analyses supported a moderated mediation of the longitudinal relationship between frequent technology use and depressive symptoms, with gender and popularity serving as moderators and technology-based behaviors serving as mediators. Effects were found above and beyond the effects of offline excessive reassurance seeking and prior depressive symptoms. Findings highlight the utility of examining psychological outcomes of adolescent technology use within the framework of existing interpersonal models of depression and the importance of nuanced approaches to studying adolescents' media use.

TABLE OF CONTENTS

INTRODUCTION.....	1
The Changing Adolescent Social World.....	3
Outcomes of Technology Use.....	5
An Integrative Model of Technology Use Outcomes.....	8
Study Hypotheses.....	12
METHODS.....	14
Participants.....	14
Attrition Analyses.....	13
Procedure.....	15
Measures.....	16
Data Analytic Plan.....	21
RESULTS.....	25
Descriptive Statistics.....	25
Hypothesis Testing.....	26
DISCUSSION.....	31
Technology-Based Social Comparison and Feedback-Seeking.....	32
Individual Vulnerabilities.....	34
Limitations and Conclusions.....	38
APPENDIX A: TABLES AND FIGURES.....	40
APPENDIX B: MEASURES.....	43
REFERENCES.....	45

INTRODUCTION

Adolescence is a critical developmental period during which the prevalence of depression increases drastically (Hankin & Abramson, 2002; Rudolph & Hammen, 1999). Interpersonal models of depression suggest that dramatic changes in the social landscape during the transition to adolescence may interact with biological and cognitive factors to partially explain this troubling phenomenon (Hankin & Abramson, 2001; Teunissen et al., 2011). Such changes include increased autonomy from parents, more frequent and unsupervised peer interactions, an increased emphasis on peer status and approval, and more complex peer relationships with members of both genders (Borelli & Prinstein, 2006; Harter, Stocker, & Robinson, 1996; Rudolph et al., 2000). As adolescents navigate this new social environment, they often encounter higher levels of interpersonal stress (Rudolph & Hammen, 1999). At the same time, adolescents' social relationships are increasingly significant in shaping self-esteem and well-being (La Greca & Harrison, 2005; Rudolph, 2009). This may be particularly true for girls, who exhibit higher levels of emotional intimacy and affiliative needs, more interpersonal stress, and ultimately, higher levels of depression during adolescence (Cyranowski, Frank, Young, & Shear, 2000; Rose & Rudolph, 2006).

Developmental researchers have argued that positive adaptation during adolescence largely is predicated on the successful resolution of two socially based, stage-salient tasks, namely, the formation of close interpersonal connections and the development of a cohesive self-identity (Cicchetti & Rogosch, 2002). In particular, social interaction becomes essential to the task of identity development, as adolescents glean self-relevant information and social approval

from the peer network (Harter, Stocker, & Robinson, 1999; Prinstein, Borelli, Cheah, Simon, & Aikins, 2005). This often manifests in the form of increased levels of two interpersonal behaviors: social comparison, or comparison with peers on perceived relevant traits (Butzer & Kuiper, 2006), and interpersonal feedback-seeking, or the solicitation of self-relevant information from valued others (Borelli & Prinstein, 2006). Although these behaviors reflect normative developmental processes, research indicates that vulnerable individuals may engage in these behaviors in such a way as to confer risk for the onset and maintenance of depressive symptoms. These aberrations in social comparison and feedback-seeking may thus represent unique depressogenic-interpersonal behaviors (Hames, Hagan, & Joiner, 2013).

Social Comparison. Depressed and depression-prone individuals may engage in overall higher levels of social comparison than healthy individuals, a finding which has been verified experimentally (Swallow & Kuiper, 1992) and through self-report (Gibbons & Buunk, 1999) among adults. This may be because depressed individuals tend to experience high levels of uncertainty about the self, and social comparison can help to reduce this uncertainty (Weary, Marsh, & McCormick, 1994). This engagement in higher levels of social comparison may be particularly problematic for depressed individuals for a number of reasons. Depressed individuals are more likely to make unfavorable comparisons that result in negative self-evaluation (Swallow & Kuiper, 1988) and less likely to engage in protective “downward comparisons,” or comparisons with others perceived to be worse-off than oneself on important dimensions (Swallow & Kuiper, 1993). In addition, they are more likely to experience negative affect as the result of “upward comparisons,” or comparisons with others perceived to be better-off (Bäzner, Bromer, Hammelstein, & Meyer, 2006). The effects of these upward versus

downward comparisons may be particularly strong when they occur on personally relevant dimensions, such as attractiveness, sociability, or achievement (Thwaites & Dagnan, 2004).

Feedback-Seeking. For many adolescents, interpersonal feedback-seeking is a normative social behavior. Joiner, Metalsky, Katz, and Beach (1999) posit that feedback-seeking may be a response to increases in anxiety and decreases in self-esteem, two common responses to social stressors that occur during adolescence. However, depressed or depression-prone adolescents may engage in a specific type of feedback-seeking that represents a risk factor in the development and maintenance of depressive symptoms. This type of feedback-seeking, Excessive Reassurance-Seeking (ERS), consistently has been found to both predict and co-vary with depressive symptoms (Hames, Hagan, & Joiner, 2013). ERS, or the tendency to repeatedly ask others for reassurance of personal worth, is the precipitating factor in a cycle that is characterized by interpersonal rejection, poor friendship quality, and elevations in depressive symptoms among adolescents (Abela, Zuroff, Ho, Adams, & Hankin, 2006; Prinstein et al., 2005). Adolescents high in ERS ask others for reassurance but may doubt the sincerity of these reassurances. They continue to request reassurance, ultimately irritating and alienating others, and confirming the original doubts (Coyne & Whiffen, 1995; Joiner et al., 1999). This cycle may be particularly common for females, among whom ERS may be both more likely to occur and more likely to result in interpersonal stress (Starr & Davila, 2008). ERS is also associated with a number of other, related interpersonal vulnerabilities, including sociotropy, anxiety about abandonment, preoccupied attachment style, dependency, self-criticism, and, importantly, social comparison (Davila, 2001; Hames, Hagan, & Joiner, 2013; Starr & Davila, 2008).

The Changing Adolescent Social World

Adolescent adjustment and identity development are greatly affected by important changes in the social landscape during adolescence, including the heightened role of peer relationships and more frequent, complex peer interactions. Thus, any comprehensive understanding of depression among this age group must be embedded within the context of the interpersonal environment. Much research has investigated the role of *in-person* peer interactions in shaping depressive symptoms. However, little is known regarding social experiences that occur through technological media, including Social Networking Sites (SNS, e.g. Facebook) and text messages. Understanding technology-based adolescent social experiences, including the potential presence of *online* depressogenic-interpersonal behaviors, is critical; these media have had a revolutionizing impact on both the frequency and types of peer interaction afforded to today's teenagers.

The ubiquity of technology in the lives of modern adolescents makes its influence impossible to ignore, with recent years marking a dramatic increase in technology use that has transformed the adolescent social world. Over 93% of American teenagers (ages 12 to 17) are now connected to the Internet, more than any other age group, with an estimated 73% belonging to at least one SNS (Jones & Fox, 2009; Lenhart, Purcell, Smith, & Zickuhr, 2010). The average young person now spends approximately 7 hours a day connected to electronic media (Rideout, Foehr, & Roberts, 2010). At least 78% of adolescents own a cell phone, with at least half of those being a smart phone (Madden et al., 2013). Adolescents, in a developmental period during which peer contact is already increasing, are now afforded almost constant communication with peers, an experience that may actually increase the importance of the role that peer groups play in development (Uhls et al., 2011).

In addition to the *amount* of peer contact, the *type* of peer interaction afforded by new media is unique to the current generation of adolescents. SNS, such as Facebook, MySpace, Twitter, and Instagram, have a number of key features: a personal “profile” with photos, links, and text meant to represent the user; “Friends,” or the collection of other users an individual has allowed into his or her network; and public commentary on a user’s profiles and photos, visible to others in the social network (boyd, 2007). These features create an online social world that is fundamentally different than its offline counterpart. One goal of research on SNS use has been to understand how this online social world may affect adolescents’ social and psychological experiences.

Outcomes of Technology Use

Since the advent of in-home Internet communication, researchers have investigated the relationship between Internet use and psychological outcomes. Kraut et al.’s (1998) influential HomeNet study constituted the first large-scale study of this kind. The researchers tracked new Internet users over the course of one or two years, finding that increases in Internet use were associated with declines in social involvement and increases in social isolation, loneliness, stress, and depression. The authors deemed this outcome the “Internet Paradox,” arguing that this new, “social technology,” was replacing strong, in-person social ties with weak, superficial online relationships, eliciting negative psychological outcomes.

Since then, a number of studies have found an association between technology use and a host of negative outcomes, including aggression, body image disturbance, alcohol use, romantic jealousy, and the belief that others are living better lives than oneself (Brown & Babowski, 2011; Chou & Edge, 2012; Muise, Christofiedes, & Desmarais, 2009). Kross et al. (2013) used experience-sampling to suggest that young adults experience declines in well-being as the result

of increased Facebook use, and O’Keeffe and Clarke-Pearson (2011) have gone so far as to reference a new condition called “Facebook depression,” or the experience of depressive symptoms in adolescents following time spent on SNS.

Not all studies of psychological outcomes associated with technology use have had these results, however. In fact, in a revision of their “Internet Paradox” study considered more relevant for modern social technologies, Kraut et al. (2001) reported a number of positive effects of Internet use on subjects’ social involvement and well-being, particularly for extraverts. Other researchers have found other positive effects resulting from technology use—that increased SNS use may result in greater social capital, higher self-esteem, and reduced loneliness (Burke, Marlow, & Lento, 2010; Steinfield, Ellison, & Lampe, 2008; Valkenburg, Peter, & Schouten, 2006). Still other researchers have found no association between time spent online and psychological adjustment (Gross, 2004).

Given these mixed findings, current research suggests that the relationship between technology use and psychological outcomes is complex. As Internet use has increased exponentially and research efforts have multiplied, studies have begun to focus on pre-existing individual differences and specific technology-based behaviors that may influence the relationships between technology use and psychological outcomes.

Individual Differences. Some studies suggest that individual differences in offline social status, self-esteem, life satisfaction, extraversion, and social support may partially explain the mixed outcomes afforded by SNS use. Researchers have categorized these differences into two competing hypotheses: the “Social Compensation” and “Social Enhancement” models (Zywica & Danowski, 2008). Some evidence supports the “Social Compensation” hypothesis, which states that those with poorer offline social resources will benefit from using the Internet, while

those with strong offline networks will experience decreases in well-being due to their replacement of in-person ties with online ones (Bessière, Kisler, Kraut, & Boneva, 2008; Ellison, Steinfield, & Lampe, 2011; Steinfield, Ellison, & Lampe, 2008). Szwedo, Mikami, and Allen (2012) describe this as a “leveling effect,” whereby less socially accepted individuals may turn to the Internet to gain social support and connection, thus improving their well-being over time.

Others support the “Social Enhancement” model, which posits that extraverted individuals with strong offline social networks are more likely to benefit from Internet use through expansion of their network and reinforcement of social ties (Valkenburg & Peter, 2007; Kraut et al., 2003). Growing support for this model suggests that the opposite may be true as well—that individuals with lower self-esteem and higher social anxiety may be more likely to experience *negative* outcomes as a result of greater SNS use (Anderson, Fagan, Woodnutt, & Chamorro-Premuzic, 2012; Kim, LaRose, & Peng, 2009).

Among adolescents, for whom social status is particularly salient, the “Social Enhancement” model may have implications for differences in online interaction based on individuals’ popularity, particularly given that popular adolescents tend to be higher in self-esteem and extraversion (Babad, 2001). For example, college students lower in popularity may strive to appear more popular online and believe that achieving this appearance is more important, while popular students are likely to have a greater number of Facebook friends and higher self-esteem (Zywica & Danowski, 2008). Additionally, adolescents with higher social status longitudinally may receive more comments indicating social support on their Facebook profiles from a greater number of friends (Mikami, Szwedo, Allen, Evans, & Hare, 2010).

Gender differences also may play a role in the differential outcomes associated with technology use. Initial research shows that females and males may use technology differently,

particularly in regard to SNS. For example, women have been found to be more likely overall to post photos online than men (Mesch & Beker, 2010). Additionally, with respect to Facebook “profile photos,” males are more likely to post pictures that primarily showcase the face, while females are more likely to include the entire body (Cooley & Reichart Smith, 2010), a difference that may have implications for appearance-based online comparisons. Finally, adolescent boys may be more likely to engage in self-disclosure online than offline, thereby accruing more social benefits than girls as the result of online interaction (Schouten, Valkenburg, & Peter, 2007; Valkenburg & Peter, 2009).

Differences in Online Behaviors. Some studies also suggest that the unique features afforded by SNS (e.g., the “profile,” “friends,” and public commentary) may encourage a host of different behaviors that may also help to explain some of the variability in outcomes associated with technology use. For example, certain studies have categorized some behaviors as more “passive,” such as viewing other users’ profiles and photos without direct communication, and “active” behaviors, such as messaging a friend, commenting on a friend’s profile, or updating one’s own profile (Wilson, Gosling, & Graham, 2012). Passive behaviors may result in greater levels of loneliness and depression, lower self-esteem, and lower social capital (Burke, Marlow, & Lento, 2010; Gonzales & Hancock, 2011; Selfhout et al., 2009). Active behaviors, however, may increase feelings of social capital and self-esteem (LaRose, Eastin, & Gregg, 2001; Valkenburg, Peter, & Schouten, 2006; Wilson, Gosling, & Graham, 2012). Other specific technology-based behaviors that have been associated with poor offline adjustment include posting of inappropriate photos, engaging in negative social comparison, posting of negative content, receiving less public commentary, and accruing fewer “friends” on Facebook (Feinstein et al., 2013, Forest & Wood, 2012; Mikami, Szewedo, Allen, Evans, & Hare, 2010).

An Integrative Interpersonal Model of Technology Use Outcomes

The relationship between frequency of technology use and negative outcomes remains inconclusive, with a number of differences in online behaviors and offline individual characteristics potentially moderating these outcomes. Researchers have called for a more nuanced understanding of the effects of technology use that emphasize individual traits and specific online activities (Davila et al., 2012; Valkenburg & Peter, 2013). Certain online and offline behaviors, as well as pre-existing individual characteristics, have emerged as promising areas for further inquiry, in that they may provide some insight into these mixed findings. Initial evidence suggests that the online behaviors of social comparison and feedback-seeking, the offline behavior of ERS, and pre-existing individual differences in social status, or popularity, may play an important role in influencing the relationship between technology use and depressive symptoms.

Preliminary theoretical and empirical findings suggest that, on average, higher levels of technology use may be associated with higher levels of technology-based social comparison and feedback-seeking among adolescents (Manago, Graham, Greenfield, Salimkhan, 2008). The flexibility of the SNS profile gives adolescents an opportunity to explore various identity constructions, and public commentary provides a constant feedback loop that may allow for more reflected appraisal, or evaluation of the self based on the perceived opinions of others (Harter, Stocker, & Robinson, 1999; Hum et. al, 2011; Manago et al., 2008). The public commentary and “friends” features of SNS have transferred many social relations from the private to public sphere (Subrahmanyam & Greenfield, 2008). With the typical adolescent maintaining about 300 online “friends” (Madden et al., 2013), behaviors on social networking sites are performed in the presence of an audience; every photo, comment, and new connection

provides details about the user to his or her public network (Manago, Taylor, & Greenfield, 2012; Steinfield, Ellison, & Lampe, 2008). This atmosphere of “performance” and public commentary may encourage high levels of feedback-seeking behaviors.

Additionally, the profile page may elicit selective self-presentation strategies that portray users in an “ideal” manner (Chou & Edge, 2007; Gonzales & Hancock, 2011). These idealized self-presentations may heighten self-focus and increase tendencies for social comparison, particularly upward comparisons (Manago et al., 2008). These behaviors may result in negative outcomes. For example, Haferkamp & Kramer (2011) found that young adults presented with SNS profiles indicating others’ high levels of attractiveness or career success engaged in social comparison processes that produced more negative feelings about the self, and Krasnova, Wenniger, Widjaja, and Buxmann (2013) found evidence for increases in envy, and concurrent decreases in life satisfaction, following social comparison on Facebook. Feinstein et al. (2013) report that negative comparisons, in particular, may place individuals at risk for rumination and, as a result, depressive symptoms.

Thus, although social comparison and feedback-seeking behaviors are typical among adolescents, high levels of technology use may facilitate increased levels of these behaviors, leading to negative outcomes. This may serve to *intensify* the issues of identity development and interpersonal connectedness, challenging adolescents to confront them with greater constancy and urgency (Subrahmanyam, 2007; Uhls et al., 2011).

Which adolescents may be most likely to engage in high levels of online social comparison and feedback-seeking behaviors? And who may be most likely to experience depressive symptoms as a result of these technology-based behaviors? Pre-existing individual differences in levels of offline ERS and social status may play an important role in explaining

these processes. For vulnerable adolescents, particularly those with a history of *offline* interpersonal risk factors such as ERS or low social status, the intensification of developmental tasks online might be especially risky for the onset or maintenance of depressive symptoms. Offline, individuals high in ERS are already more likely to engage in maladaptive social comparison and interpersonal feedback-seeking behaviors (Butzer & Kuiper, 2006; Starr & Davila, 2008; Swallow & Kuiper, 1992). In an online environment where these behaviors are facilitated, though, vulnerable adolescents may engage in abnormally high levels of these behaviors, such that they represent specific, *online* depressogenic-interpersonal behaviors. High levels of technology use among these vulnerable adolescents may lead to *excessive* online social comparison and feedback-seeking, conferring risk for depressive symptoms.

Social status may help to explain which adolescents are most likely to experience depressive symptoms as a result of engagement in these online risk behaviors. Recent findings show that in using modern social technologies, adolescents engage almost exclusively with others in their offline social networks, rather than strangers (Reich, Subrahmanyam, & Espinoza, 2012), suggesting the relevance of offline popularity to the online social context. When adolescents engage in online social comparison or feedback-seeking behaviors, their reactions to these behaviors may differ based on pre-existing beliefs about self-worth, or how they compare to others in their social networks. Individuals high in offline popularity may experience greater feelings of self-worth in comparison to others in these networks, given known associations between popularity and self-esteem. Not only might higher self-esteem among popular individuals may serve as a “buffer” against the negative effects of upward social comparisons (Haferkamp & Kramer, 2011), but popular adolescents may simply engage in fewer “upward comparisons” than their less popular peers. Further, feedback elicited by popular adolescents

may be more positive than that received by lower popularity individuals (Mikami, Szwedlo, Allen, Evans, & Hare, 2010).

Despite preliminary evidence to suggest the importance that online social comparison, online feedback-seeking behavior, offline ERS, and offline social status may have in elucidating the relationship between technology use and depressive symptoms, more information is needed. An important next step is to test the influences of these variables directly in a specific interpersonal model of technology use and depressive symptoms, and to allow for the examination of more complex relationships between these variables than has previously been considered. Specifically, this model must consider various interactions and associations between online behaviors and offline characteristics in predicting depressive outcomes and identifying potential online depressogenic-interpersonal behaviors (i.e., excessive online social comparison and excessive interpersonal feedback-seeking). As such, applying a conceptual and statistical model that allows for the simultaneous examination of both mediator and moderator effects, i.e. “moderated mediation” or “conditional indirect effects,” will provide much-needed insight into the complexity of these relationships.

An investigation that focuses on the online experience of adolescents, a traditionally understudied group in the literature, is both timely and appropriate. Furthermore, gender differences in these effects must be explored, as sex differences have been shown in levels of depression, feedback-seeking behaviors, and SNS use. Given well-known increases in depressive symptoms that occur during the adolescent transition, and the socio-developmental factors that may contribute to such increases, the application of an interpersonal model of depression to adolescent technology use has the potential to be extremely valuable.

Study Hypotheses

Three hypotheses will be examined. (1) First, it is hypothesized that higher frequencies of technology use will be associated with higher levels of depressive symptoms, and that this relationship will be mediated by online social comparison and online feedback-seeking behaviors. (2) Second, it is hypothesized that this meditational relationship will also be moderated by two separate factors: ERS and social status. (2a) It is hypothesized that ERS will moderate the meditational relationship, such that individuals high in both ERS and frequency of technology use will show the highest levels of online social comparison and feedback-seeking, and thus the highest levels of depressive symptoms. (2b) It is also hypothesized that popularity will moderate this meditational relationship, such that individuals low in popularity will show the strongest negative association between online social comparison and feedback-seeking and depressive symptoms. It is hypothesized that all of these effects will be shown over and above the effects of depressive symptoms collected at baseline. See Figure 1 for hypothesized model.

Given evidence for gender differences in adolescent levels of depression and ERS, as well as in technology use behaviors, gender differences in these relationships will be explored; however no specific gender differences are hypothesized.

METHODS

Participants

The current study included 649 participants. Students were 8th and 9th grade students in low to middle class schools (67% free or reduced price lunch). Participants were between the ages of 12 and 16 (mean age 14.6), and 57.3% were female. The ethnic composition of the sample included 47.9% White/Caucasian, 21.1% African American/Black, 23.4% Hispanic/Latino, 0.5% Asian, and 5.5% other. This sample closely matched the demographic makeup of the district from which participants were recruited.

Attrition Analyses

Three sets of attrition analyses were conducted to compare students on demographic variables that included gender, ethnicity, and socio-economic status (as measured by Mean Household Income). First, students who completed all relevant study measures at the current time point ($n = 647$) were compared to those who were excluded from analyses ($n = 130$). Those who were excluded from analyses either did not complete all measures ($n = 77$) or indicated that they did not use technology as defined in the study ($n = 53$). Those who were excluded from analyses did not differ significantly from those included in analyses in ethnicity or SES. However, those who were excluded from analyses were, on average, more likely to be male, $t(775) = 3.13, p = .002$.

Second, students who did not complete all relevant study measures ($n = 77$) were compared to those who did ($n = 700$), and no significant differences emerged in terms of gender

or SES. However, White students were significantly more likely to complete all measures than African American students, $\chi^2(3)=24.77, p <.001$.

Finally, students who indicated that they used technology as defined in the study ($n = 649$; use of cell phones, Facebook, or Instagram) were compared to those who indicated that they did not ($n = 53$). Interesting, no differences emerged between these groups in terms of socioeconomic status or ethnicity. However, the 53 students who indicated that they did not use technology were more likely to be male, $t(698) = 3.83, p <.001$; lower in depressive symptoms, $t(698) = -2.86, p = .004$; lower in ERS, $t(698) = -3.51, p <.001$; and lower in peer-reported popularity $t(698) = -4.60, p <.001$.

Additionally, 15 students did not have data for depression at baseline, reducing the number of subjects included in the final model analysis to $n = 632$. These 15 students did not differ from the rest of the sample on any demographic or other study variables.

Procedure

As part of an ongoing study of adolescent depressive symptoms and health risk behavior, a total of 1,463 students were initially recruited for participation. All students in 7th and 8th grade were recruited, except for those in self-contained special education classrooms, and recruitment was conducted using parental consent forms (distributed in classrooms) and active student assent. Among the 82.4% of students who returned consent forms ($n = 1,205$), 74.7% of parents consented to their child's participation ($n = 900$). Of these 900 students, 16 students were absent from school, 7 moved away from the area, 4 withdrew from the school, and 5 declined participation, yielding a final sample of 868 students for the study's first wave ("baseline"). The current study was conducted one year later, when students were in 8th and 9th grades. Of the original sample of 868, 90% of students participated ($n = 779$). Attrition was due to participants'

moving away from the area ($n = 14$), moving to a different school ($n = 20$), withdrawal from the school ($n = 18$), withdrawal from the study ($n = 20$), and absenteeism ($n = 17$).

Out of the 779 students surveyed, 130 students were excluded from the analysis. Of these 130, 53 indicated that they did not use technology as defined in the study. The other 77 students did not complete all relevant measures. After primary analyses, two outliers were removed from the data, and 15 subjects were found not to have provided information on baseline depressive symptoms. Thus, final model sample was reduced to $n = 632$. Participants were compensated with \$10 gift cards.

Measures

All measures were self-reported and administered to students in classrooms during the school day using computer-assisted self-interviews (CASI).

Depressive Symptoms. The Short Mood and Feelings Questionnaire (SMFQ; Angold et al., 1995; Messer et al., 1995) was used to assess core depressive symptoms, both at the current time point and one year prior (“baseline”). The SMFQ is a 13-item, unifactorial scale in which subjects endorse statements describing depressive moods and behaviors over the past two weeks on a 3-point scale (0 for “not true,” 1 for “sometimes true,” and 2 for “true”). A mean score was computed, with higher scores indicating higher levels of depressive symptoms. The SMFQ has good psychometric properties (Sharp, Goodyer, & Croudace, 2006) and has been widely used to assess depressive symptoms in adolescent samples (e.g. Rethon et al., 2009; Stansfeld et al., 2004). The current sample yielded good internal consistency (Cronbach’s alpha .94).

Popularity. Sociometric nomination procedures were used to measure peer-reported social status (Coie & Dodge, 1983). As such, all subjects were presented with a roster of all grademates. Alphabetization of the roster was reversed for a random half of the participants in

order to control for order effects in participants' selection of names. Subjects were asked to nominate an unlimited number of grademates who they believed to be the "most popular" and the "least popular." For each participant, two sums were calculated: one for the number of "most popular" nominations, and one for the number of "least popular" nominations. These sums were then standardized, and a difference score was taken between "most popular" and "least popular" standardized scores. These differences scores were then re-standardized to create a measure of "popularity," where higher scores indicated higher levels of popularity. Sociometric nomination procedures are largely considered the most reliable and valid indices of adolescents' social status among peers (Coie & Dodge, 1983, Parkhurt & Hopmeyer, 1998).

Excessive Reassurance-Seeking. Joiner and Metalsky (1995) developed the Reassurance-Seeking Scale (RSS) for use with adults and later adapted it for use with children and adolescents (Joiner, 1999) as a subscale of the larger Depressive Relationships Inventory (DIRI; Metalsky et al., 1991). One critique of the original RSS is that it is very brief (4 items), and that it lacks developmental sensitivity (Starr & Davila, 2008). Thus, for the current study, a Revised ERS scale was created to include 6 additional items, all believed to be developmentally appropriate to adolescents (e.g. "I often ask people if they think my clothes look okay"). Another criticism of the original ERS scale is that it lacks detail, simply assessing how often individuals request assurance that others like and care for them. Thus, the Revised ERS scale sought to address multiple domains of reassurance-seeking appropriate to adolescents, including reassurance-seeking about appearance (e.g., "I often ask people if I look attractive"), gossip (e.g. "I often ask people what other people say about me"), and general liking (e.g., "I often ask people if other people like me.") Exploratory factor analysis revealed that a one-factor solution fit the data appropriately. For full item list, see Appendix B.

Ultimately, the Revised ERS scale was a 10-item measure in which subjects endorsed reassurance-seeking behaviors on a 5-point scale (1 for “Not at all true” and 5 for “Extremely true”). A mean score was computed, with higher scores indicating higher levels of reassurance-seeking. The original RSS has been shown to have good psychometric properties (Joiner & Metalsky, 2001) and has been used to assess depressive symptoms in adolescent samples (e.g. Prinstein et al., 2005). The Revised ERS scale showed good internal consistency in this sample (Cronbach’s alpha .90).

Online Comparison and Feedback-Seeking. The Motivations for Electronic Interaction Scale (MEIS) was designed in order to assess subjects’ attitudes and behaviors regarding the use of technology, specified as “texting, Facebook, and other social media.” This measure was developed in three steps. First, a focus group comprised of recent high school graduates was conducted. Students were asked to generate examples of technology-based behaviors and attitudes toward technology use that are common among current high school students (e.g., “I often post a status update if I think it will make others think I am funny, nice, or cool” or “If someone defriends me on Facebook, I worry that I’ve done something wrong”). Based on their answers, a pool of 34 items was generated and administered to a sample of 261 adolescents, living in a nearby school district and comprised of similar age, gender, and ethnic composition to the current sample. Subjects endorsed the personal relevance of these attitudes and behaviors on a 5-point scale (1 for “Not at all true” and 5 for “Extremely true”). A factor analysis of this pilot data suggested that items could be grouped into categories that included: preferring online to in-person interactions, technology-based experiences causing emotional distress, using online contexts to reject peers, impatience when using technology-based media, promotion of romantic relationships online, online aggression, and using online experiences to enhance social status,.

Within this final category, certain items preliminarily assessed feedback-seeking and social comparison behaviors, i.e. “I often post a status update if I think it will make others think I am funny, nice, or cool” and “I post on my friend’s Facebook wall because I want others to see the message.”

In the second step, the scale was expanded to include 52 items. Building on the results of pilot data, and the perceived relevance of certain items to psychological outcomes, further items were added reflecting a desire to engage in social comparison and feedback-seeking behaviors online. The scale was streamlined by using a catch-all introductory statement “I use electronic interaction...,” with items finishing this statement to reflect motivations for the use of technology. The test was administered to 158 high school students, again of similar age, gender, and ethnic composition to the current sample. Subjects in this wave were asked to indicate whether each motivation for using technology differed across “private” interaction (e.g. text, e-mail) and “public” interaction (e.g. SNS); however, no significant differences emerged, and thus this distinction was dropped for the final measure. The variability and skewness of each item was assessed, and items with extremely skewed distributions were dropped from the scale. Factor analysis revealed that a total of 10 items loaded onto two factors indicating engagement in comparison and feedback-seeking behaviors online. Other factors that emerged strongly were the use of technology for general communication with romantic partners, social support seeking, and discussions about sexual health topics (Widman, Nesi, Choukas-Bradley, & Prinstein, 2014). These items were ultimately included in the final 22-item scale, which was administered to subjects in the current study.

Factor Analysis was conducted on the 22-item MEIS, with all 10 items that referenced comparison and feedback-seeking behaviors loading onto a single factor. Examples of items

from this Comparison and Feedback Subscale (MEIS-CF) include, “I use electronic interaction to see what others think about how I look” and “I use electronic interaction to compare my life with other people’s lives” (see Appendix B for complete item list). The scale showed good internal consistency (Cronbach’s alpha .92). A mean score was computed for analyses, with higher scores indicating higher levels of engagement in online comparison and feedback-seeking behaviors.

Frequency of Technology Use. The Electronic Interaction Scale for Time (EIS_T) was developed to determine the average amount of time subjects spend using specific technologies on “a typical day.” Similar to the MEIS, this measure was developed over a three-step process. A focus group of recent high school students was asked to generate technology-based communication methods they believed to be popular among high school students. Five items were suggested: SNS “posts” or “messages,” text messages, instant messages, private messages on SNS, and Facebook logins. The first sample of 261 high school students was surveyed to determine how frequently they used these types of technology, with participants indicating estimates in an open-ended format. Subjects were asked to distinguish between technology use on weekend days versus weekdays, but given a lack of significant differences between these time periods, this distinction was dropped for the next data collection. Descriptive analyses were conducted on this pilot data to determine means, medians, and variability of each type of technology.

The second step of development of the EIS_T was conducted to gather further information about adolescents’ frequency of technology use on a daily basis, and administered to a second wave of 168 students. Using descriptive statistics from the previous pilot results, response options were created to encompass the normal range of frequency of use within a

categorical measure. Categories ranged from “I don't use this” to “5 or more hours.” Subjects were also asked about in-person communication behavior as a point of comparison. A second focus group was conducted among recent high school graduates to generate a list of popular SNS among adolescents today. Thus, in this step of development, the EIS_T contained 10 items, assessing daily time spent: talking to friends in person, talking to friends through voice communication (phone, Skype, Facetime), using a cellphone (NOT including phone calls), on Facebook, Instagram, Twitter, Tumblr, Pinterest, online video games, and any other social technologies. Descriptive analyses were again conducted for this data, with cellphone use, Facebook, Instagram, and Twitter proving to be the most popular technologies.

The final EIS_T measure was refined to include only 5 items: in person communication, voice communication, non-voice cellphone use (i.e. for “texting, games, or Internet”), Facebook use, and Instagram use. The three technology items (e.g. cellphone, Facebook, and Instagram) were chosen based on the results of pilot testing, previous research on adolescent media use (Purcell, 2012), and theoretical relevance to the current study. As in pilot data, subjects indicated the amount of time that they spent each day using these technologies. Subjects indicated frequencies using a 7-point scale (0 for “I don't use this,” 1 for “Less than 1 hour,” 6 for “5 or more hours,”). See Appendix B for full item list. Subjects who answered “0” on all three items were excluded from analyses ($n=53$). A mean of the three items was then computed, with higher scores indicating higher frequencies of technology use. Self-report measures have been widely used in previous studies assessing frequency of technology use.

Data Analytic Plan

Descriptive Statistics. Descriptive statistics were conducted to examine means and standard deviations on all study variables (i.e. depressive symptoms, excessive reassurance-

seeking, frequency of technology use, online comparison and feedback-seeking). Correlational analyses were conducted between all study variables.

Hypothesis Testing. All hypotheses were examined using path analysis estimated within a structural equation modeling (SEM) framework. Multiple group analysis by gender was used to determine whether effects differed between males and females. Specifically, a model was first fit with all pathways free to vary across gender. Parameter estimates were then systematically constrained to equality across groups, with Likelihood Ratio Tests conducted to determine change in model fit. If model fit did not significantly change with the addition of an equality constraint, this constraint was retained for parsimony. See Figure 2 for final model.

Bias-corrected bootstrapping was used to estimate models, as recommended by MacKinnon, Lockwood, and Williams (2004). Bootstrapping is a non-parametric strategy that allows for computation of estimates from resampled data set, without requiring assumptions about the shape of the sampling distribution. This allows for more accurate estimates in the presence of known skewed variables such as depressive symptoms. Additionally, bootstrapping allows for accurate testing of indirect effects, which require the use of the estimate of a product of path coefficients—a term that is usually not normally distributed (Springer & Thompson, 1966). Confidence intervals of all bootstrapped values for indirect and direct effects were created. If these confidence intervals did not contain 0, effects were considered significant. Bias corrections were applied to the confidence intervals of bootstrapped values, as these corrections have been shown to improve their accuracy (MacKinnon, Lockwood, & Williams, 2004).

In order to examine the hypothesis that comparison and feedback-seeking behavior mediates the relationship between frequency of technology use and depressive symptoms, pathways were constructed from technology use frequency to comparison and feedback-seeking,

as well as from comparison and feedback-seeking to depressive symptoms. A direct pathway also was included from technology use frequency to depressive symptoms. Bias-corrected bootstrapped confidence intervals were created to test the significance of direct, indirect, and total effects.

In order to examine the hypothesis that ERS moderates the indirect effect of technology use frequency on depressive symptoms through comparison and feedback-seeking, an interaction term was created between technology use frequency and ERS. This allowed for the testing of a conditional indirect effect through the moderation of the pathway from technology use frequency to comparison and feedback-seeking behavior. This type of effect is commonly termed “moderation mediation,” or a mediation effect that varies in strength based on the value of a moderator. Pathways from the interaction term, ERS, and technology use frequency to depressive symptoms were constructed. Additionally, these three variables were allowed to covary in the model, following established guidelines for testing moderated mediation in path analysis (Preacher, Rucker, & Hayes, 2007). Confidence intervals were used to determine the significance of the pathway from the interaction term to comparison and feedback-seeking, and thus the moderation of this pathway.

In order to examine the hypothesis that popularity moderates the pathway from comparison and feedback-seeking to depressive symptoms, an interaction term was created between comparison and feedback-seeking and popularity. This allowed for the testing of a second moderated mediation effect in the model. Pathways to depressive symptoms were constructed from this interaction term, as well as from comparison and feedback-seeking and popularity. Again, these three variables were allowed to covary in the model, and confidence intervals were used to determine the significance of the moderation.

If moderation by ERS or popularity was determined to be significant, interactions were then probed by constructing confidence intervals of the bootstrapped values for the indirect effect at five values of the moderators: the mean, and one and two standard deviations above and below the mean. Probing of interactions was conducted separately for each gender, using gender-specific values for means and standard deviations.

An identical measure of depressive symptoms, gathered one year prior to the current data collection (“baseline”) was added to the model as a predictor of current depressive symptoms. This allowed for the testing of indirect, moderated, and direct pathways to current depressive symptoms over and above the effects of prior depressive symptoms. Multiple group analyses by gender were used to determine whether gender moderated any of the pathways, indirect effects, or moderated effects (a three-way interaction) in the model (see Figure 2).

All models were fit and hypotheses tested using MPlus 7.0, with data management and descriptive analyses conducted in SPSS 22.0. Effect sizes were estimated for all indirect, direct, and moderated effects. Although power analysis is not available for this type of analytic approach, the final model’s large sample size ($n = 632$) should be sufficient to detect moderation and mediation effects.

RESULTS

Descriptive Statistics. Two outliers were identified in the data, with values more than four standard deviations below the mean for popularity. These outliers were removed for further analyses, reducing the total sample number to $n = 647$. A separate analysis was conducted with outliers' popularity set to equal the next closest values (approximately 3.25 standard deviations below the mean). The pattern of results was consistent in both treatments of outliers; thus, results for the analysis in which outliers were deleted are reported here. Descriptive statistics were conducted to examine the means and standard deviations of all study variables (i.e. depressive symptoms, excessive reassurance-seeking, frequency of technology use, online comparison and feedback-seeking, and popularity), both in the full sample and within each gender. Independent sample T-tests were used to compare means on study variables by gender (see Table 1). Interestingly, females reported higher average values of most study variables, including depressive symptoms, frequencies of technology use, excessive reassurance seeking, and online comparison and feedback-seeking behavior. No gender differences were found in levels of popularity.

Pearson correlations were conducted to examine bivariate associations among all study variables (see Table 2). Significant positive associations were found between frequency of technology use, online comparison and feedback-seeking behavior, offline excessive reassurance-seeking, and depressive symptoms. Popularity was positively associated with frequency of technology use and online comparison and feedback-seeking; however, it was negatively associated with depressive symptoms. Interesting, while depressive symptoms were

positively correlated with concurrent technology use frequency, baseline depressive symptoms were *not* associated with current technology use frequency.

Hypothesis Testing

As a preliminary test, a multiple regression was conducted using robust maximum likelihood estimation to predict depression from concurrent frequency of technology use, controlling for depressive symptoms at baseline. Results indicated that technology use frequency was associated with depression, over and above the effects of baseline depression, $\beta = 0.026$, $z = 2.50$, $SE = 0.010$, $p = 0.013$.

Hypotheses were then tested, with all confidence intervals constructed using bias-corrected bootstrapping techniques with 5000 iterations. Indirect, total effects, and confidence intervals are reported in raw scale.

To test the hypothesis that ERS moderates the pathway from technology use frequency to comparison and feedback-seeking, an initial model was fit with the inclusion of the interaction term of ERS by frequency of technology use. The pathway from this interaction term to comparison and feedback-seeking was not significant in the full sample, 95% CI [-0.062, 0.074]. In the multiple group model, it was not significant for females, 95% CI [-0.062, 0.076], or males, 95% CI [-0.083, 0.098]. Thus, moderation by ERS was not supported, and this interaction term was removed from the model. However, given known associations between ERS and depressive symptoms, and hypothesized associations between ERS and online comparison and feedback-seeking behaviors, direct pathways from ERS to these two variables were kept in the model. With the interaction term removed, initial model fit was good, $\chi^2(7) = 25.156$, $p = .0007$; CFI = 0.971; TLI = 0.955; RMSEA = 0.064, 95% CI [0.038, 0.092]; SRMR = 0.041.

A multiple group analysis by gender was first conducted with all parameters free to vary across gender. Model fit was adequate, $\chi^2(14) = 34.915, p = .0015$; CFI = 0.963; TLI = 0.943; RMSEA = 0.069, 95% CI [0.040, 0.098]; SRMR = 0.049. Parameter constraints were then added systematically, with likelihood ratio tests conducted, to determine the change in model fit. First, paths from exogenous variables to comparison and feedback-seeking were tested for moderation by gender. The path from technology use frequency to comparison and feedback-seeking was constrained to equality across groups, and a chi-square difference test comparing this model to the more restrictive model revealed no significant differences in fit, $\chi^2(1) = .077, p = .781$; thus, this constraint was retained for parsimony. Next, the path from ERS to comparison and feedback-seeking was constrained to equality across groups; this did not change model fit significantly, $\chi^2(1) = .285, p = .593$, and thus this constraint also was retained for parsimony.

Next, covariances were tested for equality across gender. Constraining the covariance of popularity with comparison and feedback-seeking did not change model fit, $\chi^2(1) = .209, p = .648$, and this constraint was retained. Constraining the covariance of popularity with the interaction term of comparison and feedback-seeking by popularity did significantly worsen model fit, $\chi^2(1) = 5.94, p = .015$, and thus this parameter was left to vary freely. Constraining the covariance of the interaction term with comparison and feedback-seeking also significantly worsened model fit, $\chi^2(1) = 15.674, p < .001$, and thus this covariance was also left to vary freely across groups.

Finally, all pathways to depressive symptoms were tested for moderation by gender. Constraining to equality the path from comparison and feedback-seeking to depressive symptoms significantly worsened model fit, $\chi^2(1) = 6.938, p = .008$, indicating moderation of this pathway by gender. This path was thus left to vary freely across group. Constraining the

path from popularity to depressive symptoms did not change model fit significantly, $\chi^2(1) = .551, p = .458$, nor did constraining the path from the interaction term to depressive symptoms, $\chi^2(1) = .482, p = .488$, and thus these constraints were retained for parsimony. Constraining the path from frequency of technology use to depressive symptoms also did not significantly worsen model fit, $\chi^2(1) = 3.067, p = .080$, nor did constraining the path from ERS to depressive symptoms, $\chi^2(1) = 1.114, p = .291$, so these constraints were retained. However, constraining the path from prior to current depressive symptoms *did* significantly worsen model fit, $\chi^2(1) = 4.109, p = .043$, and thus this pathway was left to freely vary across gender.

Thus, in the best fitting model, all pathways and co-variances were constrained to equality across gender with the exceptions of the path from baseline depressive symptoms to current depressive symptoms, the path from the comparison and feedback-seeking to depressive symptoms, and the covariances of the interaction term with comparison and feedback-seeking and popularity (see Figure 2). All means and variances were left to vary freely across groups. Final model fit was adequate, $\chi^2(21) = 40.700, p = .0061$; CFI = 0.966; TLI = 0.964; RMSEA = 0.054, 95% CI [0.029, 0.079]; SRMR = 0.051.

In order to examine the hypotheses, indirect, direct, and moderated indirect effects were then examined for each gender. Among females, the indirect effect of technology use frequency on depressive symptoms, mediated by online comparison and feedback-seeking, was significant in this model, 95% CI [0.004, 0.022], indicating mediation of this pathway and support for the first hypothesis. The direct effect of technology use frequency was not significant, 95% CI [-0.020, 0.017], nor was the total effect, 95% CI [-0.010, 0.030]. Among males, the indirect effect, 95% [-0.001, 0.012], direct effect, 95% CI [-0.020, 0.017], and total effect [-0.016, 0.021] were non-significant. This indicates that the mediation effect is only significant for females.

For both genders, the path from frequency of technology use to comparison and feedback-seeking was significant and positive, 95% CI [0.060, 0.136], as was the path from ERS to comparison and feedback-seeking 95% CI [0.453, 0.653]. As expected, the path from ERS to depressive symptoms was significant, 95% CI [0.091, 0.228], as was the path from baseline depressive symptoms to current depressive symptoms was significant, for girls, 95% CI [0.387, 0.578], and boys, 95% CI [0.226, 0.502]. The pathways from popularity to depressive symptoms and technology use frequency to depressive symptoms were not significant when included in the full model.

Interestingly, for females, the path from comparison and feedback-seeking to depressive symptoms was significant and positive, 95% CI [0.047, 0.188]. For males, this pathway was non-significant, 95% CI [-0.016, 0.108]. In support of hypotheses, for both genders, this pathway was moderated by popularity, 95% CI [-0.087, -0.016]. This indicates a three-way interaction of popularity by gender by comparison and feedback-seeking, as well as moderation by popularity of the mediational pathway from technology use frequency to depressive symptoms via comparison and feedback-seeking.

The interaction of popularity by comparison and feedback-seeking was probed by constructing confidence intervals of the indirect effect at five values of popularity: the mean, and one and two standard deviations below and above the mean for each gender. For females, the indirect effect was significant at all values of the moderator except two standard deviations above the mean, with the size of the indirect effect decreasing as popularity level increased. Further probing indicates that the indirect effect was non-significant for only females ranking in the highest 10 percent of their peers on social status. For males, the indirect effect was significant only at two and one standard deviations below the mean, again with the size of the

indirect effect decreasing as popularity level increased. See Table 3 for confidence intervals.

Thus, comparison and feedback-seeking, as the result of higher levels of technology use, may be associated with depressive symptoms for almost *all* females, but especially so for girls with lower levels of popularity. For males, the effect of online comparison and feedback-seeking on depressive symptoms may *only* be significant for boys with lower levels of popularity.

DISCUSSION

The prevalence of depression increases drastically during adolescence, and interpersonal theories suggest that this increase may be explained partially by the changing complexity and function of social relationships during this time period. In recent years, the widespread adoption of social technologies, including text messaging, cell phone use, and SNS, has fundamentally transformed the adolescent social landscape, yet findings are mixed in regard to the psychological outcomes of increased technology use. Little is known regarding the role of technology-based interactions in shaping depressive outcomes and researchers have called for a more nuanced understanding of these processes (Davila et al., 2012; Valkenburg & Peter, 2013). The current study addressed this gap in the literature by outlining a model of technology use and depressive symptoms that integrates pre-existing offline individual characteristics and specific online behaviors. Findings have the potential to inform interpersonal models of adolescent depression that better account for modern adolescents' social environments.

Although preliminary findings suggested an association between frequent technology use and depressive symptoms, results confirm that this pattern is far more complex than has been discussed in prior literature. An array of mediators and moderators emerged as factors in determining the outcomes associated with a particular adolescent's technology use, in support of burgeoning understandings of media effects outcomes as conditional on the specific individuals engaging with that media (Valkenburg & Peter, 2013). Certain technology-based behaviors and offline individual characteristics emerged as factors that may put adolescents at greater risk for depressive symptoms in association with frequent technology use. In particular, individuals who

engage in higher levels of technology-based social comparison and feedback-seeking behavior, as well as females and individuals of lower social status, may be particularly at risk. Each of these risk factors will be discussed in turn.

Technology-Based Social Comparison and Feedback-Seeking

In support of hypotheses, engagement in technology-based social comparison and feedback-seeking behaviors was found to mediate the relationship between frequent technology use and depressive symptoms for both unpopular boys and the majority of girls. These findings are important in that they identify specific technology-based behaviors that may put certain adolescents at risk for the onset or maintenance of depressive symptoms. Furthermore, they emphasize the necessity of moving beyond simple correlational studies of technology use outcomes. Indeed, for girls and unpopular boys, engagement in higher levels of technology use may act as a risk factor for depressive symptoms only *insofar* as this engagement leads to higher levels of online social comparison and feedback-seeking.

The hyperpersonal model of computer-mediated communication (CMC; Walther et al., 2011) may provide one explanation as to why high frequencies of technology use may engender these technology-based behaviors, and thus, depressive symptoms. According to the hyperpersonal model, certain components of technology-based interaction serve to intensify the process of identity construction through increased feedback and decision-making. Such components include *selective self-presentation*, or the potential for more deliberate portrayals of the self in an online context, and *idealization*, or positive assumptions about others for whom limited online information is available. Vulnerability to these components may be heightened by the fact that young people spend the majority of their time on SNS looking at other people's profiles and photos, rather than posting or updating their own profiles (Pempek, Yermolayeva, &

Calvert, 2009). Given that identity development is a stage-salient task characteristic of adolescence, and that comparison and feedback-seeking are essential to this process, it is not surprising that a forum that serves to intensify this process may be associated with higher levels of these behaviors.

Further research suggests that technology use, and these technology-based behaviors, may contribute to depressive symptoms by decreasing adolescents' feelings of self-worth in comparison to others. Chou and Edge (2012) suggest that frequent users of technology employ certain heuristics that lead them to believe that "life is not fair" and "others are happier and living better lives." For example, according to the *availability heuristic* (Tversky & Kahneman, 1976), young people who frequently engage with technology may more easily recall information encountered online when forming impressions of others. The tendency for selective self-presentation online may increase the probability that adolescents encounter, and thus recall, distorted positive perceptions of their peers' lives. In forming impressions of individuals that they do not know well offline, *correspondence bias* (Jones & Harris, 1967) may lead adolescents to assume that others' photos and text reflect stable personality traits, rather than situational factors.

Given these biases, adolescents who engage in higher levels of technology use, and thus more online comparison and feedback-seeking, may form distorted perceptions of their peers. These distorted perceptions may lead adolescents to engage in harmful upward comparisons, or to doubt the sincerity of positive feedback that is sought online, leading to decreases in self-esteem and increases in depressive symptoms (Haferkamp & Kramer, 2011; Feinstein et al, 2013). Importantly, theories on the relationship between online behaviors and negative outcomes are speculative and suggest the need for further research to examine technology-based

comparison and feedback-seeking, as well as other online behaviors, as potential risk factors for depressive symptoms.

Notably, contrary to hypotheses, adolescents' engagement in ERS did not moderate this mediational relationship between frequent technology use and depressive symptoms. Specifically, adolescents with high levels of both offline ERS and technology use were *not* more likely to engage in online comparison and feedback-seeking. Evidence suggests that, although associated with one another, online comparison and feedback-seeking and offline ERS may represent distinct processes. It may be that, among modern adolescents, online comparison and feedback-seeking is a relatively normative behavior, whereas offline ERS has been well-established as a depressogenic-interpersonal vulnerability (Hames, Hagan, & Joiner, 2013). Given the current study's findings, however, this "normative" behavior may, in fact, have negative consequences for some teenagers. Future research should explore other potential moderators of the association between technology use and engagement in online comparison and feedback-seeking, beyond ERS and gender, in order to determine which, if any, adolescents may be at the highest risk of engaging in these potentially harmful online behaviors. Potential moderators to be explored include self-esteem, attitudes about media use, and content of technology-based communications.

Individual Vulnerabilities

Media-effects theories, such as the communication mediation model, suggest that the effects of media on consumers depend on the way that these media are processed (Valkenburg & Peter, 2013). The finding that both gender and social status moderate the association between online comparison and feedback-seeking and depressive symptoms is consistent with this viewpoint. Results suggest that for both genders, technology-based comparison and feedback-

seeking is more strongly associated with depressive symptoms in adolescents low in peer-reported popularity. It is likely that information about peers and the self gathered through comparison and feedback-seeking is processed differently among individuals of varying social status and gender. Although preliminary, these findings may have important implications for identifying adolescents who might be at greatest risk for experiencing negative outcomes as a result of these online behaviors.

Social Status. The finding that lower status individuals experience higher levels of depressive symptoms as a result of their online behaviors is in line with the Social Enhancement or “rich-get-richer” hypothesis. This states that individuals with larger social networks, who are higher in extraversion and self-esteem, may benefit more from the use of online social networks; less sociable and introverted individuals may experience more negative outcomes (Spies Shapiro & Margolin, 2013). Of course, the question remains *why* lower status individuals experience these negative outcomes as a result of online feedback-seeking and comparison. Given that this is a new research area for which few empirical explanations are available, several speculative theories are offered to explain these findings.

First, in terms of feedback-seeking, prior research suggests that lower status and low self-esteem individuals receive less positive feedback on their social networking profiles (Mikami, Szwedo, Allen, Evans, & Haire, 2010), post more inappropriate photos (Szwedo, Mikami, & Allen, 2012), and post “updates” that are higher in negativity and lower in positivity (Forest & Wood, 2012). While positive feedback on SNS has been found to enhance adolescents’ self-esteem, negative feedback has been found to decrease self-esteem (Valkenburg, Peter, & Schouten, 2006). Thus, it may be that unpopular adolescents are not only more likely to post or send negative content, but also to *receive* negative feedback. In seeking out feedback from

peers, unpopular adolescents may actually be garnering self-relevant information that is harmful to their self-esteem and related to increases in depressive symptoms.

Decreases in unpopular adolescents' self-esteem may also be due to smaller online network size. Given substantial overlap between online and offline networks, it is likely that adolescents who are unpopular offline have fewer "online" friends (Reich, Subrahmanyam, & Espinoza, 2012). Manago, Taylor, and Greenfield (2012) posit that larger online networks and perceived audiences predict life satisfaction and perceived social support. It may be that, when seeking feedback online, lower status adolescents perceive smaller audience sizes for their posted content, resulting in feelings of decreased peer support and overall life satisfaction.

Online social comparison processes also may play out differently for adolescents of different social statuses. General social comparison theories suggest that negative comparisons are particularly harmful when they occur in domains that are most relevant, salient, or important to the individual (Thwaites & Dagnan, 2004). Given that increasing social capital and fulfilling social-grooming needs have been identified as primary motivations for using SNS (Steinfeld, Ellison, & Lampe, 2008; Wilson, Gosling, & Graham, 2012), it is likely that an adolescent's status in the offline social hierarchy is particularly salient when comparing the self to others online. For low status individuals, this may be especially troubling, leading to negative comparisons with more popular peers that influence depressive symptoms (Allen & Gilbert, 1995). It is also possible that lower status adolescents may engage in more "upward comparisons," or comparisons with others perceived to be better off than the self. Engaging in comparison via social media, unpopular adolescents may view others as more attractive, extraverted, or sociable (Zywica & Danowski, 2008). They may experience greater "contrast effects," or larger discrepancies between qualities of the perceived and desired self (Haferkamp

& Kramer, 2011). On the other hand, if popular adolescents have higher levels of self-esteem, they may not only simply engage in greater numbers of *downward* comparisons, but also experience a “buffer” from negative affect that often results from upward comparisons (Haferkamp & Kramer, 2011).

Gender. Girls may be particularly at risk for the depressive effects of technology-based social comparison and feedback-seeking. Findings suggest that, among males, the association between these behaviors and depressive symptoms may occur only for unpopular boys. The *majority* of adolescent girls, however, may experience depressive symptoms in relation to these behaviors, with the association simply stronger for those of lower social status. These findings are consistent with some prior work on gender differences in both offline and online behaviors.

The link between offline reassurance-seeking behaviors and depressive symptoms may be particularly strong among adolescent girls (Starr & Davila, 2008), and given known situational continuities between online and offline contexts, this effect is likely to occur online, as well (Mikami, Szewedo, Allen, Evans, & Hare, 2010). Further, social comparison is not only more common among females in general, but girls are more likely to prioritize and compare themselves on dimensions of physical attractiveness online (Haferkamp & Kramer, 2011; Jones, 2001). Given the emphasis on photo sharing in today’s popular social networking tools (i.e. Facebook, Instagram), as well as the increased likelihood that girls will post photos compared to boys, it may be that online, girls are drawn to comparisons that are more self-relevant, and thus more threatening to self-worth (Sefanoe, Lackaff, & Rosen, 2011).

Furthermore, established interpersonal theories of depression show that girls are more likely than boys to become depressed following interpersonal stressors (Rudolph, 2002); thus, insofar as online comparison and feedback-seeking present a source of interpersonal stress for

girls, these behaviors are likely to be associated with depressive symptoms. It is important to note that given limited research in the field of social media and psychopathology, however, proposed theories on the moderating influences of gender are speculative; more research is needed to clarify and expand upon this potential moderator.

Limitations and Conclusions

This study provides a critical initial exploration of the role of various offline and online influences in the relationship between frequent technology use and depressive symptoms among adolescents and provides a much-needed contribution to the literature on the psychosocial outcomes of technology use. However, future research should address these preliminary findings within a prospective longitudinal framework. Although statistical controls in the model allowed for examination of effects “over and above” those of prior depressive symptoms, further work is needed to rigorously assess temporal relationships between study variables, perhaps testing for the presence of “transactional effects” between depressive symptoms and technology-based behaviors (Valkenburg & Peter, 2013). Another limitation of this study is its reliance on self-report measures, which are subject to recall and other biases. Adolescents’ reports of technology use frequency in the study are consistent with nationally representative statistics of over 2,000 students, collected by the Kasier Family Foundation (Rideout, Foehr, & Roberts, 2010). However, future research should incorporate naturalistic methods, including observational coding of adolescents’ media output, to determine the accuracy of reports on other variables. Similarly, given the lack of established measures regarding technology-based behaviors, future research should aim to develop and validate assessments of adolescents’ engagement with social technologies. A final limitation of the current study was the inability to assess ethnic differences in outcomes. Although the study’s large and diverse sample provided the opportunity to

examine effects across different ethnicities, cell sizes proved too small to examine potential interaction effects.

In summary, the current study provides novel preliminary evidence that social status, gender, and technology-based social comparison and feedback-seeking behaviors may play a role in the relationship between technology use and depressive symptoms among adolescents. Among most girls and low status boys, online social comparison and feedback-seeking helped to explain the relationship between frequent technology use and depressive symptoms, controlling for prior depressive symptoms and offline ERS. Adolescents' social environments are increasingly dependent on the existence of social technologies, including cell phones, text messaging, and SNS. The current findings highlight the importance of understanding how these modern social environments may intersect with existing interpersonal models of psychopathology.

APPENDIX A: TABLES AND FIGURES

Table 1. Means (and Standard Deviations) of Study Variables, with Gender Comparisons

	Full Sample	Girls	Boys	<i>t</i> (df)
Freq. of Technology Use	2.81 (1.58)	3.23 (1.55)	2.24 (1.43)	8.26(645)*
Online Comparison and Feedback-Seeking	1.74 (.78)	1.83 (.82)	1.63 (.70)	3.21(631)*
Depressive Symptoms	.48 (.51)	.62 (.56)	.29 (.35)	8.76(645)*
Excessive Reassurance Seeking	1.50 (.65)	1.60 (.73)	1.36 (.51)	4.68(645)*
Baseline Depressive Symptoms	.47 (.49)	.58 (.53)	.33 (.38)	6.60(630)*
Popularity	.07 (.99)	.10 (.92)	.02 (1.07)	1.03(645)

* $p < .001$

Table 2. Bivariate Associations Among Study Variables

	1	2	3	4	5	6
1. Freq. of Technology Use	--					
2. Online Comparison & Feedback-Seeking	.28***	--				
3. Depressive Symptoms	.11**	.34***	--			
4. Excessive Reassurance Seeking	.15***	.50***	.47***	--		
5. Baseline Depressive Symptoms	.05	.23***	.60***	.38***	--	
6. Popularity	.11**	.16***	-.11**	-.07	-.11**	--

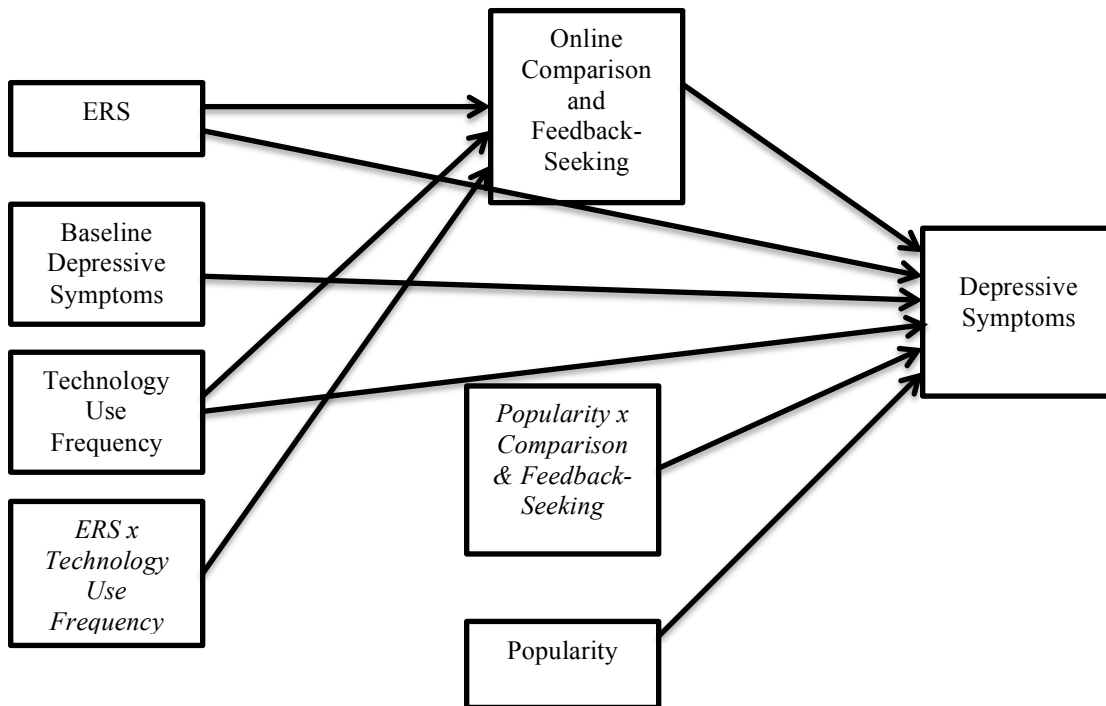
* $p < .05$ ** $p < .01$ *** $p < .001$

Table 3. Indirect Effects of Technology Use Frequency on Depressive Symptoms via Comparison and Feedback-Seeking at Various Levels of Popularity Moderator

	Girls	Boys
Popularity Mean (Standard Deviation)	0.0996 (0.916)	0.0190 (1.071)
Indirect Effects at Popularity Values (95% CIs):		
-2 SD	[0.008, 0.036]*	[0.004, 0.030]*
-1 SD	[0.007, 0.028]*	[0.002, 0.021]*
Mean	[0.004, 0.021]*	[-0.001, 0.012]
+1 SD	[0.001, 0.015]*	[-0.006, 0.005]
+2 SD	[-0.005, 0.011]	[-0.014, 0.002]

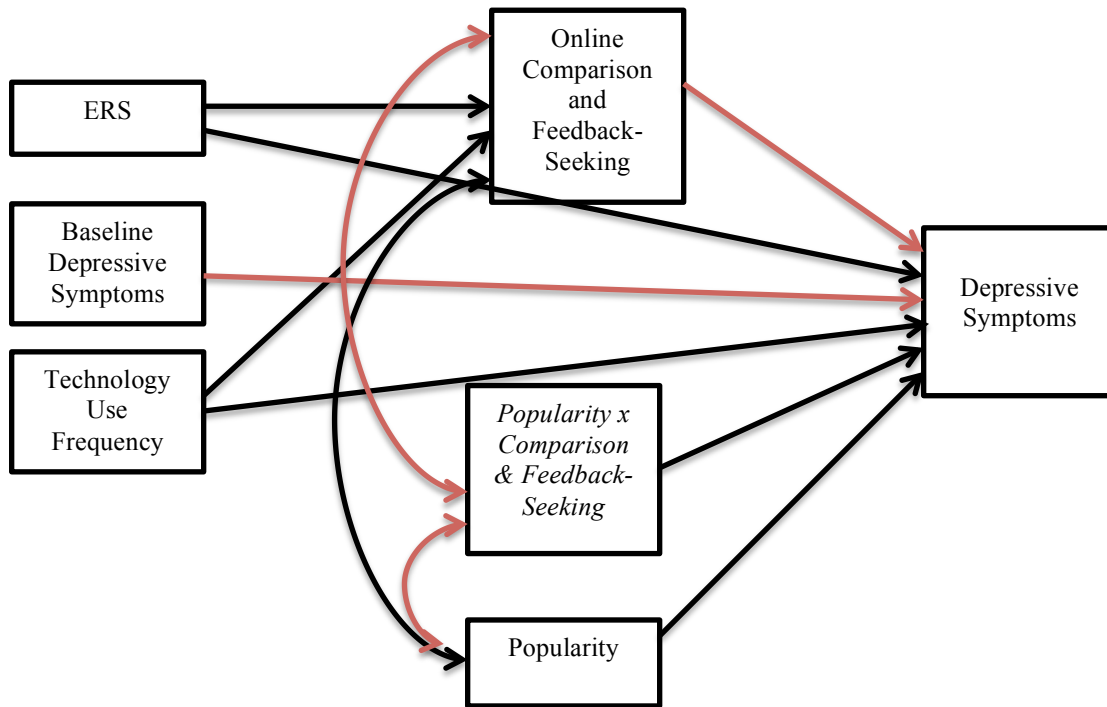
Note: Confidence Intervals that do not contain 0 are considered significant.

Figure 1. Hypothesized Model.



Note: Covariances not included for clarity of figure. Interaction terms are italicized.

Figure 2. Final Model.



Note: Paths in black are constrained to equality across gender. Paths in red are moderated by gender.

APPENDIX B: MEASURES

Revised Excessive Reassurance-Seeking Scale

1 = Not at all true 2 = A little bit true 3 = Somewhat true 4 = Very true 5 = Extremely true

How true are each of these for you?

1. I often ask people if they like me.
2. I often ask people if other people like me.
3. I often ask people if I look attractive.
4. I often ask people if they think my clothes look okay.
5. I often ask people if my weight or body shape is okay.
6. I often ask people what other people say about me.
7. I often ask people why other people do not like me.
8. I often ask people if they care about me.
9. People often tell me to stop asking how much they like me.
10. People often get mad at me for asking whether they like me.

Electronic Interaction Scale for Time (EIS_T)

Frequency of Technology Use items in **bold**

0 = I don't use this 1 = Less than one hour 2 = One hour 3 = Two hours
4 = Three hours 5 = Four hours 6 = Five or more hours

On a typical day, how much TIME do you spend...

1. ...talking to friends IN PERSON (i.e. face to face)? Only include time you are talking for fun or social reasons, NOT just time you are sitting together in class.
2. ...Talking to friends through phone calls, Facetime, and Skype (NOT including texting)?
3. **...using your cellphone for texting, games, or Internet (NOT including phone calls)?**
4. **...on Facebook?**
5. **...on Instagram?**

Motivations for Electronic Interaction Scale (MEIS)

Comparison and Feedback-Seeking Subscale (MEIS-CF) in **bold**

1 = Not at all true 2 = A little bit true 3 = Somewhat true 4 = Very true 5 = Extremely true

I use Electronic Interaction (texts, Facebook, etc.)...

1. **...to check out the way others look.**
2. **...to compare the way I look with other people's looks.**
3. ...to try to get support when I am sad/upset.
4. **...to get feedback from others on the things I send/post.**
5. **...to see what others think about how I look.**
6. ...to feel less lonely.
7. **...to compare my body/shape with other people's bodies/shapes.**
8. **...to see what others think about the things I send/post.**
9. **...to see if others think I am cool, funny, or popular.**
10. ...to ask my dating partners how they are doing.
11. **...to see what others think about my photos**
12. ...to see what my dating partners are doing.
13. **...to see what the "popular" kids think about me.**
14. ...to let someone know I'm mad at them.
15. ...to try to feel better when I'm sad/upset
16. **...to compare my life with other people's lives.**
17. ...to make social plans with my dating partners
18. ...to talk to my dating partners about using condoms.
19. ...to talk to my dating partners about using birth control (like the pill).
20. ...to talk to my dating partners about sexually transmitted diseases (STDs).
21. ...to talk to my dating partners about my sexual limits (what I will/will not do).
22. ...to talk to my dating partners about risk of pregnancy.

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