Using Social Media for Social Comparison and Feedback-Seeking: Gender and Popularity Moderate Associations with Depressive Symptoms

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Abstract This study examined specific technology-based behaviors (social comparison and interpersonal feedback-seeking) that may interact with offline individual characteristics to predict concurrent depressive symptoms among adolescents. A total of 619 students (57 % female; mean age 14.6) completed self-report questionnaires at 2 time points. Adolescents reported on levels of depressive symptoms at baseline, and 1 year later on depressive symptoms, frequency of technology use (cell phones, Facebook, and Instagram), excessive reassurance-seeking, and technology-based social comparison and feedback-seeking. Adolescents also completed sociometric nominations of popularity. Consistent with hypotheses, technology-based social comparison and feedback-seeking were associated with depressive symptoms. Popularity and gender served as moderators of this effect, such that the association was particularly strong among females and adolescents low in popularity. Associations were found above and beyond the effects of overall frequency of technology use, offline excessive reassurance-seeking, and prior depressive symptoms. Findings highlight the utility of examining the psychological implications of adolescents' technology use within the framework of existing interpersonal models of adolescent depression and suggest the importance of more nuanced approaches to the study of adolescents' media use.

Interpersonal models of depression in adolescents emphasize the cyclical associations among social experiences, depressogenic interpersonal behaviors, and depressive symptoms (Hames et al. 2013). During the adolescent transition, changes in the social environment (e.g., more frequent, complex, and unsupervised peer contact) may complicate this process (Choukas-Bradley and Prinstein 2014), particularly as social relationships take on increased importance in shaping self-esteem, well being, and identity (Harter et al. 1996; Rudolph 2009). For example, as adolescents move toward developing cohesive self-identities, they typically engage in greater levels of social comparison and interpersonal feedback-seeking (Harter 2012). However, depressed or depression-prone individuals may engage in these social behaviors in maladaptive ways, such that they represent unique depressogenic-interpersonal behaviors (Hames et al. 2013).

Although much research has investigated the interactions among these social behaviors, depressive symptoms, and in-person peer interactions in this age group, relatively little is known regarding social experiences that occur through technological media, including Social Networking Sites (SNS, e.g., Facebook) and text messages. These media have had a revolutionizing impact on both the frequency and types of peer interaction afforded to today's teenagers. In fact, these media may facilitate certain technology-based behaviors, or behaviors that occur as a result of, or in conjunction with, technology use, such as technology-based social comparison and feedback-seeking (SCFS; Manago et al. 2008).

Thus, an investigation of associations between adolescents' interpersonal behaviors and depressive symptoms within this

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online social context remains critical. The current study will investigate technology-based SCFS as one important behavior that may be associated with depressive symptoms, while considering individual characteristics that may influence this association (i.e. gender and popularity). In examining these associations, it is important to understand the unique features of adolescents' online social worlds, mixed evidence for the association between technology use and psychological adjustment, the theoretical relevance of SCFS, and the potential influence of gender and popularity. Each of these factors will be discussed in turn.

Adolescents' Online Social World

The ubiquity of technology in the interpersonal environments 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 and Fox 2009; Lenhart et al. 2010). The average young person now spends approximately 7 hours a day connected to electronic media (Rideout et al. 2010). At least 78 % of adolescents own a cell phone, with at least half of those being a smart phone (Madden et al. 2013b). 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 unique 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[1] 2007). These features create an online social world that is fundamentally different than its offline counterpart.

Additionally, these features allow adolescents to engage with these technologies in unique ways. The typical adolescent maintains a network of about 300 online friends (Madden et al. 2013a), meaning that behaviors on social networking sites are performed in the presence of an audience; every photo, comment, and new online friend provides details about the user to his or her public network (Manago et al. 2012). Thus, adolescents use the features of SNS to both create and

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[1] danah boyd has chosen not to capitalize her name; more information about her decision can be found at danah.org.

consume online content, including profiles, photos, and posts. This allows adolescents to receive constant feedback from their peers and to engage in social comparison processes with them online (Manago et al. 2008).

Technology Use and Psychological Adjustment

A review of the current literature reveals extremely mixed findings regarding the reciprocal associations between frequent technology use and psychological adjustment among adolescents. Some studies have suggested that frequent use of technology may be associated with negative outcomes. For example, frequent use of social networking sites may be associated with depressive symptoms (van den Eijnden et al. 2008), short-term declines in subjective well-being (Kross et al. 2013), romantic jealousy (Muise et al. 2009), and the belief that others are happier and living better lives than one's self (Chou and Edge 2012). Other studies have indicated the opposite: that frequent technology use may be associated with positive adjustment, including increases in self-disclosure and friendship quality (Valkenburg and Peter 2009). A recent narrative review reflects these mixed results, indicating associations between online technologies and positive outcomes such as self-esteem, social support, and self-disclosure, as well as negative outcomes, such as social isolation, depression, and cyber-bullying (Best et al. 2014).

Importantly, a number of studies have found *no* association between frequency of technology use and general well being (Gross 2004), nor between frequency of technology use and depressive symptoms (Davila et al. 2012; Jelenchick et al. 2013), further highlighting the inconclusive nature of attempts to characterize overall associations between technology use and psychological outcomes. In fact, it may not be the quantity of social networking site usage that longitudinally influences depressive symptoms, but rather the positive or negative quality of peer interactions or behaviors that occur via these technologies (Davila et al. 2012). As such, researchers have suggested the need to examine specific technology-based behaviors, as well as individual, offline characteristics, that may help explain associations between psychological adjustment and frequent technology use (Bessière et al. 2008; Valkenburg and Peter 2013). An investigation of these two factors in relation to depressive symptoms is the focus of the current study.

In line with this approach, preliminary findings have implicated reciprocal associations between various offline characteristics, technology-based behaviors, and negative outcomes. For example, research suggests that individuals with lower self-esteem and poorer offline friendship quality are more likely to engage in maladaptive behaviors using technology, such as posting negative or inappropriate content and using the Internet primarily for content consumption, rather than direct communication with peers (Mikami et al. 2010; Selfhout et al. 2009). Maladaptive technology-based

behaviors, in turn, may be associated with negative online peer feedback, as well as increases in loneliness and depressive symptoms (Burke et al. 2010; Forest and Wood 2012; Selfhout et al. 2009), which may influence future technology use in a cyclical fashion.

Technology-Based Social Comparison and Feedback-Seeking

An important next step in the literature is to draw on existing interpersonal models of psychopathology to identify specific technology-based behaviors that may act as precursors to and correlates of depressive symptoms among adolescents. Interpersonal feedback-seeking and social comparison, which have often been conceptualized as depressogenic interpersonal behaviors (e.g., Borelli and Prinstein 2006), may actually be facilitated by modern technologies. These behaviors are important to adolescent identity construction processes, as adolescents seek to ascertain normative standards of behavior and engage in reflected appraisal (i.e. evaluation of the self based on perceived opinions of others; Harter et al. 1996). However, high levels of technology use may be associated with increased levels of these behaviors among some adolescents.

Modern technologies have transferred many social relations from the private to public sphere (Subrahmanyam and Greenfield 2008), creating an atmosphere of public commentary and performance online. As adolescents use selective self-presentation strategies to portray themselves online in an ideal manner (Chou and Edge 2012; Gonzales and Hancock 2011), self-focus is heightened, increasing feedback-seeking and social comparison (Manago et al. 2008), perhaps especially upward comparisons, or comparisons with those believed to be of higher status than the self. This may serve to intensify the issues of identity development and interpersonal connectedness, challenging adolescents to confront them with greater constancy and urgency (Uhls et al. 2011). Furthermore, preliminary findings suggest that negative social comparison on Facebook may be associated with lower life satisfaction (Krasnova et al. 2013), as well as increased rumination and depressive symptoms (Feinstein et al. 2013).

Technology Use and Individual Characteristics

In understanding the associations between technology-based SCFS and depressive symptoms, it is essential to consider pre-existing, offline characteristics that may affect these associations. For example, popularity and gender may play a role. Popular adolescents, who are higher in self-esteem (Babad 2001), may engage in fewer upward comparisons, experience less negative affect as a result of these comparisons, and receive more positive feedback from peers (Mikami et al. 2010). In terms of gender, females may be more likely to compare themselves on dimensions of physical attractiveness based on

online photos (Haferkamp and Krämer 2011), perhaps making such photos more self-relevant and threatening to self-worth (Stefanone et al. 2011). Furthermore, associations between reassurance-seeking behaviors and depressive symptoms may be particularly strong among adolescent girls, for whom rates of depression are higher in general (Starr and Davila 2008), and given known situational continuities between online and offline contexts (Mikami et al. 2010), this effect may occur online, as well. However, the possibility that gender and popularity differences may occur within online contexts has not yet been rigorously examined.

Study Hypotheses

First, it is hypothesized that higher levels of technology-based social comparison and feedback-seeking behaviors (SCFS) will be concurrently associated with higher levels of depressive symptoms, controlling for offline ERS, prior depressive symptoms, and overall frequencies of technology use (i.e., total use of cell phones, Facebook, and Instagram). Second, it is hypothesized that peer popularity will moderate this association, such that individuals low in popularity will show the strongest negative association between technology-based SCFS and depressive symptoms. Third, it is hypothesized that gender will also moderate this association, such that the effect will be stronger for females.

Methods

Participants

The current study included 619 participants. Students were eighth and ninth grade students in low to middle socio-economic status (SES) 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. All procedures discussed below were approved by the university human subjects committee.

Procedure

All students in seventh and eighth grade were recruited, except for those in self-contained special education classrooms, using parental consent and adolescent assent. A total of 868 students participated in the study's first wave (*baseline*). The current study was conducted 1 year later, when students were in eighth and ninth 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 students were excluded because they indicated that they did not use technology as defined in the study (use of cell phones, Facebook, or Instagram). The other 77 students did not complete any of the measures related to technology use, due to the placement of these questions at the end of the study protocol. Attrition analyses indicated that excluded students were, on average, more likely to be male, t (775)=3.13, p=0.002, and African American, χ^2(3)=24.77, p<0.001.

After preliminary analyses, 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. A separate analysis was conducted using a Winsorising approach, in which outliers' popularity were 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. In addition, 14 subjects did not provide information on baseline depressive symptoms and 14 subjects did not complete measures of technology-based SCFS. Thus, final model sample was n= 619. 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). For all variables except popularity and socioeconomic status, a mean score of items was computed, with higher scores indicating higher levels of that variable.

Socioeconomic Status Participants' socioeconomic status (SES) was computed by calculating median household income from US Census tract data (www.census.gov) for each student's home address. The mean SES for this sample was identical to the average household income for the town in which the data were collected, according to census data.

Depressive Symptoms The Short Mood and Feelings Questionnaire (SMFQ; Angold et al. 1995) was used to assess depressive symptoms, both at the current time point and 1 year prior (*baseline*). The SMFQ is a 13-item, unifactorial scale in which subjects endorse statements describing depressive moods and behaviors over the past 2 weeks on a 3-point scale (0 for *not true*, 1 for *sometimes true*, and 2 for *true*). The SMFQ has good psychometric properties (Sharp et al. 2006) and has been widely used to assess depressive symptoms in adolescent samples (e.g., Rothon et al.

2009). The current sample yielded good internal consistency (Cronbach's alpha 0.94).

Popularity Sociometric nomination procedures were used to measure peer-reported popularity (Coie et al. 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 whom they believed to be the most popular and the least popular (Prinstein and Cillessen 2003). The range of nominations that participants received was between zero and 60. The vast majority of participants received at least one nomination. Of the full sample, only 19 students did not receive any nominations. 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 within each school grade, 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 (Prinstein and Cillessen 2003). Sociometric nomination procedures are largely considered the most reliable and valid indices of adolescents' popularity among peers (Coie et al. 1983).

Technology-Based Social Comparison and Feedback-Seeking (Technology-Based SCFS) 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"). 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. In the second step, the scale was expanded to include 52 items, with more items added reflecting engagement in social comparison and feedback-seeking behaviors online. The measure was administered to 158 high school students. Factor analysis revealed a single 10-item factor indicating engagement in social comparison and feedback-seeking behaviors using technology, as well as other factors relating to the use of technology for general communication with romantic partners, social support seeking, and discussions about sexual health topics (Widman et al. 2014).

These items were ultimately included in the final 22-item scale, which was administered to subjects in the current study. Subjects endorsed the personal relevance of a number of behaviors on a 5-point scale (1 for *Not at all true* and 5 for *Extremely true*). Examples from the 10-item Social Comparison and Feedback Seeking Subscale (MEIS-SCFS) 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." The scale showed good internal consistency (Cronbach's alpha 0.92).

Excessive Reassurance-Seeking (ERS) 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). One critique of the original RSS is that it is very brief (four items), and that it lacks developmental sensitivity (Starr and 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.").

Similarly to the MEIS, these items were developed through the use of a focus group of recent high school graduates, followed by pilot testing with a sample of 158 high school students. 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*). The original RSS has been shown to have good psychometric properties (Joiner and 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 as a unifactorial scale in this sample (Cronbach's alpha 0.90).

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. Through the use of multiple focus groups and pilot testing among a total of 429 high school students, five communication items were chosen and response options were created to capture the full range of daily electronic interaction time. For the final EIS_T, subjects indicated the amount of time they spent each day engaged in in-person communication, voice communication, non-voice cellphone use (i.e., for "texting, games, or Internet"), Facebook use, and Instagram use. Frequencies were indicated on a 7-point scale (0 for *I don't use this*, 1 for *Less than 1 h*, 6 for *5 or more hours*). For the current study, an average of the final three items (non-voice cellphone use, Facebook use, and Instagram use) was used to indicate frequency of overall technology use. Self-report measures have been widely used in previous studies assessing frequency of technology use.

Results

Descriptive Statistics Descriptive statistics were conducted to examine the means and standard deviations of all study variables (see Table 2). Independent sample t-tests were used to compare means on study variables by gender. Interestingly, females reported higher average values of most study variables, including depressive symptoms, technology-based SCFS, frequencies of technology use, and excessive reassurance seeking. No gender differences were found in levels of popularity.

Further, participants who reported using technology as defined in the study were compared to those who indicated that they did not use technology ($n=53$) on key demographic variables. No differences emerged between users and non-users of technology in terms of SES or ethnicity. However, the 53 students who indicated that they did not use technology were more likely to be male, $t(698)=3.83$, $p<0.001$; lower in depressive symptoms, $t(698)=-2.86$, $p=0.004$; lower in ERS, $t(698)=-3.51$, $p<0.001$; and lower in peer-reported popularity $t(698)=-4.60$, $p<0.001$.

Pearson correlations were conducted to examine bivariate associations among all study variables (see Table 1). Significant positive associations were found between frequency of technology use, technology-based SCFS, and offline excessive reassurance-seeking. Popularity was positively associated with frequency of technology use and technology-based SCFS; however, it was negatively associated with depressive symptoms. Pearson correlations were also conducted to examine associations between study variables and socioeconomic status (SES). Individuals lower in SES reported higher frequencies of technology use and lower levels of popularity (see Table 1). Interestingly, although depressive symptoms were positively correlated with concurrent technology use frequency, this association was no longer significant after accounting for other variables in the full regression model, as discussed below.

Analyses were also conducted to determine whether means and standard deviations of study variables differed by ethnicity (see Table 2). Results indicated that levels of ERS were significantly lower among Latino/Hispanic participants versus Caucasian and African American participants; levels of

Table 1 Bivariate Associations Between Study Variables, Full Sample and by Gender

	Full sample							By gender						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1. Frequency of technology use	–							–	**0.25*****	**0.09**	**0.13***	**0.03**	**0.09**	**−0.10**
2. Technology-based SCFS	0.28***	–						0.24***	–	**0.22*****	**0.38*****	**0.16***	**0.15***	**−0.11**
3. Depressive symptoms	0.11**	0.34***	–					−0.02	0.35***	–	**0.44*****	**0.50*****	**−0.16***	**−0.04**
4. Excessive reassurance seeking	0.15***	0.50***	0.47***	–				0.09	0.54***	0.44***	–	**0.28*****	**−0.08**	**−0.06**
5. Baseline depressive symptoms	0.06	0.23***	0.60***	0.38***	–			−0.06	0.22***	0.57***	0.38***	–	**−0.19****	**−0.01**
6. Popularity	0.12**	0.17***	−0.11**	−0.06	−0.11**	–		0.14**	0.18**	−0.12*	−0.07	−0.09	–	**0.24*****
7. Socio-economic status	−0.13***	0.01	−0.07	−0.02	−0.09*	0.17***	–	−0.12*	−0.05	−0.05	0.02	−0.11*	0.11*	–

For associations by gender, males reported above the diagonal in **bold**, females reported below the diagonal

*$p<0.05$ **$p<0.01$ ***$p<0.001$

Table 2 Means (and Standard Deviations) of Study Variables, with Gender and Race/Ethnicity Comparisons

	Full sample	Girls	Boys	t(df)	American African	Caucasian	Latino/Hispanic	F(df)
Frequency of technology use	2.80 (1.57)	3.23 (1.54)	2.21 (1.43)	8.39 (617)**	3.42 (1.76)[a]	2.50 (1.38)[b]	2.81 (1.57)[c]	11.15 (615)**
Technology-based SCFS	1.73 (0.77)	1.82 (0.82)	1.61 (0.68)	3.47 (617)**	1.87 (0.81)[a]	1.72 (0.75)[a]	1.56 (0.63)[b]	5.51 (615)**
Depressive symptoms	0.48 (0.51)	0.62 (0.56)	0.28 (0.35)	8.83 (617)**	0.49 (0.51)	0.44 (0.49)	0.52 (0.51)	1.32 (615)
Excessive reassurance seeking	1.50 (0.66)	1.60 (0.73)	1.36 (0.50)	4.68 (617)**	1.55 (0.66)[a]	1.55 (0.67)[a]	1.35 (0.53)[b]	3.95 (615)*
Baseline depressive symptoms	0.47 (0.49)	0.58 (0.53)	0.33 (0.38)	6.53 (617)**	0.52 (0.52)	0.44 (0.48)	0.46 (0.43)	1.58 (615)
Popularity	0.07 (1.00)	0.11 (0.92)	0.03 (1.09)	0.992 (617)	0.07 (0.85)	0.08 (1.19)	0.005 (0.66)	0.833 (615)

Row means that do not share superscripts are significantly different

*$p<0.01$ **$p<0.001$

technology-based SCFS were significantly higher among African American participants versus Latino/Hispanic participants; and frequency of technology use was significantly higher among African American participants versus Latino/Hispanic and Caucasian participants. No differences were found in levels of depression between racial/ethnic groups.

Hypothesis Testing Hypotheses were tested within a hierarchical multiple linear regression framework using maximum likelihood estimation in SPSS 22.0. All continuous predictor variables were mean centered to reduce multicollinearity and to aid in ease of interpretation. Baseline depressive symptoms, excessive reassurance seeking, and overall frequency of technology use were entered as covariates in an initial step. The main effects of gender, popularity, and technology-based SCFS were added in the second step.

In order to test the hypothesis that popularity moderates the relationship between technology-based SCFS and depression symptoms, an interaction term was created by computing the product of the centered values of technology-based SCFS and popularity. In order to test the gender moderation hypothesis, another interaction term was created by computing the product of gender and the centered value of technology-based SCFS. A third interaction term was created between gender and popularity. These three two-way interaction terms were added at the third step. A three-way interaction term was created and entered on a fourth step (see Table 3).

The full regression model explained a significant proportion of the variance in depressive symptoms, $R^2=0.470$, $p<$ 0.001. In support of the first hypothesis, results revealed a significant main effect of technology-based SCFS on depressive symptoms ($B=0.21$, $p<0.001$). Additionally, in support of the second and third hypotheses, analyses revealed a significant technology-based SCFS x gender interaction effect ($B=-0.08$, $p<0.05$), as well as a significant technology-based SCFS x popularity effect ($B=-0.11$, $p<0.01$). This model was further analyzed with the addition of ethnicity and SES variables as covariates. The pattern of significant and non-significant effects remained the same; thus, to present a more parsimonious model, ethnicity and SES were not included in results.

Interactions were probed following procedures outlined by Aiken and West (1991) and using interaction utilities provided by Preacher et al. (2006). First, models were reduced by removing covariates and non-significant interaction terms (Holmbeck 2002). For the gender interaction, simple intercepts and slopes for the regression of technology-based SCFS on depressive symptoms were computed for both males and females. Results revealed significant slopes for both girls, b $(se)=0.239$ (0.03); $p<0.001$, and boys, b $(se)=0.133$ (0.04); $p<0.001$, indicating that greater levels of technology-based SCFS were associated with greater levels of depressive symptoms for both genders. The slope for girls was significantly steeper than for boys, indicating that the effect of technology-based SCFS on depressive symptoms is stronger among females (see Fig. 1).

For the popularity interaction, simple intercepts and slopes for the regression of technology-based SCFS on depressive
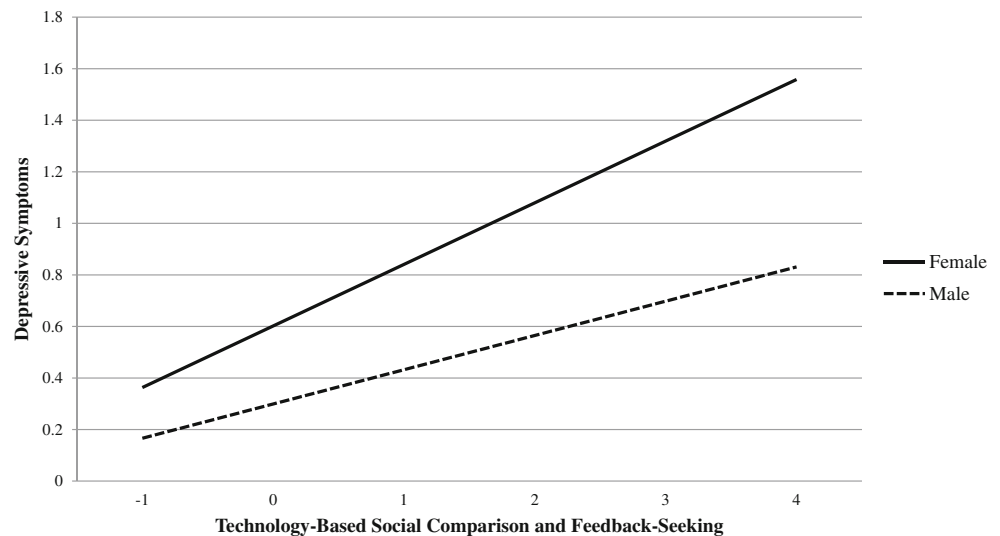
Table 3 Prediction of Depressive Symptoms by Technology-Based Social Comparison and Feedback-Seeking (SCFS), Popularity, and Gender ($n=619$)

Predictors	ΔR^2	Step statistics b (se b)	β	Final statistics b (se b)	β
Step 1, covariates	0.42**				
Baseline depressive symptoms		0.51 (0.04)	0.48***	0.45 (0.04)	0.43***
Excessive reassurance seeking		0.21 (0.03)	0.28***	0.15 (0.03)	0.19***
Frequency of technology use		0.01 (0.01)	0.04	−0.01 (0.01)	−0.04
Step 2, main effects	0.04**				
Technology-based SCFS		0.09 (0.02)	0.13***	0.14 (0.03)	0.21***
Gender (female)		−0.19 (0.03)	−0.18***	−0.20 (0.03)	−0.19***
Popularity		−0.04 (0.02)	−0.07*	−0.04 (0.02)	−0.08†
Step 3, two way interactions	0.01*				
SCFS × gender		−0.09 (0.04)	−0.08*	−0.09 (0.04)	−0.08*
SCFS × popularity		−0.05 (0.02)	−0.09**	−0.07 (0.03)	−0.11**
Popularity × gender		0.02 (0.03)	0.02	0.02 (0.03)	0.02
Step 4, three way interaction	0.00				
SCFS × gender × popularity				0.03 (0.04)	0.03
Total R^2	0.47**				

Gender was coded as 0 for females, and 1 for males. SCFS=social comparison and feedback-seeking

† $p<0.06$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$; All variables mean centered with the exception of Gender

Fig. 1 Plot of simple slopes for technology-based social comparison and feedback-seeking (SCFS) by gender interaction on depressive symptoms. Note that technology-based SCFS is mean centered
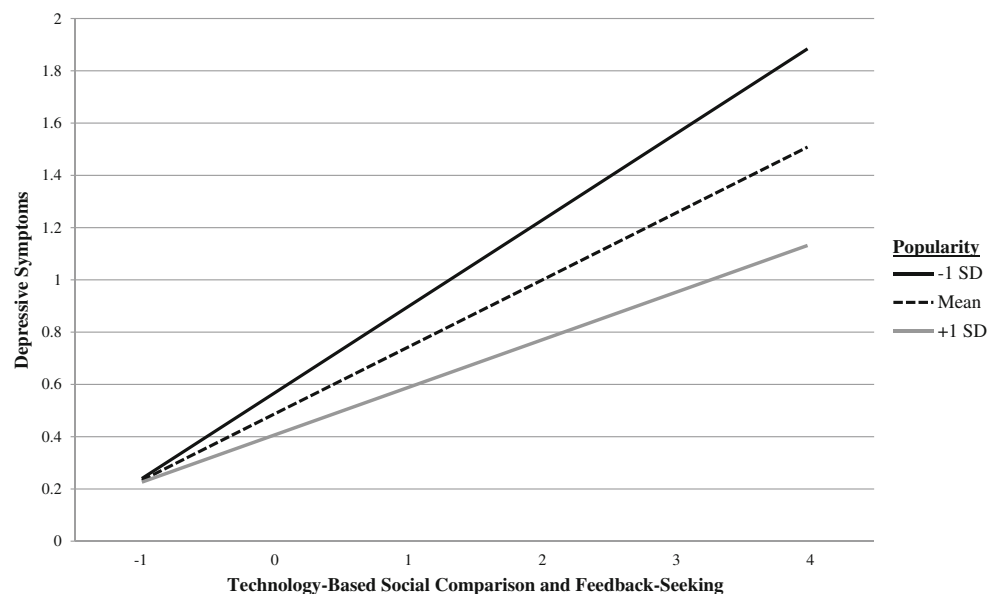

symptoms were computed at the mean of popularity, as well as at one standard above and below the mean. Results suggested stronger associations between technology-based SCFS and depressive symptoms for individuals low in popularity, (−1 SD), b $(se) = 0.329$ (0.04), $p < 0.001$, than for individuals high in popularity (+SD), b $(se) = 0.181$ (0.03), $p < 0.001$ (see Fig. 2). To further explore this effect, the Johnson-Neyman (J-N) technique was used to identify the region of significance (Bauer and Curran 2005), that is, the values of popularity for which technology-based SCFS had a significant effect on depressive symptoms. Results suggested that the association was significant at all centered values of popularity less than 2.08 (approximately two standard deviations above the mean). The slope at this boundary was b $(se) = 0.10$ (0.05), $p < 0.05$. This indicates that technology-based SCFS may be associated with

depressive symptoms for the majority of individuals, but with stronger associations for those lower in popularity.

Discussion

Interpersonal theories of adolescent depression highlight bidirectional associations among depressive symptoms, social experiences, and interpersonal behaviors that occur within an increasingly complex social environment 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; however, little is known about the role of *technology-based* social experiences in these depressogenic interpersonal

Fig. 2 Plot of simple slopes for technology-based social comparison and feedback-seeking (SCFS) by popularity interaction on depressive symptoms. Note that technology-based SCFS is mean centered

processes. Researchers have called for a more nuanced understanding of the specific online behaviors and pre-existing individual characteristics that may influence these associations (Bessière et al. 2008; Davila et al. 2012; Kraut et al. 2002; Valkenburg and Peter 2013). Findings have the potential to inform interpersonal models of adolescent depression that better account for modern adolescents' social environments.

Although results are preliminary, and no strong conclusions about directionality can be made given the concurrent nature of the data, the current investigation provides a valuable contribution to the literature. Results identified technology-based SCFS as one online behavior that may have implications for both online and offline functioning. In support of the first hypothesis, technology-based SCFS was found to be associated with depressive symptoms, controlling for overall frequencies of technology use, offline ERS, and prior depressive symptoms. In support of the second hypothesis, findings indicated that this association might be dependent on the offline characteristic popularity, with the strongest associations between technology-based SCFS and depressive symptoms found for adolescents lower in popularity. In support of the third hypothesis, gender was also found to moderate the association between technology-based SCFS and depressive symptoms, with the association stronger for females. Each of these findings will be discussed in turn.

Associations Between Technology-Based SCFS and Depressive Symptoms

Findings regarding the association between technology-based SCFS and depressive symptoms may be understood in the context of several theories. First, it may be that the online environment facilitates higher levels of SCFS. The hyperpersonal model of computer-mediated communication (CMC; Walther et al. 2011) suggests that certain components of technology-based interaction serve to intensify the process of identity construction through increased feedback and decision-making within these environments. Specific components of this model 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. In other words, the online context fosters idealized self-presentations and individuals are likely to make positive assumptions about others subsequent to viewing online content. Given that young people spend the majority of their time on SNS looking at peers' profiles and photos, rather than posting or updating their own profiles (Pempek et al. 2009), adolescents may be especially likely to engage in technology-based SCFS and may be vulnerable to negative comparisons with their peers. Given that identity development is a stage-salient task characteristic of adolescence, and that social comparison and feedback-seeking are essential to this process, it is not surprising that a forum that may serve to intensify this process may be associated with higher levels of these behaviors.

Second, adolescents engaging in technology-based SCFS may form distorted perceptions of their peers, leading them to engage in harmful upward comparisons, or to doubt the sincerity of positive feedback that is sought online, and experience decreases in mood or self-esteem. 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 and Kahneman 1973), 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. Furthermore, given the very large size of a typical adolescent's online social network, it is likely that many online connections are mere acquaintances offline. Thus, in forming impressions of individuals that they do not know well offline, correspondence bias (Gilbert and Malone 1995) may lead adolescents to assume that others' photos and text reflect stable personality traits, rather than situational factors.

Third, it may be that depressive symptoms precede and predict technology-based SCFS. Some research suggests that depressed and dysthymic individuals may be motivated to seek out negative information about others (Wenzlaff and Beevers 1998). Interpersonal theories of depression similarly suggest that within offline social worlds, depressed and depression-prone individuals are more likely to engage in overall higher levels of social comparison (Gibbons and Buunk 1999) and feedback-seeking behaviors (Hames et al. 2013). Situational continuity between offline and online contexts (Mikami et al. 2010) suggest that this effect is likely to occur online, as well. In doing so, depressed individuals may prefer to compare themselves to others perceived to be equal to or less fortunate than them. This may explain why depression and technology-based SCFS are significantly associated. Unfortunately, within a computer-mediated, hyperpersonal environment in which peers selectively portray the most positive aspects of their lives, however, these downward comparisons may not be possible. In an online world where users portray themselves in an ideal manner, depressed individuals may be stymied in their efforts to seek out negative information about others, potentially experiencing a worsening of symptoms in light of others' perceived happiness.

Effects of Popularity

Consistent with the second hypothesis, another important finding revealed that popularity moderated of the association between technology-based SCFS and depressive symptoms.

Notably, findings suggested stronger associations between technology-based SCFS and depressive symptoms for unpopular individuals. Downward comparisons may be especially challenging for adolescent low in popularity. Prior research suggests that individuals lower in popularity and self-esteem receive less positive feedback on their social networking profiles (Mikami et al. 2010) and post updates that are higher in negativity and lower in positivity (Forest and 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 et al. 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. Additionally, given the substantial overlap between online and offline networks (Reich et al. 2012), it is likely that adolescents who are unpopular offline have fewer online friends. Manago et al. (2012) posit that larger online networks and perceived audiences predict life satisfaction and perceived social support. Thus, 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.

Effects of Gender

Finally, consistent with the third hypothesis, gender moderated the association between technology-based SCFS and depressive symptoms. In particular, results suggested that the association between technology-based SCFS and depressive symptoms was particularly strong for females compared to males. Prior work has indicated important differences between adolescent girls and boys that may be relevant to an online context, with girls more likely experience depressive symptoms as the result of reassurance-seeking behaviors offline (Prinstein et al. 2005). Furthermore, girls are more likely to prioritize and compare themselves on dimensions of physical attractiveness online (Haferkamp and Krämer 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 (Stefanone et al. 2011).

Furthermore, established interpersonal theories of depression show that the link between interpersonal stressors and depressive symptoms may be particularly strong for girls (Rudolph 2002); thus, insofar as technology-based SCFS 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 this field,

proposed theories on the moderating influences of gender are speculative; more research is needed to clarify and expand upon this potential moderator.

Findings from this study offer rare data to understand the association between offline characteristics, online behavior, and adolescent depressive symptoms. Importantly, results did not identify any overall association between frequency of technology use and depressive symptoms. Rather, findings suggest the importance of exploring specific technology-based behaviors and offline, individual characteristics in identifying for whom and under what conditions associations with depressive symptoms may be present. Although preliminary, these findings may have important implications for identifying adolescents for whom frequent technology use may be both a precursor to and an outcome of maladaptive psychological adjustment. In this emerging field, relevant theories remain speculative and suggest the need for further research.

Limitations and Conclusions

This study provides a critical initial exploration of the associations among popularity, gender, online behavior, and depressive symptoms among adolescents and provides a much-need contribution to the literature on the psychosocial correlates of technology-based behaviors. 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 and 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 2000 students, collected by the Kaiser Family Foundation (Rideout et al. 2010). However, future research should incorporate naturalistic methods, including observational coding of adolescents' media output, to determine the accuracy of reports on technology-based SCFS and other variables. Initial studies using direct observation of adolescent media content (e.g. Underwood et al. 2012) have shown promising results. 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. It should also be noted that, as is typical in school-based samples, mean levels of depressive symptoms were very low in the current analyses. Thus, although providing preliminary insight into these effects within a community setting, results may not generalize to a clinical

sample. A final limitation of the current study was the inability to fully assess differences in outcomes by ethnicity or SES. Although the study's large and diverse sample provided the opportunity to examine effects across different ethnicities, it is possible that cell sizes were too small to examine potential interaction effects. Additionally, the use of census tract data provides only a rough estimate of families' true SES; more sensitive measures of SES should be used in future studies.

In summary, the current study provides novel preliminary evidence that technology-based social comparison and feedback-seeking behaviors may be associated with depressive symptoms among adolescents, controlling for overall technology use, prior depressive symptoms, and offline ERS. Furthermore, popularity and gender may play a role in this effect, such that the association between these behaviors and depressive symptoms is particularly strong among adolescents low in popularity and among females. 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.

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

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