

## How Adolescents Use Text Messaging Through their High School Years

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### Abstract

Co-construction theory suggests adolescents use digital communication to address developmental challenges. For a sample of 214 ethnically diverse adolescents, this research used direct observation to investigate the frequency, content, and timing of texting with parents, peers, and romantic partners through grades 9–12. Analyses showed that texting frequency follows a curvilinear trajectory, peaking in 11<sup>th</sup> grade. Adolescents discussed a range of topics, predominantly with peers. Communication with parents was less frequent, but consistent over time. Approximately 45-65% of adolescents communicated with romantic partners, texting heavily and about topics similar to those discussed with peers. Texting may help adolescents navigate key developmental challenges of adolescence—the establishment of autonomy, intimate peer relationships, romantic relationships, and self-identity.

Keywords: text messaging, psychosocial development

### How Adolescents Use Text Messaging Through their High School Years

Many adolescents are heavily engaged in text messaging, sending and receiving an average of 67 messages per day (Lenhart, 2015). Despite the rapid rise of messaging applications (e.g. WhatsApp) and social media platforms (e.g. Instagram), texting remains the most prevalent form of communication with peers (Lenhart, Smith, Anderson, Duggan & Perrin, 2015). Adolescents have embraced texting as a way to stay connected with their friends and romantic partners, communicate with their parents, and engage in microsocial planning (i.e., communicating details about where and when to meet, homework, schedules, and other logistics). Adolescents prefer text messaging as a way to communicate with peers because, “When I text, I can say just what I want to say” (Lenhart, Ling, Campbell, & Purcell, 2010, p. 48).

Text messaging may well be a life phase phenomenon; texting increases during adolescence but decreases during the young adult years (Ling, 2010). Texting appeals to adolescents because it allows them to communicate privately in real time, but to reflect on their choice of words if needed (Abeele, Schouten, & Antheuinis, 2016). Texting allows for discrete communication outside the purview of adult supervision (Abeele et al., 2016). Adolescents can also use this digital communication to address major developmental tasks of adolescence: establishing autonomy from parents, fostering close peer relationships (Erickson, 1968; Sullivan, 1953), exploring sexuality and developing one’s identity (Subrahmanyam, Smahel, & Greenfield, 2006).

This study examined how adolescents use texting by capturing and coding the content of adolescents’ text messages across four years of high school. Through the lens of co-construction theory, we examined fine-grained descriptive information about how adolescents text in their daily lives to facilitate developmental tasks of adolescence: with whom they communicate and what they say, how much they text, how quickly they respond to others’ messages, and how frequently they text over time.

### **Co-Construction Theory**

Co-construction theory posits that in digital communication, adolescents actively construct content that shapes their social experiences; “adolescents are not at the mercy of an externally created environment; they are creating, and more to the point, co-creating their Internet environment through

processes of social interactions” (Subrahmanyam et al., 2006, p. 396). Co-construction theory further argues that adolescents use digital communication to navigate developmental challenges (e.g., sexuality, identity) in the online world just as they do in their offline lives (Subrahmanyam et al., 2006). Co-construction theory posits “physical and virtual worlds are psychologically connected” (Subrahmanyam, Reich, Waechter, & Espinoza, 2008, p. 124) and that adolescents’ online social lives may be “psychologically continuous” with their offline social worlds (Subrahmanyam et al., 2008, p. 421).

Most research on co-construction theory has examined relations between adolescents’ offline behavior and their Internet communication (Abraham & Trimuliasari, 2015; Borca, Bina, Keller, Gillbert & Begotti, 2015; Cernikova, Dedkova & Smahel, 2018; Guo, Sun & Li, 2018). Adolescents’ communication in unmonitored chatrooms frequently includes issues of identity and sexuality just as it does in their offline conversations (Subrahmanyam et al., 2006). Adolescents who are more aggressive face-to-face are more likely to engage in cyberbullying online, and adolescents who are more prosocial in their in-person social interactions engage in more prosocial behavior online (Wright & Li, 2011).

### **Empirical Investigations of Adolescents’ Text Messaging**

Texting has rarely been examined through the theoretical perspective of co-construction. Yet given how frequently adolescents send text messages and how it seamlessly fits into their lives, it is likely that adolescents’ communication via text messaging is psychologically connected to their offline social lives. Adolescents frequently exchange text messages with peers they know in their offline lives; 88% of adolescents text friends at least occasionally and 55% report texting friends daily (Lenhart, 2015).

Understanding how adolescents use text messaging requires examining with whom they communicate and what they say in their ongoing daily interactions. Most recent research on text messaging involves college or young adult samples (e.g., Holtzman et al., 2017; Hsieh & Tseng, 2017; Ishii, Rife, & Kagawa, 2017; McEwan & Horn, 2016; Ouellette & Michaud, 2016). Almost all studies rely on survey data (e.g., Abee et al., 2016; Gallimberti et al., 2015; Grover et al., 2016; Ishii et al., 2017; Lenhart, 2015; Ling, 2010; McEwan & Horne, 2016; Nesi, Widman, Choukas-Bradley, & Prinstein, 2016). However, important exceptions examine small samples of text messages of college

students (Eshghinejad & Moini, 2016; Ouellette & Michaud, 2016) and young adults (Aledavood et al., 2016), as well as one laboratory study with college students (Holtzman et al., 2017). These observational studies showed that text messaging follows particular patterns across time (Aledavood et al., 2016), and that in comparison to face-to-face social support, seeking support via text messaging may have fewer benefits (Holtzman et al., 2017). These authors were able to evaluate *actual* text messaging, rather than perceptions of device use, which are not necessarily correlated (*Blinded for peer review, 2012*).

Most research on text messaging has also focused on negative features of this communication. Survey studies have found that problematic cell phone use was related to substance abuse (Gallimberti et al., 2015), that nighttime text messaging was associated with sleeping less, more sleepiness during the day, and lower academic performance (Grover et al., 2016), and that exchanging a greater proportion of communication with romantic partners via text messages was related to lower interpersonal competence one year later (Nesi et al., 2016). Several studies have shown that sexting relates to risky sex (*Blinded for review, 2017*; Choi et al., 2016; Rice et al., 2017).

Only a few previous studies have investigated positive features of text messaging. An online survey of young adults in Taiwan found that text messaging with emoticons afforded individuals the ability to convey a variety of meanings, personalization and emotion within messages (termed “information richness”), which contributed to perceiving mobile messaging as playful (Hsieh & Tseng, 2017). An online survey study found that college students who find technology to be gratifying are more likely to report satisfaction and competence in text messaging (Ishii et al., 2017). A survey study with US college students found that using text messages for four relationship maintenance strategies (positivity, assurances, sharing, and networking) was related to increased relationship satisfaction and closeness (McEwan & Horn, 2016).

### **Developmental Tasks of Adolescence**

This study used observational data to provide a fine-grained description of adolescent text messaging. We will emphasize the potential for texting to facilitate four key developmental tasks during adolescence: establishing autonomy from parents, fostering intimate peer relationships, navigating

romantic relationships, and developing a coherent self-identity.

**Autonomy from parents.** Adolescents seek behavioral, emotional, and cognitive autonomy from parents (Goossens, 2006). Ideally, parents promote autonomy in each form by encouraging opportunities for the adolescent to demonstrate independence and individuation, without abdicating supervision and emotional support altogether (Qin & Pomerantz, 2013). Cell phones allow adolescents to seek and parents to support their child's developing autonomy in each of these domains. Parents can support the child's behavioral and emotional autonomy by permitting the child to communicate with peers and romantic partners at will; all while allowing parents the opportunity for supervision, by using the phone to check on the adolescents' location and by using texting as an opportunity to provide advice and guidance. Indeed, parents of adolescents report that the potential for monitoring their children is one of the primary reasons for purchasing their child a mobile phone (Devitt & Rooker, 2009). In one of the largest studies to specifically examine how texting relates to parent-child relationships, Lenhart and colleagues (2010) emphasize that cell phones afford adolescents greater ability to connect with parents, but also helped them feel more autonomous from their parents as a result of their cell phone ownership.

For adolescents, text messaging with parents supports behavioral autonomy by providing scaffolding opportunities (e.g., the child could seek advice about car trouble from afar; Fletcher, Benito-Gomez & Blair, 2018). Alternatively, parents' ability to contact adolescents encourages parents to permit adolescents to operate more independently. For example, over 90% of parents of adolescents reported using text messaging as a means to solicit information from their child, including where they were, who they were with, and what they were doing (Rudi, Dworkin, Walker & Doty, 2015). Interviews with Finnish adolescents highlighted parents granting more freedom and autonomy as a result of the ability to check-in via text messaging (Oksman & Turtiainen, 2004). Text messaging can foster emotional autonomy from parents by allowing adolescents to more easily seek validation, comfort, and support from their peer network (Cupples & Thompson, 2010) instead of from parents. Text messaging can support cognitive autonomy from parents in that it allows adolescents to communicate with peers about moral and social norms, for better or for worse (*Blinded for review, 2014*). Adolescents prefer texting over phone

communication specifically because it facilitates communicating with peers without worrying about parents listening to conversations (Lenhart et al., 2010).

Despite these opportunities for text messaging to facilitate the development of autonomy from parents, there is also the potential for it to impair this developmental process if parents use texting as a way to drastically increase their oversight. In line with this, a few studies have found that the expectation of continuous contact is a source of conflict among adolescent-parent relationships (Blackwell, Gardiner & Schoenebeck, 2016) and parents' digital solicitations for information are less effective than in-person solicitations (Hessel, He & Dworkin, 2017). This suggest that although text messaging has the potential to promote autonomy, excessive parental contact via text might inhibit it.

If text messaging is used in the service of establishing autonomy from parents, we hypothesized that adolescents would text with peers more than with parents and that texting with parents would occur at low but steady rates (Lenhart et al., 2010). We also expected that texting with parents would be predominantly neutral (e.g. monitoring and checking in) or positive (e.g. conveying affection; *Blinded for review*, 2015; Fletcher et al., 2018).

**Development of meaningful peer relationships.** Cell phones and text messaging afford opportunities for fostering peer relationships, with adolescents reporting that connecting with peers is their primary motivation for texting (Blair & Fletcher, 2011). Digital communication facilitates intimate self-disclosure, an important process for friendship formation (Gottman & Mettetal, 1986). Direct observation of interpersonal communication has shown that computer-mediated communication is characterized by more frequent self-disclosure (Tidwell & Walther, 2002) and greater depth of self-disclosure (Joinson, 2001) compared to face-to-face communication. However, much of this research has examined digital communication in general (see Nguyen, Bin & Campbell, 2012 for a review) and among college-aged samples (but see Davis, 2012 for similar findings among a high school sample). Text messaging is an ideal context for conversations with friends because it allows for intense contact (e.g., texting your best friend at any time), but also broad contact, as teens can interact with their entire friend group more easily.

Despite concerns that smartphones would displace the importance of offline friendships, evidence suggests that text messaging and other digital communication actually facilitate closer relationships with offline peers (Valkenburg & Peter, 2007). Adolescents' primary motivation for text messaging is seeking connection with friends (Blair & Fletcher, 2011; Morrill, Jones & Vaterlaus, 2013), and recognize the value of these platforms for intimate self-disclosure (Davis, 2012). Similarly, participants who were able to instant message with a same-aged peer after an experimentally-induced exclusion protocol reported greater improvements in self-esteem and acceptance compared to those who played a computer game following the exclusion protocol (Gross, 2009). Adolescents recognize the utility of text messaging in fostering connection, belongingness, and support from peers.

If text messaging is used in the service of enhancing peer connections (Blair & Fletcher, 2011; Lenhart, 2015), we expected that adolescents would engage in intimate and potentially risqué self-disclosure via text message with peers more than with parents, such as negative talk about the self and others, antisocial behavior, and sex. We also expected that adolescents would respond more rapidly to peers than to their parents, which could highlight the increased importance that adolescents place on their peer relationships.

**Exploration of intimate, romantic relationships.** Text messaging is also an important venue for exploration of intimate, romantic relationships. In middle adolescence, youth are more likely to engage in casual dating, with these dyadic bonds becoming more consolidated in late adolescence as youth become increasingly involved with romantic partnerships that provide them with companionship and emotional support (Connolly & McIsaac, 2011). Although the majority of research examining sexual text message communication has focused on engaging in sexting as a risk factor (Houck et al., 2014; Walrave et al., 2015; Van Ouytsel, Ponnet, Walrave & d'Haenens, 2017), text messaging may also facilitate exploration with romantic relationships. Emerging adults who reported engaging in similar texting behaviors as their partner (e.g. initiating text conversations at similar rates) demonstrated greater relationship satisfaction (Ohadi, Brown, Trub & Rosenthal, 2018). Furthermore, digital communication allows individuals' in long-distance romantic relationships to maintain relationship satisfaction



comparable to geographically local couples (Jiang & Hancock, 2013). This may be similarly important for adolescents who have limited control over their ability to see a romantic partner in person, and are beginning to explore this new form of relationship. In a prior study, 65% of adolescents sent or received text messages discussing hypothetical or actual sex, suggesting that sexting may be developmentally normative in this phase of life (*Blinded for review*, 2017).

If text messaging is used in the service of exploring intimate, romantic relationships that are ascending in developmental importance during adolescence (Connolly & McIsaac, 2011), we predicted that adolescents would exchange more text messages with romantic partners than with peers or parents. We also expect adolescents to use texting as a platform in which to engage in emotionally-laden and intimate discussions (*Blinded for review*, 2017, Van Ousel et al., 2017) and thus texting with romantic partners will involve higher frequencies of positive talk, negative talk and communication about antisocial and sexual content.

**Development of self-identity.** Text messaging with peers can also serve as a forum for experimenting with and consolidating a self-identity. Major developmental theorists agree that adolescence is a period when young people struggle with identity versus role confusion (Erikson, 1968). Although young people follow different paths to identity achievement, many adolescents are in a stage of identity moratorium (Marcia, 1980), in which they have not yet firmly committed to an identity but are in the process of gathering data and trying out different possible selves. A large body of research has examined identity exploration via digital communication (broadly defined) and social media specifically. Half of adolescents report engaging in identity exploration via the Internet (Valkenburg, Shouten & Peter, 2005), using digital platforms to experiment with a wider range of identity expressions (Valkenburg & Peter, 2008). Although these digital realms provide opportunities for identity exploration, they can simultaneously undermine consolidating one's identity by allowing adolescents to engage in continuing exploration without committing to an identity. (see Valkenburg & Peter, 2011). However, the negative effects of this digital self-exploration are mediated by positive peer relationships and interactions (Davis, 2013).

Adolescents may be more comfortable trying on different possible selves via text messaging than by communicating in person; they can consider what they want to say with less fear of embarrassment. Text messaging may also be a context for the type of gossip that Fine (1985) considered a form of moral negotiation: making a negative statement about someone else to test peers' reactions as a way of determining the boundaries of acceptable behavior. Text messaging may also provide an ideal opportunity to experiment with delinquent topics, and to express profanity away from adult ears (*Blinded for review*, 2014). Adolescents may be able to gauge peer responses to different deviant behaviors, to give and receive peer approval for antisocial behavior, or even to instruct each other in how exactly to succeed in antisocial behavior (e.g., where to smoke at school, where to buy drugs, *Blinded for review*, 2014). Co-construction theory posits that adolescents will leverage the technological affordances of texting in the service of navigating self-identity. If this theory is correct and text messaging serves as a venue for identity exploration via conversations with peers, peers and romantic partners should be the primary groups with whom adolescents communicate. We also predict that proportions of emotionally-laden and risqué content will be higher with peers compared to parents: positive talk, negative talk, antisocial talk, and sexting.

### **The Current Study**

Almost all of the research on possible effects of texting has used self-report methods. In contrast, this study uses observational data (collected 2008 – 2012) to understand how adolescents use text messaging in their daily lives across the high school years: how frequently they text, with whom they communicate, and what they say to which types of partners. This study aims to provide objective, high quality data on exactly how adolescents use text messaging as a way of beginning to understand how text messaging may relate to navigating developmental challenges of adolescence.

The first purpose of this study was to identify developmental changes in the overall frequency of text messaging during mid- to late-adolescence. If text messaging is indeed a “life phase phenomenon,” (Ling, 2010, p. 277) then frequency should peak in adolescence and decline as adolescents transition into adulthood. This study used objective billing records to examine adolescents' texting frequency across a

span of 56 months (from the summer prior to 9<sup>th</sup> grade through the winter following the end of 12<sup>th</sup> grade). We hypothesized text messaging would increase until approximately age 16 when many adolescents get a license to drive, then decline as adolescents finished high school.

The second purpose of this study was to examine if texting behavior represents major developmental tasks during adolescence. Developmental theorists conceive of adolescence as a time of great developmental change when young people seek autonomy from their parents, strive to form close peer relationships (Sullivan, 1953), act on their own sexual impulses to begin romantic relationships (Sullivan, 1953), and seek to explore and consolidate a self-identity (Erickson, 1968). In line with co-construction theory (Subrahmanyam et al., 2006), we propose that adolescents' intense use of text messaging reflects the potential for this platform to serve as a powerful tool for engaging in the developmental challenges of adolescence.

## **Method**

### **Participants**

Participants were initially recruited from southwestern, suburban elementary schools during third grade for a five-year longitudinal study investigating social and physical aggression. Letters were sent home inviting children and parents to participate in a study about children's friendships. Prior to entering high school, participants were invited to participate in a second wave of the study, for which they were provided BlackBerry phones that captured all incoming and outgoing text message communication. Of the 209 participants invited, 187 agreed to participate (90%). In addition to these participants, 22 new participants were recruited, and eight adolescents with whom we had previously lost contact rejoined during high school, bringing the final sample to 214 (50% female).

Parents reported on participant race or ethnicity, with 52% White or Caucasian, 21% Black or African-American, 20% Hispanic or Latino, 2% Asian, and 5% Mixed or Other. During 9<sup>th</sup> grade, parent-reported income was as follows: 11% earned less than \$25,000, 17% earned between \$25,000 and \$50,000, 16% earned between \$51,000 and \$75,000, 17% earned between \$76,000 and \$100,000, and 25% earned over \$101,000. Fourteen percent did not report income.

## Procedure

Participants were given BlackBerry phones with paid service plans and unlimited texting and data during the summer prior to 9<sup>th</sup> grade (2008). Participants and parents provided informed consent to have the participants' BlackBerry content monitored and stored. Content sent and received with the phone was archived in a secure database, which provided a daily digest of text messages for each participant. Exchanged text messages were labeled by date, time, and the texting partner's phone number. Texting partners' names as they appeared in the contact list, were also stored, and provided clues to the partners' relation to the target child (e.g. "love of my life", "mom"). Content was flagged and routinely monitored for language that indicated immediate harm to oneself or to others. Parents were contacted by the principle investigator if it was apparent that immediate intervention was necessary.

To maintain ecological validity, participants were encouraged to use their BlackBerry as their primary device for communication but were allowed to use other devices. On average, the participants almost always utilized their BlackBerry, although they "sometimes" texted on another phone (*Blinded for review, 2012*). Additionally, our data suggest participants were comfortable exchanging communication regarding illicit activities, with 90% reporting that they did not adjust their behavior as a result of being monitored (*Blinded for review, 2019*). Thus, we believe that the content captured and analyzed in this study is an accurate reflection of adolescent digital communication, particularly because our observed rates of sexual talk and profane language are comparable to the rates found in unmonitored online chat rooms (Subrahmanyam et al., 2006; *Blinded for review 2012*). A full description of the methodology is discussed in *Blinded for review (2012)*, and detailed ethical considerations can be found in *Blinded for review (2012)* and *Blinded for review (2019)*.

Text messages sent and received during each participant's four years of high school were archived. Due to the vast amount of communication exchanged during this period, a small sample of days from Grades 9 through 12 was selected and coded. For each grade, two days in October around the Homecoming game and dance and two days in February were selected, for a total of four days coded for each grade. These periods were chosen due to the social activities associated with the Homecoming

dance/football game and Valentine's Day. Despite selecting these specific days, the number of texts exchanged per day were nonetheless in line with self-reports of daily texting rates (Lenhart et al., 2012).

If no content was archived for a participant during these periods, or if there were errors in the archived data (e.g. only incoming or outgoing messages were captured), the search was expanded until four days of content were identified within each grade to ensure the maximum number of participants were included in each year. Fifty percent of the sample with ninth grade data had dates outside of the target months, primarily due to archiving errors during the first year of data collection. The majority of the sample had archived data during the target months in grades 10 (74%), 11 (62%) and 12 (74%).

After a transcript was selected, it was distributed to one or two of 31 trained coders. These coders participated in a training class over the course of a semester and completed training after achieving an inter-coder reliability rating greater than  $\kappa = .60$  for at least five practice transcripts. Subsequently, for each data point, 20% of transcripts were double-coded to ensure inter-rater reliability. Coders would assign each utterance in a text message with a content code. An utterance was a unit of communication that conveys a complete thought. This could range from a complete sentence ("Are you picking Steven up before you go to the store") to a single word ("Yes"). Text messages could contain more than one utterance; however, 98% of texts contained two or fewer utterances ( $M = 1.14$  utterances,  $SD = .45$ ). If the same utterance appeared to fall under multiple different content codes, coders resorted to a coding hierarchy to determine which code would take precedence.

## Measures

*Monthly texts exchanged throughout high school.* Billing records, provided by cell phone carriers (Sprint for grade 9 and AT&T for grades 10, 11 and 12), were used to examine the total number of text messages sent and received throughout the duration of the study. From these bills, we identified the number of messages exchanged each month using each participants' phone between May 2008 and December 2012. Billing records were not available during May, June and July of 2009 (during the transition from Sprint to AT&T). Billing records for two additional months (February and April, 2010) were not available due to corrupted digital PDF's of the bills. Although billing records were not available

during February, 2010, archived data were still available for micro-coding.

*Dyad member codes.* Each dyad partner was labeled by his or her relation to the target child. This relation was determined by the target child's contact information (e.g. "mom"), the content of the texting conversation, the style of the linguistics in the text, and if the target child referred to the partner by name during the conversation. The current research examined the text messages sent to and received from peers ( $\kappa = .67$ ), romantic partners ( $\kappa = .78$ ), parents ( $\kappa = .93$ ).

*Antisocial codes.* Antisocial content included discussion about drugs, physical aggression, and any other illegal or rule-breaking behavior. Antisocial content also included lying to authority figures, intentional rule or law breaking, trespassing and property crimes, truancy, gang involvement, and carrying a weapon. Communication about buying, selling, or using any illegal substances or illicitly using legal substances was also coded as antisocial. Finally, discussion about physical aggression, including recalling actual instances of physical aggression (e.g. physical fights between peers) or intimidating threats of aggression were coded as antisocial ( $\kappa = .82$ ).

*Negative talk codes.* Content was coded as negative talk when the discussion included negativity, or discussion of objectively negative events. Negative social interactions include manipulative behaviors, social exclusion, mocking someone, or spreading malicious gossip. Negative talk was also coded for negative appraisals of oneself or others, negative feelings or affect ("I feel sad"), sarcasm, jealousy, or negative events (e.g. "I'm having a terrible day", "John failed his Chem test"). ( $\kappa = .68$ ).

*Positive talk codes.* Utterances were coded as positive for any discussion of positive events or feelings. This could include recalling positive events that happened to oneself or others (e.g, "I aced my test", "John finished in first place"), positive feelings (e.g. "I'm on cloud nine!"), or positive assessments of oneself or others ("Bill's new haircut looks so good!"). Positive talk also captured invitations to events, apologies and expressions of sympathy ( $\kappa = .65$ ).

*Sexual codes.* Sexual content included references of past, present or future sexual behavior. Sexual references consisted of behaviors that actually occurred (e.g. "I finally hooked up with Tina from Spanish class"), hypothetical behaviors that have not occurred (e.g. "what would it be like to hook up

with Tina from my Spanish class?”), or future scenarios (“I’m going in for the kiss after the movie tonight with Tina”). Additionally, the sexual codes captured refusal to engage in a particular sexual behavior or sexual behaviors in general. Sexual behaviors captured by this code included kissing, general arousal, sexual petting or rubbing, oral sex, sexual intercourse, and masturbation. Moreover, sending and receiving provocative picture messages was coded as sexual. Messages containing photographs were not archived. However, discussions about pictures that had been sent were coded as sexual when the context made it clear that they were discussing a sexual photograph (e.g. “thanks for that naked pic”) ( $\kappa = .76$ ).

*Neutral codes.* Utterances were coded as neutral when the content was not in reference to a topic captured by other codes (e.g. antisocial, sexual), and when the content did not have positive or negative valence. Discussion about other people in which the content is neither negative nor positive, and did not fit any other code, was also coded as neutral. Content that contained positivity or negativity could still be coded as neutral if the discussion focused on celebrities or media (e.g. “I don’t like the new Taylor Swift album”). Discussion about the project’s researchers were coded as neutral regardless of content ( $\kappa = .69$ ).

*Latency in responding to a received text message.* To examine the latency in response between when participants received a message from a parent, peer, or romantic partner, we calculated the number of seconds between when a participant received a message from an individual and when they sent a response to that same individual. In instances where the individual sent the participant multiple messages before the participant responded, the latency captures the time between the last message and the subsequent response. These latencies were then combined into average response times to text messages sent from parents, peers, and romantic partners. Response times were then multiplied by 60 to present the latencies in minutes. It is important to note that latencies could only be calculated when a message was both received from and then responded to within a particular dyad within that day. For example, if a parent texted a child and the child never responded, no latency could be calculated. If this was the only parent dyad, that child would be excluded from any analyses on parental latency for that grade.

## Results

The first analyses used the billing data to examine the developmental pattern of text messaging

across the high school years. The total number of texts sent and received by all participants that sent at least one text were averaged for each of the 51 months available, excluding the five months previously explained as missing for technical reasons. A quadratic fit model provided a strong match to the data,  $R^2 = .85$ ,  $F(2, 48) = 139.29$ ,  $p < .001$ . The results, presented in Figure 1, indicate a curvilinear trajectory of text messaging that increased steadily in 9<sup>th</sup> grade and peaked at the end of 11<sup>th</sup> grade (April 2011), followed by a decline through the rest of high school and the first several months outside of high school. The average age in the sample during the peak month was about 17 years, 2 months. Separate analyses of boys and girls showed similar quadratic fits with girls peaking in the sample a few months earlier than boys – about 16 years, 11 months compared with 17 years, 3 months. A statistical test showed these ages to be statistically different ( $p < .01$ ).

The remaining analyses used the four days of coded text messages in each grade of high school. Analyses began with an examination of the distribution of texting variables; all of the texting variables exhibited non-normal distributions with a strong positive skew. The data were transformed several ways (e.g. square-root- and log-transformations); however, the distributions remained skewed and with high kurtosis scores. To account for this, non-parametric statistical tests were used to test for significant differences in texting behavior over time, and with different partners. Because of the large number of statistical tests of significance that were conducted, a more conservative threshold was used ( $p < .01$ ) for interpretation of findings as statistically significant to offset the increased risk of Type 1 error. We first examined with whom adolescents communicate via text messaging and the types of topics discussed, organized by developmental domains.

A series of independent Samples T-Tests were conducted to examine if participants with days in the target timeframes (October and February of each grade) differed from those with data captured outside of these timeframes (other months within each grade). Participants with coded data during February of 9<sup>th</sup> grade exchanged significantly more neutral utterances ( $M=177.1$ ,  $SD=212.5$ ) than participants with coded data from outside of February ( $M=122.1$ ,  $SD=139.6$  and  $M=173.5$ ;  $t = -2.02(166)$ ,  $p < .05$ ). A similar distinction was found between the number of neutral utterances exchanged between



participants with coded data during February of 11<sup>th</sup> grade ( $M=268.9$ ,  $SD=250.3$ ) and participants with coded data from outside of February ( $M=173.5$ ,  $SD=148.3$ ;  $t = -3.12(168)$ ,  $p < .05$ ). However, participants with data during the target windows did not differ in the amount neutral utterances compared to those with other dates during grades 10 or 12. The amount of antisocial, negative, positive, or sexual communication exchanged in the target months versus other dates.

### **Establishing Autonomy from Parents**

Table 1 presents the frequency and proportion of text messages that were exchanged with parents, peers, and romantic partners over four days in each year of high school. As can be seen in Table 1 and Figure 2, adolescents exchanged a far greater number of text messages with their peers compared to their parents, as hypothesized. Wilcoxon signed-ranked tests indicated that these rates were significantly different in all four grades (Grade 9:  $T = 14188.5$ ,  $p < .001$ ,  $r = .86$ ; Grade 10:  $T = 15388$ ,  $p < .001$ ,  $r = .87$ ; Grade 11:  $T = 15575$ ,  $p < .001$ ,  $r = .87$ ; Grade 12:  $T = 16088.5$ ,  $p < .001$ ,  $r = .86$ ).

To examine if adolescents' communication with parents contained significantly more positive and neutral content than negative, antisocial and sexual topics, we created two variables by summing all positive and neutral utterances exchanged with parents, and summing all negative, sexual, and antisocial utterances exchanged with parents. Wilcoxon signed-ranked tests supported that adolescents exchanged significantly more positive/neutral content than negative/sexual/antisocial content with parents at each grade (Grade 9:  $T = 3075$ ,  $p < .001$ ,  $r = 0.58$ ; Grade 10:  $T = 6441$ ,  $p < .001$ ,  $r = 0.69$ ; Grade 11:  $T = 7503$ ,  $p < .001$ ,  $r = 0.72$ ; Grade 12:  $T = 9441.5$ ,  $p < .001$ ,  $r = 0.76$ ).

### **Development of Meaningful Peer Relationships**

We next examined if adolescents communicated about these same emotionally-laden and risqué topics with peers more than with their parents. Wilcoxon signed-ranked tests compared discussion of these topics at each grade. Within each grade, adolescents exchanged significantly more of this communication with peers than they did with their parents (Grade 9:  $T = 14146.5$ ,  $p < .001$ ; Grade 10:  $T = 14535$ ,  $p < .001$ ; Grade 11:  $T = 15731.5$ ,  $p < .001$ ; Grade 12:  $T = 16042.5$ ,  $p < .001$ ).

Finally, we examined the average latency in adolescents' responding to text messages from

parents, peers, and romantic partners during each grade (Table 3). To test if these differences were significant, we conducted a series of Friedman's ANOVA's to examine different response times between parents, peers, and romantic partners in each grade of high school. There were no significant differences in response latency between any of these groups in 9<sup>th</sup> grade (however, given that only 29 participants had calculated latencies for all three communication partners, this finding should be interpreted cautiously). There were significant differences in response times in 10<sup>th</sup> grade ( $\chi^2(2) = 58.02, p < .01$ ). Follow-up comparisons suggested that adolescents responded faster to their romantic partners ( $T = 1.17, p < .01, r = .83$ ) and peers ( $T = .768, p < .01, r = .54$ ) than to parents, however there was no difference in response time between peers and romantic partners. There were also significant differences during 11<sup>th</sup> grade ( $\chi^2(2) = 94.44, p < .01$ ), with adolescents responding faster to romantic partners than they did to their parents ( $T = 1.471, p < .01, r = 1.04$ ) or their peers ( $T = .667, p < .01, r = .47$ ). Adolescents also responded more quickly to their peers than they did to their parents in 11<sup>th</sup> grade ( $T = .805, p < .01, r = .57$ ). A similar pattern was found in 12<sup>th</sup> grade, with adolescents again responding to messages from romantic partners faster than their parent ( $T = 1.14, p < .01, r = .81$ ) or their peers ( $T = .505, p < .01, r = .36$ ). Adolescents also responded to peer texts faster than messages from their parents ( $T = .634, p < .01, r = .45$ ).

### **Exploration of Intimate, Romantic Relationships**

We next examined how adolescents communicated via text messages with their romantic partners. Table 1 presents the number of text messages exchanged with romantic partners at each grade. In any given year, a sizeable portion of the subsample did not communicate with any individual identified as a romantic partner. Next, we examined if communication patterns with romantic partners differed from communication with parents or peers. This required consideration of how to address adolescents who did not communicate with a romantic partners in a given year. For example, in the 9<sup>th</sup> grade, only 76 participants exchanged at least one message with an individual coded as a romantic partner. Because the purpose of these analyses was to compare rates of communication for those with romantic partners, analyses omitted any participant who was not involved in communication with a romantic partner.

We completed a series of Friedman's ANOVA's. There were significant differences in texting

frequency with different dyads within each grade (Grade 9;  $\chi^2(2) = 106.75, p < .001$ ; Grade 10;  $\chi^2(2) = 124.075, p < .001$ ; Grade 11;  $\chi^2(2) = 142.056, p < .001$ ; Grade 12;  $\chi^2(2) = 157.475, p < .001$ ). Pairwise comparisons revealed that for each grade, adolescents texted more with their romantic partners than they did with their parents (Grade 9:  $T = -1.43, p < .001, r = -1.01$ ; Grade 10:  $T = -1.29, p < .001, r = -0.91$ ; Grade 11:  $T = -1.308, p < .001, r = -0.93$ ; Grade 12:  $T = -1.22, p < .001, r = -0.86$ ). However, there were no significant differences between texts exchanged with romantic partners and with peers; adolescents who communicated with romantic partners did so at similar rates as with their other peers.

To examine if adolescents discuss more emotionally-laden and risqué topics with their romantic partners than with their peers, we summed together communication about positive topics, negative topics, and discussion of antisocial and sexual behaviors exchanged with peers and romantic partners (separately for each type of dyad). We then conducted Wilcoxon signed-ranked tests to compare discussion of these topics at each grade. There were no significant differences between how much emotionally-laden and risqué communication adolescents engaged in with their peers and their romantic partners within any grade. Additional analyses examined if there were differences in the individual types of communication exchanged between romantic partners and peers. In grades 11 and 12, adolescents exchanged fewer text messages about antisocial topics with their romantic partners than they did with their peers (Grade 11:  $T = 1289.5, p < .001, r = -0.28$ ; Grade 12:  $T = 1290.5, p < .001, r = -0.45$ ). Adolescents also exchanged more positive communication with their romantic partners in 9<sup>th</sup> grade than they did with their peers ( $T = 1984.5, p < .001, r = 0.31$ ). Finally, in grades 9<sup>th</sup>, 10<sup>th</sup>, and 11<sup>th</sup>, adolescents engaged in more sexual communication with their romantic partners than they did with their peers (Grade 9:  $T = 1353, p < .001, r = 0.41$ ; Grade 10:  $T = 2882, p < .001, r = 0.43$ ; Grade 11:  $T = 2834.5, p < .001, r = 0.37$ ).

### **Development of Self Identity**

The types of topics that adolescents discussed via text message are presented in Table 2 and Figure 3. It is clear from Figure 3 that a majority of communication exchanged with all communication partners was neutral, followed by positive and negative topics. To examine if adolescents' communication with parents contained significantly more positive and neutral content than negative,

antisocial and sexual topics, we created two variables by summing all positive and neutral utterances exchanged with parents, and summing all negative, sexual, and antisocial utterances exchanged with parents. Wilcoxon signed-ranked tests supported that adolescents exchanged significantly more positive/neutral content than negative/sexual/antisocial content with parents at each grade (Grade 9:  $T = 3075, p < .001, r = 0.58$ ; Grade 10:  $T = 6441, p < .001, r = 0.69$ ; Grade 11:  $T = 7503, p < .001, r = 0.72$ ; Grade 12:  $T = 9441.5, p < .001, r = 0.76$ ).

Figure 3 demonstrates that negative, sexual and antisocial topics were relatively less common communication topics than positive and neutral topics across all partners, but to examine if adolescents discussed these negative/sexual/antisocial topics more with peers than with parents, we summed the frequency of these three topics together. We then conducted a series of Wilcoxon signed-ranked tests. Within each grade of high school, adolescents discussed negative/sexual/antisocial topics more with peers than with parents (Grade 9:  $T = 13661, p < .001, r = 0.85$ ; Grade 10:  $T = 14028, p < .001, r = 0.84$ ; Grade 11:  $T = 15209, p < .001, r = 0.86$ ; Grade 12:  $T = 15814.5, p < .001, r = 0.85$ ).

### Discussion

Overall, the results of this observational study of adolescents' texting supported our hypotheses that adolescents use text messaging to navigate the developmental challenges of adolescence as proposed by co-construction theory (Subrahmanyam et al., 2006). Results indicated that adolescents communicate about a wide variety of both mundane and meaningful topics, predominantly with peers and romantic partners. Adolescents nonetheless used text messaging to interact with their parents fairly consistently across the high school years. For adolescents who communicated with romantic partners, they did so at similar rates and about similar topics as with their peers, although these patterns began to differentiate more during the later years of high school.

The pattern of text messaging across high school provides support for the notion that text messaging may be a life phase phenomenon, peaking during adolescence, but diminishing as adolescents approach adulthood (Ling, 2010). Text messaging increased throughout the beginning of high school, peaking at around 16-17 years old towards the end of 11<sup>th</sup> grade and then steadily declining. Adolescents

exhibited a rapid growth in text messaging behaviors during 9<sup>th</sup> grade. Eighty two percent of 13-14 year olds report owning cell phones, whereas 92% of 15-17 year olds own cell phones (Lenhart, 2015). Accordingly, 9<sup>th</sup> grade may be a transitional period when cell phone ownership rises. A larger proportion of peers owning cell phones may account for the rapid increase in texting frequency during this year. The peak during 11<sup>th</sup> grade is also interesting. Adolescents often learn to drive during the end of 10<sup>th</sup> grade or beginning of 11<sup>th</sup> grade. Perhaps the ability to drive enables them to see their friends in person and diminishes the need to text at such high rates. Time behind the wheel *should* be time that youth are not texting, resulting in the observed texting decrease. This curvilinear trend in text messages peaking at 16-17 years old follows a very similar pattern to one found using self-reported texting behaviors adolescence (Coyne, Padilla-Walker & Holmgren, 2018).

*Establishing autonomy from parents.* The results indicated that text messaging may support differentiation from parents in that participants communicated less with parents than peers or romantic partners. Still, adolescents communicated regularly with parents. Adolescents consistently exchanged 5-6 messages with parents per day during grades 10-12, generally about positive and neutral content. Given that adolescents spend approximately 11 minutes of individual time per day with mothers and 7 minutes with fathers (Lam, McHale & Crouter, 2012), even these few daily messages may be an important component of parent-child communication, a way to check in about important issues when needed.

The ability to check-in with parents at any time could promote autonomy, as parents may feel more comfortable allowing adolescents to manage day-to-day tasks (Fletcher et al., 2018) or go out unsupervised if they can reach each other when needed (Oksman & Turtiainen, 2004). In addition to the behavioral autonomy that text messaging may afford adolescents, text-messaging may also promote adolescents' cognitive and behavioral autonomy from parents by allowing them to explore their identity on a platform largely outside of parents' supervision. Although these results suggest that adolescents use texting to facilitate their developmental need for behavioral, emotional and cognitive autonomy, it is important to note that the ability for parents and adolescents to maintain continuous and immediate access could also inhibit feelings of autonomy, if the adolescent feels continuously connected with parents.

These findings are in line with other studies examining other digital media platforms. In general, parental monitoring via a wide range of digital technologies is less effective than in-person communication (Hessel, He & Dworkin, 20017; Rudi & Dworkin, 2018). If parents use their adolescents' phones as a means of surveillance by tracking children's locations or expecting constant communication, this could thwart the development of autonomy. One important aspect of how text messaging might relate to autonomy from parents is the dyadic nature of this communication. Parents and adolescents report distinct perceptions of text message communication. For example, although text messaging was a predictor of adolescents' perceptions of quality time with both mothers and father, this text messaging was not related to mothers' or fathers' perceptions of quality time with their adolescent (Vaterlaus, Beckert & Schmitt-Wilson, 2019). Similarly, these data were collected between 2008 and 2012, when parents may have been more reluctant to use text messaging as a means of interacting with their children. Additional research is needed to examine this possibility.

*Development of meaningful peer relationships.* These results clearly indicated that adolescents use text messaging to communicate frequently and intensely with their peers, in keeping with their primary motivations for texting (Blair & Fletcher, 2011; Davis, 2012) and their developmental needs to form intimate, platonic friendships and for some, romantic partnerships (Sullivan, 1953). Adolescents communicated with their peers and romantic partners more than they did with parents at every grade, and they communicated more with peers than parents about emotionally-laden topics, sexuality, and antisocial behavior. Text messaging often serves as platform for adolescents to reach out to peers when they are dealing with difficult situations, need advice, or simply to vent (Cupples & Thompson, 2010). In this way, text messaging may be an important context for developing intimate peer relationships. Co-construction theory suggests that adolescents are intentional in both their selection and use of digital platforms, aligning them to their offline psychological processes (Subrahmanyam et al., 2006). Text messaging allows the deep self-disclosure and support-seeking even as adolescents are physically separated from each other.

The potential for text messaging to foster intimate relationships may make this digital platform

especially relevant given the advent of social media. A large and growing body of research indicates that passively viewing peers' social media content relates to a variety of peer experiences, including envy (Ding, Zhang, Wei, Huang & Zhou, 2017) and perceived friend support (Frisson & Eggermont, 2015). The inherently active nature of texting may promote engaging with peers, instead of passively viewing their activities, as on many social media platforms.

*Exploration of intimate, romantic relationships.* Overall, these results supported our hypotheses that text messaging could be an important venue for developing romantic relationships: adolescents with romantic partners communicated with them energetically and about emotionally-laden, sensitive issues at higher rates than with parents. However, contrary to our predictions, the frequency and content of communication with romantic partners did not differ from that of peers. The exception to this was adolescents exchanging more sexual communication with romantic partners than with peers in 9<sup>th</sup>, 10<sup>th</sup>, and 11<sup>th</sup> grades. This is not surprising, given that sexting conversations—which accounted for a large proportion of sexual communication—were most often exchanged with romantic partners. Text messaging may provide a low-pressure environment in which to explore romantic relationships. The lack of eye contact and other interpersonal cues may make text messaging an easier venue in which to discuss intimate details, inquire about sexual topics, and assert oneself while navigating conflicts.

It is also interesting to note that texting with romantic partners appears to occur in addition to peer communication, it did not replace communication with peers. Participants communication with peers was generally similar for both participants who did and did not text with romantic partners. Although devoting increasing time to romantic relationships is a normative process (Connolly & McIsaac, 2011), texting may provide an important method for maintaining one's platonic relationships.

Although texting may facilitate exploration of romantic relationships, it is important to understand how it might also fundamentally change adolescents' dating experiences. For example, adolescents (especially boys) are prone to use text messaging as a way to closely monitor and restrict their romantic partner's social interactions, which may create conflict, jealousy and mistrust (Rueda, Lindsay & Williams, 2015). Alternatively, "phubbing" (focusing on one's phone instead of interacting with the

person you are physically with) has a negative impact (Roberts & David, 2016)

Despite the potential benefits that texting may afford adolescents' navigation of romantic relationships, this platform can also be a context for risky behavior. There is a well-established association between sexting and a variety of negative psychosocial outcomes (Houck et al., 2014; Walgave et al., 2015; Van Outsel et al., 2017). Furthermore, even if texting provides an "easier" context in which to navigate conflict, it is possible that doing so will in fact interfere with the development of conflict resolution skills. Future research should examine this question.

*Development of self-identity.* The results supported our hypotheses that adolescents would use text messaging in ways that facilitate experimentation with their self-identity. As predicted, adolescents communicated much more frequently with peers and romantic partners. Adolescents communicated about more emotionally-laden and risqué topics with their peers than parents. Text messaging allows adolescents constant access to an audience of peers through which they can experiment with a variety of self-identities and discuss these issues with peers.

Here too, the active nature of text messaging could make it importantly distinct from other digital platforms. All digital communication allows youth to experiment with their self-identity, with this exploration potentially leading to a fractured sense of self (Valkenburg & Peter, 2011). Furthermore, passively viewing others' curated self-presentations on social media could create an unrealistic image that facilitate the engagement of potentially harmful social comparisons (Vogel & Rose, 2016), which may have important implications in informing adolescent identity. However, digital self-exploration in the context of positive peer relationships actually facilitates self-concept clarity (Davis, 2013). Text messaging provides adolescents opportunities to communicate with peers discreetly and requires that they do so actively and specifically, which could be ideal for exploring identity issues.

*Limitations and strengths.* All of these results must be interpreted in light of methodological limitations. Although these results provide a description of adolescent text messaging that could be in the service of navigating developmental challenges, this study did not directly examine whether texting promotes optimal development. Communication about the specific developmental tasks (e.g. adolescents



checking-in with parents) was not specifically identified in the coding system. Instead, broader conversational topics (e.g. positive talk, negative talk) were captured. A coding system that captures discussion of these specific developmental processes would provide more nuanced understanding of how texting can facilitate development. In addition, these analyses did not examine potential gender differences beyond the overall texting trajectory across high school. Furthermore, these non-parametric tests did not account for the potential nested nature of these data. Although participants were initially recruited in the same school district in 3<sup>rd</sup> grade, by 9<sup>th</sup> grade (when texting data collection began) they were dispersed across over 45 different schools in several states. Accordingly, nesting within school or classes should not likely have a major effect, but additional analyses are needed to verify this.

Also, these analyses provide only a brief snapshot of text message communication during four days in each year. Although we examined trends across the four years of high school, an enormous amount of communication was not examined. Furthermore, our selection of text messaging during periods with presumably greater social activities (near homecoming and Valentine's Day) may not generalize to all other days. The time-intensive nature of this coding (taking approximately 1.5 years to code each two-day sample of messages) makes recoding with random samples of days for these analyses prohibitive. Future research can leverage machine-learning techniques to analyze larger samples of texts more rapidly.

Another potential limitation is the advent of social media and other types of digital platforms may affect the generalizability of these patterns. For example, 95% of teenagers now own smartphones (Anderson & Jiang, 2018) compared to 25% in 2012 during the final year of data collection (Lenhart, 2012). The later years of this study (2011 and 2012) coincided with a rise in alternative messaging apps, such as Kik and Whatsapp, and there has been rapid growth in the popularity a variety of social media platforms (e.g. Instagram and Snapchat) that has diversified the ways that adolescents communicate with each other. These additional communication platforms may account for an overall decrease in the rate of texting since these date were collected (Anderson & Jiang, 2018; Lenhart, 2015). Thus it is also possible that the declining rates of texting during the later years of high school may reflect diffusion of

communication into other messaging platforms that were beginning to emerge during this period.

Unfortunately, we are not able to disentangle if this decline represents a developmental change, or a cohort shift to other applications.

Despite the emergence of other communication platforms, these new platforms do not necessarily diminish the importance of texting (even if they contribute to a decrease in frequency). Adolescents still prefer to communicate with peers via texting compared to social media (Rideout & Robb, 2018), and they spend a greater amount of time texting per day than they do on all social media platforms combined (although tests of the significance of these differences were not reported; Twenge, Martin & Spitzberg, 2018). Additional research is needed to understand how texting fits into the broader ecosystem of digital communication. The growth in social media has been accompanied by comparable increases in empirical research on these platforms; researchers must be careful not to neglect the importance of texting as newer communication platforms emerge. According to co-construction theory, adolescents' adoption and use of these platforms should reflect how they facilitate or inhibit adolescents' broader developmental goals (Subrahmanyam et al., 2006). These results provide some evidence that adolescents' texting may indeed be reflective of these developmental needs.

Despite these limitations, this study had important strengths. The longitudinal design and the wealth of observational data allowed careful description of how exactly adolescents use text messaging. This study is one of the first fine-grained, observational studies of the hidden world of adolescent text messaging. If studying online communication provides a view "into the secret world of peer culture" (Greenfield & Yan, 2006, p. 392), then these descriptive results are a critical first step in understanding how texting might relate to developmental processes.

*Future directions.* Future research should examine more specifically how text messaging relates to the developmental challenges of adolescence. These results indicate that text messaging may be a platform well suited for navigating developmental tasks, but further research is needed to understand specifically how these challenges are (or are not) addressed in texting. Does texting with parents do more to support emerging autonomy or possibly inhibit independence through parents' constant digital

presence? Is intimate self-disclosure with friends via text messaging qualitatively different from in-person self-disclosure? Does the nearly constant communication with peers and romantic partners facilitate positive or negative conflict resolution skills? Finally, does self-presentation with peers via text messaging result in the type of peer feedback that fosters positive identity development?

Further examination of potential gender differences in texting behaviors is also warranted. Research suggests that boys and girls have different motivations for texting (Morrill et al., 2013) and text at different levels (Lenhart, 2015). These findings have generally been restricted to self-reports and have not been found in observational studies (*Blinded for review*, 2012; *Blinded for review*, 2014). Nonetheless, these results did find gender differences in the long-term trajectory of text message use, and further research is needed to understand these potential differences.

Although a great deal of research has examined how text messaging may be harmful (Gallimberti et al., 2015; Nesi et al., 2016; Wolfe, Marcum, Higgins, & Ricketts 2016), this platform may provide a technological means for navigating many of the traditional challenges of adolescence. These communication technologies are now firmly entrenched in modern society and are unlikely to go away, so understanding how youth can use them to navigate the developmental challenges of adolescence may be a critical step in promoting the healthy development of future generations.

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Table 1

Mean Text Messages Exchanged during Four Days with Parents, Peers, and Romantic Partners across High School

	Frequency of Texts				Percentage of Texts			
	Grade 9	Grade 10	Grade 11	Grade 12	Grade 9	Grade 10	Grade 11	Grade 12
Parents	6.78 <sup>a</sup> (12.85)	23.96 <sup>c</sup> (27.42)	19.35 <sup>e</sup> (19.52)	27.46 <sup>g</sup> (27.73)	3.16% (9.41%)	5.01% (7.65%)	4.68% (7.06%)	6.45% (8.65%)
N	172	180	178	180				
Peers	234.96 <sup>b</sup> (224.82)	400.23 <sup>d</sup> (323.94)	359.7 <sup>f</sup> (345.47)	325.13 <sup>h</sup> (240.32)	69.45% (30.39%)	62.19% (29.07%)	61.58% (27.83%)	60.05% (25.12%)
N	172	180	178	180				
Romantic Partners	267.68 <sup>b</sup> (283.32)	435.43 <sup>d</sup> (517.03)	376.66 <sup>f</sup> (444.04)	295.36 <sup>h</sup> (295.64)	47.04% (26.33%)	42.64% (26.75%)	42.42% (26.24%)	37.7% (23.97%)
N	76	102	109	118				
Total	378.19 (354.88)	708.73 (623.09)	651.78 (620.37)	590.27 (403)	-	-	-	-
N	172	180	178	180				

Note: SD's presented in parentheses. Different superscript letters indicate significant difference in texts exchanged between communication partners (within the same year)

Table 2

Communication Topics exchanged with Parents, Peers, and Romantic Partners during four days across High School

		Average Frequency of Utterance per Participant						Percentage of Communication about Each Topic				
	N	Antisoc. Comm.	Neg. Comm.	Neutral Comm.	Pos. Comm.	Sexual Comm.	Total Utterances	Antisoc. Comm.	Neg. Comm.	Neutral Comm.	Pos. Comm.	Sexual Comm.
Grade 9												
Parent(s)	172	0.04	0.57	6.27	0.92	0.00	7.80	0.52%	7.31%	80.39%	11.78%	0.00%
Peer(s)	172	5.44	41.11	184.50	32.77	4.74	268.55	2.02%	15.31%	68.70%	12.20%	1.76%
Romantic Partner(s)	76	3.95	49.74	177.46	57.51	17.62	306.28	1.29%	16.24%	57.94%	18.78%	5.75%
Total	172	7.28	64.56	272.53	59.83	12.54	416.74	1.75%	15.49%	65.40%	14.36%	3.01%
Grade 10												
Parent(s)	180	0.11	0.88	12.52	1.05	0.02	14.57	0.76%	6.02%	85.89%	7.21%	0.11%
Peer(s)	180	9.62	47.88	319.78	40.58	5.39	423.26	2.27%	11.31%	75.55%	9.59%	1.27%
Romantic Partner(s)	102	8.05	59.33	317.68	69.93	30.33	485.32	1.66%	12.23%	65.46%	14.41%	6.25%
Total	180	14.32	82.62	514.37	81.46	22.66	715.43	2.00%	11.55%	71.90%	11.39%	3.17%
Grade 11												
Parent(s)	178	0.08	0.49	11.45	0.98	0.01	13.01	0.60%	3.80%	88.00%	7.56%	0.04%
Peer(s)	178	13.75	46.61	281.32	39.40	5.62	386.70	3.56%	12.05%	72.75%	10.19%	1.45%
Romantic Partner(s)	109	8.29	58.87	265.48	65.47	24.07	422.18	1.96%	13.94%	62.88%	15.51%	5.70%
Total	178	19.02	84.45	461.27	81.31	20.60	666.65	2.85%	12.67%	69.19%	12.20%	3.09%
Grade 12												
Parent(s)	180	0.24	1.44	18.03	2.13	0.01	21.84	1.12%	6.59%	82.53%	9.74%	0.03%
Peer(s)	180	13.73	49.37	235.42	39.53	4.97	343.01	4.00%	14.39%	68.63%	11.53%	1.45%
Romantic Partner(s)	118	5.14	53.88	201.04	49.84	12.27	322.18	1.60%	16.72%	62.40%	15.47%	3.81%
Total	180	17.40	86.67	390.54	75.13	13.04	582.79	2.99%	14.87%	67.01%	12.89%	2.24%

Note: Each grade represents four days of coded communication.

Table 3

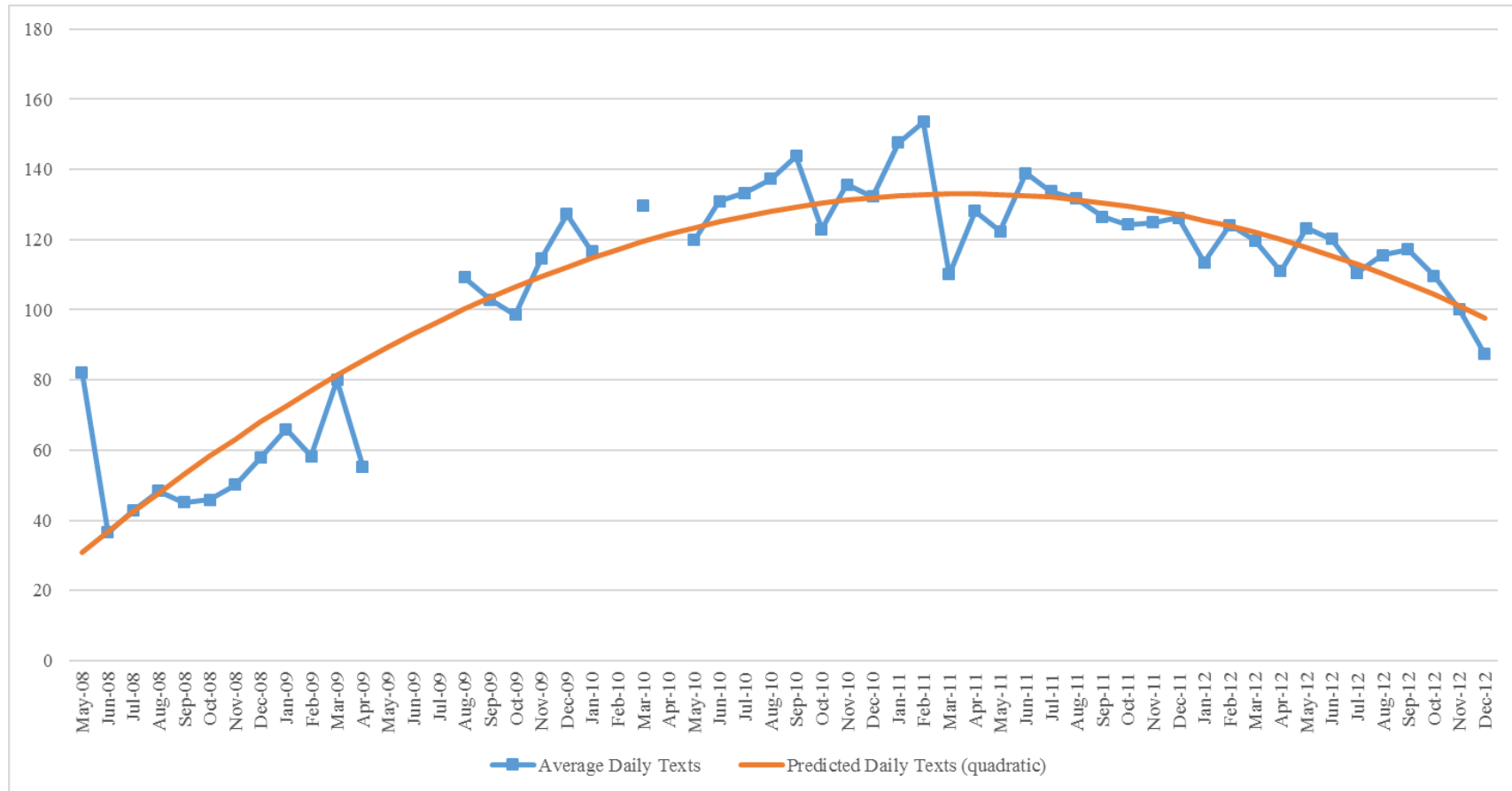
Average Delay in Minutes when Responding to text messages  
from Parents, Peer, and Romantic Partners

Grade	Parents	Peers	Romantic Partners
Grade 9	41.86 (56 / 62.66)	15.07 (166 / 17.04)	25.7 (76 / 112.64)
Grade 10	50.87 <sup>a</sup> (139 / 60.08)	14.32 <sup>b</sup> (171 / 12.99)	8.21 <sup>b</sup> (100 / 9.65)
Grade 11	65.88 <sup>c</sup> (139 / 80.32)	13.42 <sup>d</sup> (176 / 8.84)	8.35 <sup>e</sup> (108 / 7.56)
Grade 12	62.8 <sup>f</sup> (148 / 123.8)	17.53 <sup>g</sup> (177 / 11.29)	15.3 <sup>h</sup> (117 / 21.52)
All grades (averaged)	50.39 <sup>i</sup> (189 / 44.09)	14.5 <sup>i</sup> (213 / 12.59)	9.27 <sup>k</sup> (167 / 8.1)

Note: N's and SD's presented in parentheses in that order. Different superscript letters indicate significant difference in texts exchanged between communication partners (within the same year).

Figure 1.

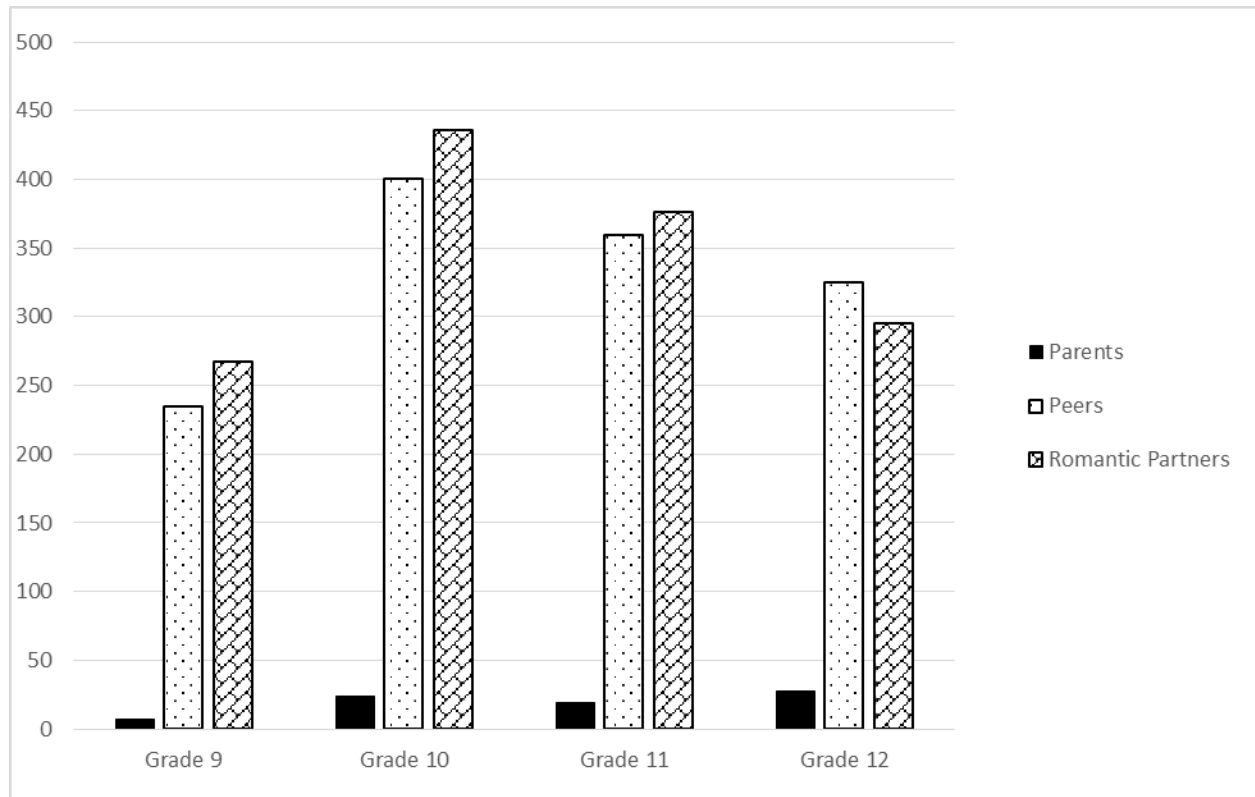
Average text messages exchanged per day, during each month of high school and the first six months following graduation.



Note: Each school year begins in August, starting with 9<sup>th</sup> grade in August, 2008.

Figure 2

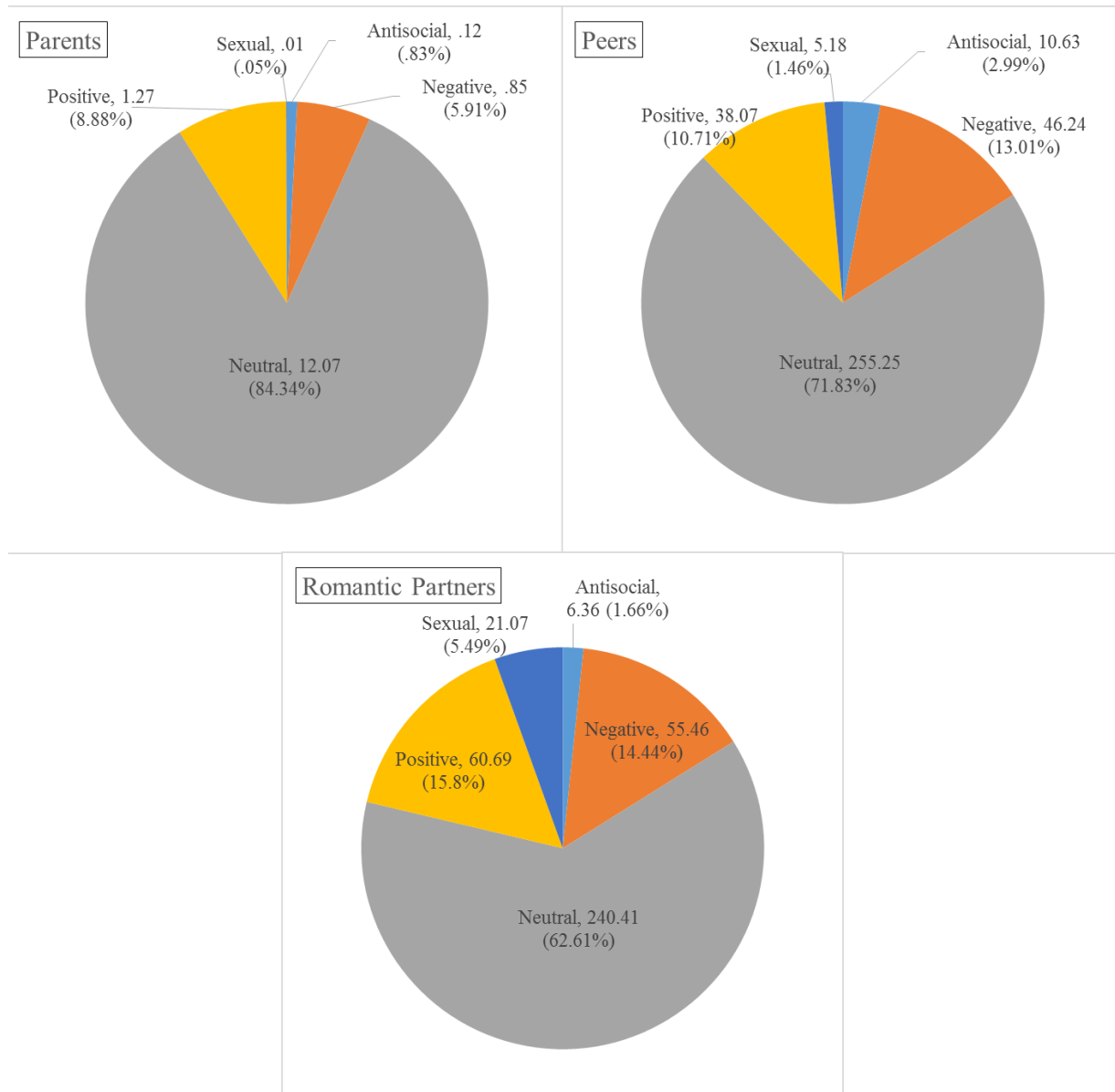
Number of Texts Exchanged in Four Days with Parents, Peers and Romantic Partners Throughout High School



Note: for Romantic partners, these totals reflect the average number of texts exchanged by individuals who had a romantic partner.

Figure 3

Conversational topics exchanged with parents, peers, and romantic partners (four days per grade, all grades averaged)



NOTE: Percentages represent the proportion of communication within each dyad member that is about each topic. For example, 8.88% of communication with Parents is positive, not 8.88% of positive communication is exchanged with parents.