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Cell Phone Use and Child and Adolescent Reading Proficiency

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Abstract

This study examined the association between cell phone use, including minutes spent talking and number of text messages sent, and two measures of children's reading proficiency — tests of word decoding and reading comprehension — in the United States. Data were drawn from the Child Development Supplement to the Panel Study of Income Dynamics, a nationally representative survey of 1,147 children 10–18 in 2009. Children whose parents were better educated, who had higher family incomes, who had fewer siblings, and who lived in urban areas were more likely to own or share a cell phone. Among those with access to a phone, children who spent more time talking on the phone were less proficient at word decoding, whereas children who spent more time sending text messages had greater reading comprehension. Although girls spent more time texting than did boys, there were no gender differences in the association between time spent talking or number of text messages sent with achievement. In spite of racial/ethnic differences in cell phone use levels, there were no racial/ethnic differences in the association between cell phone use and reading proficiency.

As every American parent knows, the cell phone has become the modal form of adolescent communication. According to one study, 75% of U.S. 12–17 year olds owned a cell phone in 2010, compared with 45% in 2004 (Lenhart, Ling, Campbell & Purcell, 2010). Cell phones are becoming more common at the elementary school level as well; in 2010, 31% of 8 to 10 year olds had access to a cell phone (Rideout, Foehr & Roberts, 2010). Children are enthusiastic users of cell phones. Parents also benefit from the additional security of being in touch with their child and knowing their location (Ling, 2007). However, having a family contract is not cheap, amounting to several hundred dollars a month for a family, limiting its accessibility. Because of the young ages at which children begin to use such phones, the amount of time spent, and the disparity in access across socioeconomic groups, it is important to understand the link between cell phone use and the development of traditional literacy skills, a core schooling goal for preteens and teens.

Considerable attention has focused on describing youth cell phone use (Lenhart et al., 2010); less attention has been paid to consequences. Time spent talking on the phone links children to other children and to parents (Ling, 2007). At the same time, talking on the phone is unlikely to be associated with greater literacy skills and could displace valuable study and reading time. The literature has reported on popular concern about the potential adverse effects of sending text messages on learning Standard English (Crystal, 2008; Thurlow, 2006), particularly because of the use of abbreviated words and phrases. However, texting, that is, sending text messages, could be linked to greater reading proficiency because it is a

form of written communication requiring at least basic literacy skills (Plester & Wood, 2009).

The association of cell phone use with the development of reading skills that are so important for success in school is the focus of the present study. Only a handful of studies have addressed such concerns; most have been conducted in the United Kingdom or Australia, where cell phones are commonly known as mobile phones. In assessing outcomes, it is important, first, to examine which children have access to a cell phone. The present study examines how age, gender, family income, race/ethnicity, urban residence, and other factors are linked to U.S. children's access to a personal cell phone. It then addresses the association between the extent of cell phone use either for voice calls or for text messages and the reading comprehension and word decoding skill of children ages 10 to 18 with access to such a phone.

Background

Since 1971, the reading scores of American children aged 9 and 13 on the National Assessment of Educational Progress have improved, with much of the growth occurring prior to 2004 (Rampey, Dion & Donahue, 2009). Although minority children continue to lag behind in reading achievement, Black and Hispanic students experienced the largest gains and the race gap showed the largest decline between 1999 and 2004. These improvements could be linked to greater access to home computers and high speed Internet over that period. Previous research has shown that the increased use of computers in the early part of this century was linked to increased achievement, particularly for females and for Black and Latino students (Hofferth & Moon, 2011). Whereas the pre-2004 period was one of increased use of computers and the Internet, the post-2004 period has shown dramatic growth in the use of mobile phones by children. Could this be a benefit or a hindrance to continued improvement in reading achievement in the near future?

Cell Phones and Children's Reading Proficiency

The concern about the greater use of the cell phone by children leading to less reading achievement has focused primarily on voice communication. Because it is a social medium, children who spend a lot of time talking on the cell phone may read less and spend less time on their studies (Ling, 2007). The reason why cell phone use for voice communication could undermine children's reading is that of displacement, a commonly documented hazard of increased electronic media use (Anderson, Huston, Schmitt, Linebarger & Wright, 2001). If talking on the phone interferes with time spent reading, for example, it could reduce reading skill. No previous research has examined the potential association between voice communication using the cell phone and reading, so a negative association is anticipated based upon displacement theory. Because positive effects of text messaging could offset any negative impact of using the phone for talking, thus resulting in no overall impact of the cell phone, it is important to separately examine minutes spent talking and the frequency of text messaging.

What might be the mechanism linking cell phone text messaging to children's greater reading proficiency? The first possibility is greater exposure to the written word (Plester &

Wood, 2009). Nine out of ten U.S. cell phone users 12–17 send text messages (Lenhart et al., 2010). Texting involves composing and writing words, phrases, and sentences. Because of greater exposure to written language — including vocabulary, spelling, and syntax — texting may be linked to increased reading proficiency. Literacy and texting skills may be complementary, not substitutes; if so, greater use of the phone for texting could be positively related to reading.

The second possibility is that texters gain greater proficiency in the English language through text messages, particularly phonological skill, and such understanding is fundamental to learning Standard English. Most cell phone users use “textese,” or “textisms,” a largely sound-based form of spelling that reduces the time and cost of texting. This language includes abbreviations, contractions, and non-conventional spellings. The use of textese instead of Standard English is deliberate. In spite of some fears (Crystal, 2008), several studies have found that texters recognize when textese is appropriate and when not; both early adolescent and young adult users are clearly aware that their spellings are not Standard English and they rarely use them in their class work (adolescents) or in formal communications (young adults) (Ling & Baron, 2007; Plester & Wood, 2009; Rosen, Chang, Erwin, Carrier & Cheever, 2010).

Third, writing text messages has an element of playfulness and fun, which may engage the child’s imagination more than a typical school language arts curriculum and thus promote a more creative, engaged, and literate child (Plester & Wood, 2009).

Research Findings linking Text messaging to Vocabulary and Reading

The results of studies that have investigated the texting and literacy link find no association between whether someone engages in text messaging at all and literacy measures, regardless of age. For example, one study of the use of textese by Australian 10 to 12 year olds (N = 86) did not show any significant score differences between texters and nontexters on standardized reading tests (Woodcock-Johnson letter-Word Identification and Word attack tests) (Kemp & Bushnell, 2011). A study of American college students also failed to find any difference in literacy scores on the Woodcock-Johnson Letter-Word and Reading Fluency tests between those who did and who did not send text messages (Drouin & Davis, 2009). Two out of three participants in this study expressed the opinion that the use of textese may hinder their recall of Standard English; however, those who expressed this opinion scored no worse on the reading tests than those who did not.

Among those who engage in text messaging, length of exposure to text messages, number of messages sent, and the ratio of textisms to total words may also be linked to literacy. A strong association between reading skill and length of exposure to traditional print materials has been documented (Cipielewski & Stanovich, 1992). The same association appears to apply to text message exposure. Research on a British sample of preteens (N = 88 10–12 year olds) showed that the younger the child received a cell phone the better their word reading ability (on the British Ability Scales) and the more textisms they used (Plester & Wood, 2009). Research has also found an association between the use of textese and increased language proficiency. The same study of British 10–12 year olds (N = 88) found that the ratio of textisms to total words used was positively associated with word reading,

vocabulary, and phonological awareness measures (Plester, Wood & Joshi, 2009). Moreover, in this study the children's textism use predicted word reading ability after controlling for individual differences in age, short-term memory, vocabulary, phonological awareness, and how long they had owned a mobile phone. Consistent with the argument that phonological awareness is the mediating factor, the results suggested a stronger positive association between textisms and word reading than either vocabulary or spelling skill, particularly for younger children. Reading messages written in textese has been shown to be slower than reading messages written in Standard English (Kemp & Bushnell, 2011). Because of the importance of context in determining the content of a message, this skill may also be associated with better passage comprehension, which requires test takers to be able to identify the appropriate omitted word in a passage. A unique study of older children examined the association between experience sending text messages, the proportion of textisms, the number of categories of textisms, and consistency in textisms of students in grades 8–9 (De Jonge & Kemp, 2010). The authors found an inverse correlation between these indicators and reading and spelling scores on the Wide Range Achievement Test, but these results did not hold after text message frequency was partialled out. In this analysis high school and university level students were combined because of small sample sizes (Total N = 84) and, unfortunately, neither high school nor university students were representative of the population of students in that the reading and spelling levels of the former equaled or exceeded those of the latter. One other study of young adults found positive effects of text messaging on reading that were context specific. This research on young U.S. adults 18–25 (N = 335) found a positive association between textism usage and informal writing, but a negative association with formal writing (Rosen et al., 2010).

Selectivity

All the above studies were cross-sectional, and could not establish causality. The direction of effect may be reversed if worse readers spend more time talking on the phone and if better readers text more. In the Australian study of 10–12 year olds, skill at Standard English was linked to skill at reading textese; better readers were faster at both composing and reading text messages than poorer readers (Kemp & Bushnell, 2011). In that study, speed of reading textese accounted for 10–14% of the variance in literacy scores beyond the effect of age in reading conventional messages.

The association between texting and literacy may also be spurious if more advantaged children are both more likely to use the cell phone for texting and score better on reading achievement. Because the present study, as was most previous research, is cross-sectional and observational, we adjust statistically for factors that have been found to be linked to both access to a cell phone and to children's reading skills, such as race/ethnicity, gender, parental education and reading comprehension, family income, family structure, and rural-urban residence. These controls will eliminate some potential alternative explanations, but cannot establish causality.

In the single experimental study that randomly assigned non-cell-phone children ages 9–10 to use a mobile phone, no overall difference in test scores between 10–12 year olds who previously had or had not used a mobile phone was found (Wood, Jackson, Hart, Plester &

Wilde, 2011). There were substantial differences however, in certain types of literacy skills by amount of use of a cell phone; those children who used more textese demonstrated better phonological awareness and fluency and showed greater improvement in spelling. These results suggest that text messaging may be causally linked to children's literacy skills.

Gender and Race/Ethnic Differences in the Link between Cell-phone Use and Literacy

Descriptive research has clearly shown girls to be the more frequent users of cell phones, both for conversations and for text exchanges. The Pew Internet and American Life Project found that, on a daily basis, 59% of girls called friends on their cell phone, compared to 42% of boys, and 86% of girls text messaged friends, compared to 64% of boys (Lenhart et al., 2010). Research also showed that girls have an advantage in literacy achievement, testing higher on both vocabulary and on reading (Rampey et al., 2009). We expect differences in the influence that cell phone texting may have on boys' and girls' reading scores. Because boys lag behind girls in reading, using the phone for texting may benefit boys' reading proficiency more than that of girls. However, girls have been shown to produce messages with more textisms than boys; consequently, they may benefit more. The direction of effect cannot be predicted.

Hispanics and Blacks are more likely to own a cell phone than have a land line. In 2008 25% of Latinos and 21% of Blacks lived in cell-only households compared with 17% of Whites (Pew Internet and American Life Project, 2009; Pew Internet and American Life Project, 2010). Little is known about access of Asian children to the cell phone. Because it is associated both with access to a cell phone and to achievement, we control for race/ethnicity throughout. Additionally, we examine whether the influence of cell phone use on reading differs across racial/ethnic groups. Because of lack of theory regarding differences, we do not hypothesize the nature or direction of these interactions.

Hypotheses

Our hypotheses are the following:

1. The greater the time spent talking on a cell phone, the lower the reading proficiency scores of children and adolescents.
2. The greater the number of text messages sent using a cell phone, the higher the reading proficiency of children and adolescents.
3. The association between text messages or talking on a cell phone and reading proficiency will vary by the gender of the child/adolescent, but the direction is not predicted.
4. The association between text messages or talking on a cell phone and reading proficiency will vary by the race/ethnicity of the adolescent.

Method

Data

This study utilizes a newly released wave of data from the Panel Study of Income Dynamics Child Development Supplement. The PSID is a 42-year longitudinal survey of a representative sample of U.S. individuals and their families (*Panel Study of Income Dynamics*, 2011). In 1997, the PSID refreshed the sample to include post-1968 immigrants and inaugurated the first Child Development Supplement (CDS I), which was administered to the parents of children aged 0–12 and up to two of their children. The first wave of the CDS included 3,563 children from 2,380 families, a response rate of 88%, and the second wave (CDS II), conducted in 2002 and 2003, included 2,907 (out of 3,191 eligible) children and adolescents aged 5–18, a response rate of 91%. This study used data from the third wave (CDS III), conducted in 2007 and 2008. In this wave, 1,506 out of 1,676 eligible children 10–18 (living at home/not finished with high school) participated (a 90% response rate). Only data on children who were the biological, step, or adopted son or daughter of the household head or spouse/partner were drawn from CDS III. After this restriction was applied, the sample size was 1,438 children from CDS III. Data on maternal vocabulary test scores were missing in 249 cases, 10 cases had zero weights, 32 cases were missing parental education, and 1 was missing family income; the total sample for the current study, therefore, was 1,147. Weights were calculated by the survey team from the U.S. Current Population Survey based upon the initial probability of selection (stratified by race, income, and family structure) and attrition from the sample (Gouskova, Heeringa, McGonagle, Schoeni & Stafford, 2008; Heeringa, Berglund, Khan, Lee & Gouskova, 2011). When weights are applied (using the weighting procedures in standard statistical packages), these data have been shown to be representative of the U.S. population (Fitzgerald, Gottschalk & Moffitt, 1998), with the exception that post-1997 immigrants to the U.S. are underrepresented. Sample sizes shown and used for statistical testing are actual sample sizes.

In the third wave that was completed in 2008 (but not in prior years), the study collected information about cell phone use. Children were asked whether they owned a cell phone, shared a cell phone with family members, or neither owned nor shared a cell phone. Because sharing phones across household members is a common practice (Lenhart et al., 2010), we counted children who shared as well as those who owned a phone as having access; in our sample only about 15% of those with access to a phone shared it. If children owned or share a cell phone and used it, they reported how many minutes they had used and how many text messages they had sent in the last month. The weekly minutes of cell phone use and number of text messages sent were computed by converting monthly use figures to daily use figures, and then summing these to arrive at a number representing weekly use. For multivariate analyses, weekly cell phone minutes were converted to hours and the weekly number of text messages sent was divided by 100 to make the coefficients more comparable in scale to those of the other variables in the analysis; the change in units does not influence statistical significance.

Dependent Variables

Reading Proficiency—Children's reading proficiency was measured using two subtests of the Woodcock-Johnson II Revised Test of Achievement: Letter-Word Identification, a test of children's ability to identify printed letters and words (word decoding), and Passage Comprehension, a test of the ability to identify a missing key word that makes sense in the context of a sentence (reading comprehension) (Schrank, McGrew & Woodcock, 2001; Woodcock & Mather, 1989). These tests were age-standardized with a mean of 100 and a standard deviation of 15. The interviewers were trained and provided with the materials needed to administer this test in the target child's home.

Control Variables

Cell phone use varies by gender (male, female), age (10–12, 13–15, 16–18), and race/ethnicity (nonLatino White, nonLatino Black, Latino, Asian, and other), and we first examined group differences. Family characteristics were included in multivariate analyses as control variables that might influence both cell phone use and the child's reading scores. These include the education of the parent, the number of children in the household, and the ratio of family income to poverty. Including the Woodcock-Johnson Passage Comprehension test score of the mother adjusts for potential selectivity in who uses a cell phone by the level of reading skill in the family. A variable combining number of parents and the employment of the parents was created to adjust for both family structure and employment (two parents, both working; two parents, one employed; two parents, neither working; and single parent). Residence in a central city, noncentral-city metropolitan area, other urban area or small town, or rural area controls for cell phone availability; because of the lower density of population, cell towers and cell phone service have, until recently, been less available in rural areas (Lenhart et al., 2010).

Procedure

We first present levels of cell phone ownership among 1,147 children, and cell phone minutes used and text messages sent among the 727 who used the phone, by gender, age, and racial/ethnic group in 2008. Second using logistic regression, we regressed whether the child owns or shares a cell phone on family background variables to see what distinguishes children with and without access to a cell phone and results are presented in terms of odds ratios. Third, using a sample of 727 children who reported using the cell phone in the previous month, we separately regressed their score on the Woodcock-Johnson Letter-Word and Passage Comprehension tests on hours of cell phone use and number of text messages, without controls. In a second model we added controls for age, gender, race/ethnicity, parental education, family income, number of children, number of parents and parental employment, urbanicity, and maternal score on the Passage Comprehension Test. In a third model we added the interaction between gender and cell phone use. There were significant interactions neither across age groups nor across race/ethnicity in the effects of voice phone or text message use on reading, and these results are not presented. Effect sizes were calculated by dividing the unstandardized coefficients by the standard deviation of the dependent variable in that regression.

Results

Descriptive Analyses: Gender and Age Differences

Of our 1147 children 10–18 in 2008, 74% owned or shared a cell phone (Table 1, top panel, top row, first column). In the month they were interviewed, 63% actually used the phone. As expected, cell phone ownership or sharing increased with age, amounting to 58% of children 10–12, 79% of children 13–15, and 84% of children 16 or older. Among only those 727 who used the cell phone (Table 1, bottom panel, top row, first column), the weekly number of minutes using the cell phone averaged 62 and the weekly number of text messages sent averaged 78, about 11 per day. Although this seems low compared to other reports that showed an average of 50 messages per day (Lenhart et al., 2010; Rideout et al., 2010), it includes those who did not use their phones for texting. Our sample also included 10–11 year olds, who were not included in other estimates. If the weekly number is restricted only to those who sent messages (37%), the number of messages would average 239 per week, or about 34 per day (not shown). As expected, the number of minutes and messages was smaller for 10–12 year olds, about 16 minutes and 11 text messages. It rose to 58 minutes and 72 text messages for 13–15 year olds and 99 minutes and 131 text messages for those 16 or older.

Girls' likelihood of owning or sharing a cell phone exceeded that of boys. Only the 13–15 year olds showed no gender difference in owning or sharing a cell phone. Although there were no gender differences in cell phone minutes, there were consistent differences in the number of text messages sent, with girls' text messages exceeding boys' for all age groups.

Racial and Ethnic Differences

Latino children had less access to a cell phone than did White children; 59% of Latino children owned or shared a cell phone, compared with 77% of White children (Table 2). Black and Asian children did not differ from White children in cell phone access. Among those who used a cell phone, Black and Asian children sent fewer text messages than White children whereas Latino children spent both less time talking on the phone and less time sending text messages.

Although across all ages Black children did not differ from White children in cell phone access, within some age groups there were Black-White differences. Black children 10–12 were more likely to own or share a cell phone than White children 10–12 and Black children 13–15 were less likely than white children to own or share a cell phone (not shown). There were no racial/ethnic differences in cell-phone ownership or sharing among those 16 years old or older.

Descriptive Characteristics of the Sample, by Gender

Table 3 shows the means and standard deviations of the continuous variables and percentages for categorical variables, by gender. Two thirds of the sample was White; one third was minority. Compared to comparable figures for children 10–19 for the U.S. in 2009, Hispanic children are underrepresented (12% vs. 19% in the U.S.) and White children are overrepresented (67% vs. 61% in the U.S.) (U.S. Census Bureau, 2012). The other racial/

ethnic groups appear in the sample in proportion equal to that of the total U.S. population of children. Of the total sample, 29% were 10–12, 39% were 13–15, and 31% were 16–18. Over half of the mothers (54%) had completed some college or more, comparable to the proportion of all U.S. women who had completed some college (57%). Most children lived in families with two parents, both employed (53%); only 24% lived with a single parent, again, comparable to the proportion in the entire U.S. Three quarters of children lived in a metropolitan area, including the central city and surrounding suburbs.

There were few gender differences in these variables. Girls were slightly younger than boys; a higher proportion of girls were age 10–12. A significantly higher proportion of girls than boys lived with a parent who had completed high school but had not obtained more schooling. Girls lived in households with more children than did boys and girls were more likely than boys to be in a single earner two-parent family, whereas boys were more likely than girls to live in a dual earner family.

Cell Phone Access

Table 4 examines whether the child owned or shared a cell phone. Older age and gender were the most important factors, with family resources a close second. Children 13–15 were 148% $((2.48-1)*100)$ more likely to own or share a phone and children 16–18 were 185% more likely to own or share a phone than children 10–12. Girls were 69% more likely to own or share a phone than boys. Children in families with greater parental education, income, and fewer children were more likely to own or share a phone. Each additional unit increment in the ratio of income to poverty increased phone ownership or sharing by 11%, whereas each additional child reduced it by about 38% $((.62-1)*100)$. Children of parents who completed some college were 89% more likely to own or share a phone than those with a parent who had not completed high school. Children living in a two-parent family with no breadwinner were highly likely to have a phone, but this group was quite small. As expected from lesser access to a cell phone network, children in rural areas were 69% $((.31-1)*100)$ less likely to own or share a phone than those in the central city. However, children in all the other residential locations were also less likely to own or share a cell phone than central city residents, although the difference was not as large as it was for rural residents. The mother's own reading comprehension score was not related to whether her child owned or shared a cell phone.

Reading Proficiency

Letter-Word Identification Test—Without controls, spending more time talking on the cell phone was associated with a significantly lower score on the Letter-Word Identification Test (Table 5, Model 1). Including all controls (Model 2), each additional hour spent talking on the phone was associated with a decline of .55 points on the letter-word test ($p < .05$), an effect size of 0.04, a small effect. Including the interaction of gender with cell phone hours (Model 3) increased the coefficient of cell phone hours ($b = -.72$, $p < .05$) on letter-word score, but the effect size was still small (0.05). The interaction of gender with cell phone use in influencing letter-word score was not statistically significant.

Text messages sent were not significantly associated with the letter-word score either without or with controls. In Model 3, with interactions between gender and cell phone hours and gender and text messages included, the association was positive and marginally significant ($b = .82, p < .10$) but the effect size was still small, 0.05. Gender did not interact significantly with number of text messages in influencing letter-word score.

Race and ethnicity were the variables most strongly linked to the letter-word score, with Blacks, Latinos, and children of other races having significantly lower scores than White children, and Asian children having significantly higher scores. The effect sizes were large: 0.64 for Blacks, 0.37 for Latinos, and 0.71 for Asians. Interactions between cell phone use and race/ethnicity and between text message use and race/ethnicity were also examined. Contrary to expectation, there were no significant interactions between voice or text message use and any of the racial/ethnic groups in influencing letter-word score (not shown).

Neither parental education nor the mother's reading test score was significantly linked to the child's letter-word test score. The effect size for parental education was moderate, 0.22, but did not reach statistical significance at $p < .05$. There were no residential location differences in letter-word score.

Girls had significantly higher Letter-Word Identification Test scores than did boys, $b = 2.51, p < .05$, an effect size of 0.15. However, there was no significant gender difference in the association between the number of text messages or voice time and the letter word test score (Model 3), as neither interaction was statistically significant.

Passage Comprehension—On the test of passage comprehension, children who sent more text messages had significantly higher scores before controls were included ($b = .80, p < .05$, effect size = 0.05, Model 1) and even after ($b = .56, p < .05$, effect size = 0.04, Model 2). This coefficient increased ($b = .85, p < .05$, effect size = 0.06) after the interactions were included in Model 3. Cell phone hours for talking were not significantly associated with the Passage Comprehension Test score.

As for the letter-word score, race and ethnicity were major influences. Black children, Latino children, and children of other races had lower scores on this test, whereas Asian children had higher scores. Interactions between race/ethnicity and text messaging or talking on the phone were not significantly associated with passage comprehension. Thus, there were no racial/ethnic differences in the effect of text messaging or talking on the phone on children's passage comprehension score (not shown).

Parental education and family structure were important to children's reading. Children with a parent who had completed some college scored significantly higher on the passage comprehension test and the effect was moderate (effect size = 0.30). Having a mother with a better reading score was also associated with her child having a better reading score, but this was not as strong (effect size = 0.04). Children living in a two-parent single earner family were better readers than those with two employed parents (effect size = 0.22), whereas children in a single parent family were not as proficient as those living with two parents (effect size = 0.26). There were no differences by residential location.

Consistent with previous research, girls were shown to have higher reading comprehension than boys ($b = 2.39$, $p < .05$, effect size = 0.16). The interactions between gender and either voice use or text use of a cell phone (Model 3) were not statistically significant; thus, there were no gender differences in the effect of text messaging (or voice phone use) on reading score (Model 3).

Discussion

In 2009, cell phones were used by three quarters of American children, with almost 60% of 10–12 year olds, 79% of 13–15 year olds and 84% of 16–18 year olds having access to such a phone. The majority of children used the phone to send text messages as well as to talk. In spite of substantial popular concern about the impact on children's literacy of extensive texting, no previous evidence indicated that using a phone to text per se was associated with lesser literacy among early adolescents. Therefore, this study focused on how the amount and type of usage of a cell phone may be associated with reading proficiency among those who have access to a phone. Based upon a large nationally representative U.S. study of children, the results of the present study paint a more positive but nuanced picture of cell phone use and children's reading proficiency.

Supporting the first hypothesis that talking on the phone would be linked to lower reading proficiency, spending more time talking on the phone was associated with a lower score on the Letter-Word Identification Test, a measure of word decoding. This association is statistically significant, but small. It is likely that this negative association reflects displacement; other analyses of the same data (not presented here) showed a small negative but marginally significant correlation between the time children spent reading and the time spent talking on the phone. However, an alternative explanation for this finding is that children and adolescents who are not proficient at or do not like to read may choose to talk on the phone. Even if they were not talking on the phone they might choose to do another non-literacy-based activity. With the cross-sectional data it is not possible to sort out the direction of causation.

Hypothesis 2, that greater text messaging would be linked to a higher score on the Reading Comprehension Test, is also supported. In contrast to time spent talking, more time spent texting is associated with significantly better reading comprehension. This is likely to operate through two mechanisms, which we could not test directly. First, more texting means more exposure to the written word, and greater exposure to written language has been shown to be associated with better reading skills. Unfortunately, the survey did not ask when the youth first received a phone. Age is not a good proxy for exposure because of the very recent availability and growth of text messaging. Second, text messaging, especially using textese, is associated with developing the types of phonological skills that are important to being a good reader. The findings clearly indicate that it is not the use of the cell phone per se, but the written language skills involved in texting that are linked to children's reading skill. The number of text messages sent was positively associated with reading comprehension whereas time spent talking on the phone was not. It is, of course, also possible that children who have good reading proficiency may be more likely to send text messages than those who are less proficient. Although it is impossible to sort out causality using cross-sectional

data, we have adjusted for the initial level of reading proficiency in the family by controlling for the mother's reading proficiency. Net of the overall level of reading proficiency that characterized the family even before a child first obtained his/her own cell phone, we still found evidence that children who sent more text messages were better at reading comprehension. The Passage Comprehension Test shows the participant a sentence with a key word removed and asks the participant to pick the word out of a list that best fits the meaning of the sentence. This is a skill that is similar to what would be required to read messages that contain multiple textisms. So, although this particular link has not been tested in prior research, the comprehension skills involved in reading messages containing textisms and reading sentences with unknown words may be similar, thus explaining the association. More research is needed to explore this finding.

Although several earlier studies focused on early adolescents, the present study found no reason to anticipate differences in the association between use of textese and reading proficiency as children age from age 10 to about age 18. No interactions between age and use of the phone for text messaging were found. Of course, the writing that college-age and older young adults engage in could, in the long-run, be influenced by their earlier experience with text-based messages and textese, but few young adults currently have the length of experience to test such a hypothesis.

Hypothesis 3, that there would be a gender difference in the association between cell phone use and reading proficiency, was not supported. Even though girls spent more time texting than boys and their reading scores exceeded those of boys, there was no difference between the two groups in the association between either voice use or text use of a cell phone and reading. The results described above hold for both genders.

Hypothesis 4, that there would be racial/ethnic differences in the association between cell phone use and reading proficiency, was not supported. Although there were racial/ethnic differences in the use of cell phones for talking and for text messaging, and there were also differences in reading achievement across racial/ethnic groups, the association between cell phone use and reading was similar for all groups. One caveat is that the sizes of the Hispanic and Asian samples were small. Research with larger samples of these groups is suggested.

Other Major Findings

One of the most important conclusions is that family factors have much stronger effects on children's word decoding and comprehension than does their child's or adolescent's use of the cell phone. The effect sizes we found for voice phone and text messaging were quite small, under 0.10, whereas the effects of other variables such as race/ethnicity were large, above 0.50. After race/ethnicity, maternal education and family structure/parental employment were the most important factors influencing reading comprehension, with moderate effect sizes. Gender was also significantly associated with reading proficiency, but with a small effect size.

Limitations of the study

Although the data were obtained at one point in time, thus limiting the extent to which we can conclude that the associations we documented are causal, the results were consistent

with observational studies that examined the association between use of textese and specific literacy skills and with the single experimental study that found a positive effect of text messaging on literacy skills.

One major limitation of the study is that the data on minutes of cell phone use and number of text messages are self-reported by the children and adolescents. Younger children may be less accurate reporters of their cell phone habits than older children and adolescents. This could contribute to the failure to identify age differences in the association between cell phone use and reading proficiency. However, most of the cell phone studies we reviewed depended upon self-report to establish text use and frequency of texting. Additionally, this study was unable to determine the extent of the use of textisms relative to Standard English by individual children. Rather, it relied solely on self-reported total number of messages sent.

Strengths of the Study

The data were drawn from a large, representative sample of the entire U.S. population of children of all ages, genders, race/ethnicities, and residential location in the context of a detailed study of child development. The fact that it was not focused specifically on cell phone use should reduce the danger of producing socially desirable responses regarding the use of electronic media. The response rates to the survey were high and the data of correspondingly high quality. We were able to control for family characteristics such as parental education and family structure that were associated with both differential reading proficiency and with cell phone access and whose omission could confound the true association between cell phone use and reading proficiency. Another important inclusion was the reading score of the mother, obtained from the same test taken by her child, which adjusts for underlying family differences in verbal capacity prior to the child's use of the cell phone. We also controlled for urbanicity; the findings showed that there are regional and urban differences in exposure to cell phones, but that this dimension does not influence reading proficiency.

Conclusions

Although in 2008 roughly three-quarters of American children age 10 to 18 had access to a cell or mobile phone, access is not randomly distributed. Children whose parents were better educated, who had higher family incomes, who had fewer siblings, and who lived in urban areas were more likely to own or share a cell phone. Children are also more likely to have access as they age into adolescence, when more than 8 out of 10 use such a phone. The vast majority of children used the phone for sending text messages; this research found several reasons for parents or educators to be less concerned about the use of the cell phone for sending text messages than for talking. The results showed that greater text messaging was associated with greater reading comprehension. In contrast, greater use of the phone to communicate by voice was associated with lower scores on decoding letters and words. These results are consistent with the interpretation that a technological device that increases preadolescents' and adolescents' exposure to written words and sentences, especially in ways that are fun and social, may improve their literacy skills.

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Table 1
Proportion of Children with Access to a Cell Phone and Mean Usage among Those with Access

Weekly time	All			Boys			Girls			Boys vs. Girls		
	n	M	SD	n	M	SD	n	M	SD	p		
All Children Aged 10–18	1147			595			552					
Own or share cell phone	853	0.74		429	0.72		424	0.77				
Used the phone	723	0.63		381	0.64		348	0.63				
Aged 10–12	341			165			176					
Own or share cell phone	199	0.58		83	0.50		115	0.66		**		
Used the phone	181	0.53		83	0.50		99	0.56				
Aged 13–15	472			268			204					
Own or share cell phone	373	0.79		216	0.81		158	0.77				
Used the phone	307	0.65		190	0.71		118	0.58				
Aged 16–18	334			162			172					
Own or share cell phone	279	0.84		129	0.79		152	0.88		*		
Used the phone	240	0.72		107	0.66		132	0.77				
Children who used the Cell Phone												
All Aged 10–18	727			379			348					
Cell phone use_minutes ^a		62	154		62	182		62	118			
Number of text messages sent ^b		78	192		64	184		92	199			
Aged 10–12	180			82			98					
Cell phone use_minutes ^a		16	46		17	54		15	40			
Number of text messages sent ^b		11	51		8	34		13	60			
Aged 13–15	308			190			118					
Cell phone use_minutes ^a		58	141		52	151		66	124			
Number of text messages sent ^b		72	188		55	176		95	203		*	
Aged 16–18	239			107			132					
Cell phone use_minutes ^a		99	201		104	254		95	140			
Number of text messages sent ^b		132	238		112	233		149	242		*	

Note. Means and proportions are weighted. N's are unweighted.

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p < .001,
**
p < .01,
*
p < .05, two-tailed t test.
b Weekly minutes of cell phone use, including 0.
b Weekly number of text messages sent, including 0.

Proportion of Children 10–18 with Access to a Cell phone and Mean Use among Users, by Race/Ethnicity

Table 2

Weekly time	White			Black			Latino			Asian			Other race		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD	n	M	SD
All children 10–18	572			470			75			18			12		
Own or share cell phone	438	0.77		356	0.76		44	0.59		14	0.79		10	0.79	
Used the phone	383	0.67		214	0.60		42	0.56		12	0.67		6	0.50	
Children who used the Phone	383			284			42			12			6		
Cell phone use_minutes ^a		57	140		79	182		27	46.27		121	342		206	209
Number of text messages ^b sent ^b		91	205		53	170		23	72.49		23	69		196	353

Note. Means and proportions are weighted. N's are unweighted.

p < .001,

**
p < .01,

*
p < .05, two-tailed t test of this group vs. White group.

^aWeekly minutes of cell phone use, including 0.

^bWeekly number of text messages sent, including 0.

Table 3
Descriptive Statistics on Test Scores and Control Variables for Full sample, by Gender

Weekly time:	All		Boys		Girls		Boys vs. Girls	p
	M	SD	M	SD	M	SD		
Reading scores:								
Letter-word Identification	104.09	17.05	103.55	17.97	104.66	16.01		
Passage Comprehension	100.35	15.04	99.55	15.75	101.19	14.22		
Background:								
Race/Ethnicity								
White	0.67		0.67		0.67			
Black	0.16		0.16		0.15			
Latino	0.12		0.13		0.12			
Asian	0.03		0.03		0.03			
Other race	0.02		0.02		0.02			
Age of Child								
Age 10–12	0.29		0.26		0.32			*
Age 13–15	0.39		0.41		0.38			
Age 16–18	0.31		0.32		0.30			
Girl	0.49		-		-			
Parent Education								
Less than high school	0.16		0.16		0.16			
High school	0.30		0.27		0.33			*
Some college or more	0.54		0.56		0.51			
Number of children in household	2.29	1.16	2.22	1.13	2.36	1.19		*
Family income to poverty ratio	4.23	4.57	4.43	5.45	4.02	3.39		
Family Structure & Employment								
Two parents working	0.53		0.57		0.49			**
One parent working in two parent family	0.21		0.18		0.25			**
No breadwinner in two parent family	0.03		0.02		0.03			

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	All		Boys		Girls		Boys vs. Girls	
	M	SD	M	SD	M	SD	p	
Weekly time:								
Single parent family	0.24		0.23		0.24			
Urban-Rural Residence								
Central city	0.23		0.23		0.23			
Metropolitan	0.49		0.49		0.50			
Urban & Small town	0.22		0.24		0.21			
Rural	0.05		0.04		0.06			
Mother's test score	32.07	5.22	32.09	5.24	32.06	5.20		
N	1147		595		552			

Note. Means and proportions are weighted; N's are unweighted.

p < .001,

**
p < .01,

*
p < .05, two-tailed t test.

Table 4**Predictors of Children's Cell Phone Access**

Variable	B	SE	<i>p</i>	<i>OR^a</i>
Constant	1.16	0.67		
Race/Ethnicity				
White (omitted)				
Black	0.17	0.25		1.18
Latino	-0.22	0.27		0.81
Asian	0.13	0.51		1.14
Other race	0.50	0.67		1.65
Age of Child				
Age 10–12 (omitted)				
Age 13–15	0.91	0.17	***	2.48
Age 16–18	1.05	0.20	***	2.85
Girl	0.52	0.15	***	1.69
Parent Education				
Less than high school (omitted)				
High school	0.29	0.24		1.34
Some college or more	0.63	0.26	*	1.89
Number of children in household	-0.48	0.07	***	0.62
Family income to poverty ratio	0.11	0.04	*	1.11
Family Structure & Employment				
Two parents working (omitted)				
One parent working in two parent family	-0.24	0.20		0.78
No breadwinner in two parent family	1.61	0.60	**	5.02
Single parent family	-0.29	0.21		0.75
Urban-Rural Residence				
Central city (omitted)				
Metropolitan	-0.47	0.22	*	0.62
Urban & Small town	-0.67	0.25	**	0.51
Rural	-1.18	0.36	**	0.31
Mother's test score	0.00	0.02		1.00
Fit Statistics				
-2 Log likelihood	1095.18			
AIC	1133.18			
BIC	1229.03			

Note. N=1147. Data are weighted; N's are unweighted.

p < .001,

**
p < .01,

*
p < .05, two-tailed test.

^aOdds ratio for the probability of own or share (n=862) vs. not own or share.

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Table 5

Predictors of Letter-Word Test Score, Children who Used the Phone

Variable	Model 1	Model 2	Model 3
Constant	105.03 ***	74.63 ***	74.32 ***
Weekly time:			
Cell phone use_hours ^a	-0.63 *	-0.55 *	-0.72 *
Number of text messages sent ^b	0.56	0.38	0.82
Background:			
Race/Ethnicity			
White (omitted)			
Black		-10.68 ***	-10.82 ***
Latino		-6.20 **	-6.17 **
Asian		11.79 ***	11.91 ***
Other race		-8.68 *	-9.57 *
Age of Child			
Age 10–12 (omitted)			
Age 13–15		0.59	0.59
Age 16–18		-1.25	-1.26
Girl		2.34 *	2.51 *
Parent Education			
Less than high school (omitted)			
High school		1.39	1.61
Some college or more		3.54	3.62
Number of children in household		0.89	0.90
Family income to poverty ratio		0.14	0.15
Family Structure & Employment			
Two parents working (omitted)			
One parent working in two parent family		-1.29	-1.30
No breadwinner in two parent family		-3.27	-3.22
Single parent family		-1.92	-1.92
Urban-Rural Residence			

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Variable	Model 1	Model 2	Model 3
Central city (omitted)			
Metropolitan		-0.65	-0.72
Urban & Small town		-1.28	-1.48
Rural		-2.36 ***	-2.41 ***
Mother's test score		0.87	0.87
Girl * Cell phone use hours			0.48
Girl * Number of Text messages			-0.85
R ²	0.01	0.29	0.29

Note: N=727. Data are weighted; N's are unweighted.

p < .001

**
p < .01,

*
p < .05, two-tailed test.

^aWeekly hours of cellphone use.

^bWeekly number of text messages sent / 100.

Table 6

Predictors of Passage Comprehension Test Score, Children who Used the Phone

Variable	Model 1	Model 2	Model 3
Constant	100.89 ***	80.29 ***	80.12 ***
Weekly time:			
Cell phone use_hours ^a	-0.29	-0.12	-0.31
Number of text messages sent ^b	0.80 *	0.56 *	0.85 *
Background:			
Race/Ethnicity			
White (omitted)			
Black		-7.93 ***	-8.07 ***
Latino		-6.54 ***	-6.52 ***
Asian		8.66 **	8.89 **
Other race		-13.19 ***	-13.97 ***
Age of Child			
Age 10–12 (omitted)			
Age 13–15		2.49 *	2.41
Age 16–18		-1.85	-1.95
Girl		2.39 *	2.20 *
Parent Education			
Less than high school (omitted)			
High school		1.78	1.90
Some college or more		4.41 *	4.40 *
Number of children in household		-0.39	-0.37
Family income to poverty ratio		0.05	0.07
Family Structure & Employment			
Two parents working (omitted)			
One parent working in two parent family		3.28 **	3.31 **
No breadwinner in two parent family		0.42	0.43
Single parent family		-3.91 **	-3.95 **
Urban-Rural Residence			

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Variable	Model 1	Model 2	Model 3
Central city (omitted)			
Metropolitan		1.14	1.08
Urban & Small town		2.03	1.89
Rural		-4.05	-4.13
Mother's test score		0.55	0.56
Girl * Cell phone use hours			0.62
Girl * Number of Text messages			-0.59
R ²	0.01	0.31	0.31

Note: N=727. Data are weighted; N's are unweighted.

*** p < .001,

** p < .01,

* p < .05, two-tailed test.

^aWeekly hours of cellphone use.

^bWeekly number of text messages sent / 100.