Language and Social Factors in the Use of Cell Phone Technology by Adolescents With and Without Specific Language Impairment (SLI)

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Purpose: This study aimed to compare cell phone use (both oral and text-based) by adolescents with and without specific language impairment (SLI) and examine the extent to which language and social factors affect frequency of use.
Method: Both interview and diary methods were used to compare oral and text-based communication using cell phones by 17-year-olds: 52 adolescents with SLI and 52 typically developing (TD) peers.
Results: Overall, adolescents with SLI are motivated users of mobile technology, and they engage with both oral uses (phoning) and text-based uses (text messaging). However, adolescents with SLI do not exchange text messages as often as their TD peers. Social rather than language factors are associated with frequency of cell phone use in adolescence.
Conclusions: These findings indicate that social difficulties restrict text-based uses of cell phones by adolescents with SLI, which can in turn reduce the opportunities that these adolescents have to develop social networks and make arrangements to engage in peer social interaction.

KEY WORDS: cell phones, language, social factors, adolescence, specific language impairment (SLI)

Specific language impairment (SLI) is an interesting disorder, as it involves marked difficulties with language in the absence of sensory impairment (e.g., deafness), cognitive difficulties, or frank neurological damage (Bishop, 1997; Leonard, 1998). At early school entry age (around 5 years), SLI is common with an incidence of approximately 7% (Tomblin et al., 1997). This rate appears to decline with development. One of the few prevalence studies suggests that approximately 3% of adolescents experience SLI (McKinley & Larson, 1989). Thus, some individuals initially diagnosed as having SLI appear to recover and attain normal language competence (Bishop & Edmundson, 1987; Botting, Faragher, Simkin, Knox, & Conti-Ramsden, 2001). However, there is a significant proportion of children who have continued difficulties with language throughout development (Conti-Ramsden, Durkin, Simkin, & Knox, 2009; Snowling, Adams, Bishop, & Stothard, 2001). These young people with persistent SLI are of particular interest to clinicians and researchers.

Adolescents and Mobile Technology

Adolescence is an important developmental period. The individual who was a child is now on his/her way to becoming an adult. This scenario

presents many changes for the young person (Durkin, 1995). In adolescence, for example, peers and peer-oriented activities become more important to the individual. Today's youth have a wider variety of options for communicating with their peers than was available 15 years ago. Communication via cell phone and the Internet is now widely available and very popular with the young (Durkin, Conti-Ramsden, Walker, & Simkin, 2009; Katz & Aakhus, 2002; Lenhart, Madden, & Hitlin, 2005; Livingstone & Bober, 2003; Riva, 2002; Wartella, Caplovitz, & Lee, 2004). In the case of mobile communication, everyday social arrangements and interpersonal contact are now routinely effected by mobile technology. Adolescents tend to be at the forefront when it comes to the adoption of new media facilities. A recent survey of over 2,000 teenagers in the United States revealed that 80% of teens, or approximately 17 million young people, have a cell phone (CTIA & Harris Interactive, 2008). The figures are very similar for teenagers in the United Kingdom: Approximately 90% of adolescents own a cell phone; 96% of these use SMS (short messaging services), and 1 in 10 spends more than 45 minutes a day using it (Oftel, 2001). Cell phone use is common in adolescents of both sexes (Oksman & Turtiainen, 2004). Adolescents are aware of the convenience of cell phones and the freedom they afford in terms of independence, safety, and privacy (Kasesniemi & Rautiainen, 2002; Ribak, 2009; Srivastava, 2005). They are therefore highly motivated to use them. Adolescents have described leaving home without a cell phone as feeling almost like leaving home without their clothes on ("Survey: Teen's", 2008).

Cell phones afford what can be broadly categorized as two principal routes for interaction: *oral communication* and *text-based communication* via SMS and similar technologies. Adolescents, who generally have limited financial resources, have a preference for text messaging over talking on their cell phone. They know it is less expensive, but they are also aware of other benefits of the medium: It is quicker than talking and often more convenient (Grinter & Eldridge, 2003; Haste, 2005). Text messaging also appears to be the preferred mode for interacting with peers. Although there are cultural differences among adolescents, studies have consistently found that young people exchange most of their text messages with peers (Kasesniemi & Rautiainen, 2002; Ling & Yttri, 2002). In the United Kingdom, Grinter and Eldridge (2003) found that 90% of text messages sent were to friends. Adolescents are thus highly socially motivated to use their cell phones. Text messaging via cell phones is a key feature of keeping in touch with friends and planning social activities with peers. In many ways, the cell phone has become not so much a technological tool but a social tool.

Adolescents With SLI

What might be expected about uses of cell phones by adolescents with SLI? On first consideration, it would appear likely that adolescents with linguistic impairments are disadvantaged in the face of language-dependent modes of communication and interaction. In early adolescence, young people with SLI are at risk of negative self-perceptions with respect to communication and interpersonal relations (Conti-Ramsden & Botting, 2004; Jerome, Fujiki, Brinton, & James, 2002). By adolescence they are shyer than their peers (Wadman, Durkin, & Conti-Ramsden, 2008) and also have difficulties with peer relations. Durkin and Conti-Ramsden (2007) found that 16-year-old adolescents with SLI had poorer quality of friendships than their age peers. Furthermore, approximately 40% of the adolescents with SLI who participated in the study had no particular friends with whom they shared activities. Thus, adolescents with SLI may have limited opportunities for social interaction with peers. In addition, information communication technologies such as cell phones present a host of additional processing requirements and, at times, skills in multitasking (Livingstone, 2002). If interactions are problematic, and language-related tasks are onerous, then social withdrawal and little engagement with mobile technology may be a compelling option for individuals with SLI. However, there are theoretical reasons to qualify these expectations.

First, not all linguistic requirements of the new media are necessarily stringent. For example, in peer-oriented uses of text-based media, the rules of spelling and grammar appear to be considerably relaxed, text messaging using cell phones is informal, and expressive mistakes are tolerated (Livingstone & Bovill, 2001). In addition, text-based media allow for asynchronous, editable forms of interaction that can offer young people with SLI more time to read, think, write, and rewrite (edit) language. Many young people with persisting SLI have difficulties with literacy, including reading and spelling (Botting, Simkin, & Conti-Ramsden, 2006; Catts, Fey, Tomblin, & Zhang, 2002; Snowling, Bishop, & Stothard, 2000). In this respect, although literacy is certainly fundamental to text-based media, it may not be as arduous as some more traditional modes of interaction for persons with SLI. Similarly, oral communication via cell phones is mainly conversational. In contrast to genres such as narrative or expository discourse, research into later language development and studies of adolescents with SLI have shown that conversational discourse is rarely challenging enough to reveal language vulnerabilities in older individuals (Nippold, 2007; Scott & Windsor, 2000). These considerations suggest that the weaker spoken and literacy skills of adolescents with persisting SLI may not have a strong direct impact on

frequency of use of cell phones in either oral or text-based modes.

Second, recent research with people suffering from shyness and social anxiety shows that communication that is not face-to-face can be actively sought and experienced as beneficial (Caplan, 2003; Davis, 2001; Stritzke, Nguyen, & Durkin, 2004; Valkenburg, Schouten, & Peter, 2005). In particular, people who find face-to-face interaction uncomfortable may be drawn to media that mitigate some of the unwelcome cues and negative evaluative feedback that face-to-face interactions can bring (Stritzke et al., 2004; Valkenburg et al., 2005). Both oral and text-based uses of cell phones have the potential to provide some social distance in interpersonal communication, and this may be an incentive for adolescents with SLI who are known to be shyer than their typically developing peers (Wadman, Durkin, & Conti-Ramsden, 2008). However, there is also evidence that the beneficial effects of interpersonal interaction via new media follow the "rich get richer" model. That is, better outcomes are more likely for extraverted individuals who already enjoy more friendships and social support (Kraut et al., 2002). As noted above, young people with SLI are at risk of poor social relations and may be disadvantaged in terms of peer support (Durkin & Conti-Ramsden, 2007). It may be that the number and quality of each individual's friends could affect the frequency of use of interpersonal new media, that is, few friends in real life translates into few friends to interact with via cell phone. Adolescents with SLI who tend to have fewer friends may therefore not be as socially motivated to use their cell phones as their typically developing peers.

New technologies can afford new opportunities for their users. Cell phones provide contactability, personal security, personal efficiency, and uncertainty reduction. But, in addition, cell phones are a new source of socializing, affording opportunities for interpersonal communication, social interaction, and social control (Katz, 1997), in particular via the text-based medium. Young people with SLI are of particular interest because they tend to possess characteristics that make some uses of cell phones attractive (e.g., communication via cell phones is not particularly linguistically demanding and is more socially friendly for shyer individuals); however, at the same time they may face a major liability because of their poorer social relationships with peers.

The Present Study

Although there are a number of studies examining the use of cell phones by adolescents, much less is known about young people with developmental difficulties. To our knowledge, this is the first investigation to examine the use of mobile technology in individuals with known linguistic impairments. Within this context, the present study aimed to compare cell phone use (both oral and text-based) in adolescents with and without SLI and examine the extent to which language and social factors affect frequency of use. Language factors included oral language, reading, and spelling measures. Social factors included shyness, friendships, and social motivation to use a cell phone.

Given the penetration of mobile technology in the life of today's youth, we expected adolescents with SLI to be motivated to engage with cell phones and be as aware as their typically developing peers of their general benefits. We also expected that the preference for text messaging (as opposed to calling) would also be evident for adolescents with SLI, for the same reasons of low cost, ease, and convenience. Because the language demands of cell phone use are relatively low and informal, we expected to find similarities across groups in terms of frequency of use, particularly in oral uses of cell phones. However, the likely social difficulties accompanying persisting SLI, for example, shyness and poorer friendships, should impact negatively on the frequency of text messages exchanged, as this is the preferred medium for interaction with peers. Thus, it was expected that social factors, rather than linguistic factors, would contribute to explaining the variance in frequency of text-based uses of cell phones.

Method
Participants

Adolescents with persisting SLI. The adolescents with persisting SLI in this investigation were originally part of a wider longitudinal study, the Conti-Ramsden Manchester Language Study (Conti-Ramsden & Botting, 1999a, 1999b; Conti-Ramsden, Crutchley, & Botting, 1997). This initial cohort was recruited from 118 language units attached to English mainstream schools. Language units are specialist classes usually attached to mainstream schools, in which there is regular speech and language therapist input as well as specialist teachers and high teacher to pupil ratio. These language units provided a list of Year 2 children attending for at least 50% of the week. Across England approximately 500 children met this criterion. All language units were asked to participate, and two declined this invitation. Subsequently, approximately half of the eligible children in each unit were randomly sampled. This resulted in an initial study cohort of 242 children. The age range was 7;5 [years;months] to 8;9 and consisted of 186 boys and 56 girls (girls forming 23.1% of the cohort). These children were reassessed as part of the original study at 8, 11, 14, and 16 years of age.

From the original cohort of 242 children described above, 90 adolescents with a history of SLI volunteered to participate, of whom 96% had access to a cell phone. Of these adolescents, 52 met criteria for persisting SLI, that is, at the time of the study they met the following criteria: performance IQ (measured by the Wechsler Abbreviated Scale of Intelligence [WASI]; Wechsler, 1999) of 80 or more and concurrent expressive and/or receptive language index score (measured by the Clinical Evaluation of Language Fundamentals, Fourth Edition [CELF–4]; Semel, Wiig, & Secord, 2003) greater than 1.5 standard deviations below the mean (a standard score of 77 or below). These 52 participants all had access to a cell phone. Table 1 presents the psycholinguistic profiles of the adolescents with SLI. The gender distribution of the group was 39 boys and 13 girls (boys forming 75% of the sample). The mean age was 17;1 (range 16;2 to 18;2).

Typically developing (TD) adolescents. A comparison group of adolescents from a broad background participated in the study. They had no history of special educational needs or speech and language therapy provision and had previously participated in the Manchester Language Study at the 16-year phase. The Manchester Language Study used Census data as per the 2001–2002 General Household Survey (Office for National Statistics, 2002) to target adolescents who would be representative of the range and distribution of households in England in terms of household income and maternal education. The 52 adolescents who participated in this study had normal performance IQ and language skills, that is, both measures were above a standard score of 85 (see Table 1). They all had access to a cell phone and were matched with the adolescents with SLI on age (mean age 16;10, range 16;0 to 17;10), gender (40 boys and 12 girls, boys forming 77% of the sample), and socioeconomic background.

Table 1. Psycholinguistic measures (standard scores) for adolescents with specific language impairment (SLI) and typically developing (TD) adolescents.

Measure	Adolescents with SLI (N = 52)		TD adolescents (N = 52)		Cohen's d
	M	SD	M	SD	
WASI Performance IQ	97.8	10.9	108.4	9.4	1.04
CELF–4 Receptive language	69.1	13.3	102.0	7.7	3.03
CELF–4 Expressive language	62.1	9.4	103.9	8.9	4.57

Note. All comparisons *p* < .001. WASI = Wechsler Abbreviated Scale of Intelligence; CELF–4 = Clinical Evaluation of Language Fundamentals—Fourth Edition.

Participants' Socio-Economic Status (SES) Background

As part of a previous stage of assessment at 16 years of age, data were collected from both sets of participants' parents to ascertain levels of maternal education and household income as measures of SES. Maternal education levels ranged from no educational qualifications obtained by the end of compulsory education (in the United Kingdom individuals can leave high school without formal qualifications at 16 years of age), and this applied to 35.4% of mothers of adolescents with SLI and 18.0% of mothers of TD adolescents. It was found that 54.2% of mothers of adolescents with SLI and 72% of mothers of TD adolescents had GCSE O-levels, A-levels, or college qualifications (GCSE O-levels are equivalent to a high school diploma in the United States, and A-levels or college qualifications are noncompulsory examinations usually taken in the United Kingdom between 16 and 18 years of age). Finally, 10.4% of the mothers of adolescents with SLI and 10.0% of the TD adolescents were educated to university or postgraduate level. No significant differences in maternal education levels were found between the adolescents with SLI and TD adolescents, $\chi^2(2, N = 98) = 4.04, p = .133$.

Household income bands ranged from less than £10,400 per annum (SLI 22.0%; TD 7.8%) to £10,401–£20,800 (SLI 20.0%; TD 31.4%) to £20,801–£36,400 (SLI 38.0%; TD 31.4%) to more than £36,401 per annum (SLI 20.0%; TD 29.4%). Household income bands did not differ significantly between groups, $\chi^2(3, N = 101) = 5.90, p = .117$. Importantly, therefore, the adolescents with SLI were similar to the TD adolescents in terms of SES indicators. Further, the household income of both groups ranged from the lowest bracket found in the 2001–2002 General Household Survey (Office for National Statistics, 2002) to the highest bracket and thus was representative of the range of household income distribution found in England as a whole.

Materials

Concurrent Psycholinguistic Assessments for Group Identification

Performance IQ was assessed using the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). The Block Design and Matrix Reasoning subtests were used to derive a performance IQ score. This test has been shown to have good reliability for performance IQ (.94–.96) as well as construct validity (.76–.84).

Expressive and receptive language abilities were assessed using the Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF–4; Semel, Wiig, & Secord, 2003). The CELF–4 is an individually administered language test designed for 5- to 21-year-olds. The CELF–4

has been shown to have good reliability with stability coefficients ranging from .88 to .92 as well as good concurrent validity as demonstrated by high correlations with other independent language measures (correlations of .80–.87).

Cell Phone Use Interview

This is a structured interview concerning frequency of cell phone use (oral and text-based) and motivation for text-based versus oral uses of cell phone that formed part of a wider interview administered to the participants regarding the use of new media. Four interview questions/statements were developed based on the work of Ling and Yttri (2002).

Set 1: General motivation for cell phone use. Participants were asked to indicate how much the following statements were true of them. Three statements were included that referred to general cell phone use and were not specific to either oral or text-based use: "having a cell phone is a kind of freedom;" "having a cell phone is important for my personal safety;" and "my life is much better because of owning a cell phone." Responses were coded on a 5-point scale from 1 (*not true of me at all*) to 5 (*very true of me*).

Set 2: Frequency of cell phone use. This was the main outcome variable for the study. Participants were asked about the number of phone calls made, phone calls received, text messages sent, and text messages received daily. Responses were coded on a 5-point scale as "none or a few per week/month," "less than 5 a day," "between 5 and 10 a day," "between 10 and 20 a day," or "more than 20 a day."

Set 3: Motivation for text-based versus oral cell phone use. Participants were told by the interviewer "When using a cell phone, some people prefer text messages to speaking. Below are some reasons for this preference. How much do you agree that when compared to speaking, texting is: quicker, cheaper, easier, more convenient, quieter so you can message later at night, more acceptable in public places like the cinema or shops, better for private messages, better for allowing time to think of responses, or better because you can use pictures or symbols?" Responses were coded on a 5-point scale from 1 (*not at all agree*) to 5 (*agree very much*).

Set 4: Social motivation for cell phone use. A measure of social motivation for interacting with peers was derived from responses to two statements concerning cell phone use: "I use my cell phone to keep in touch with friends" and "I use my cell phone to plan my social activities." Adolescents were asked how true they thought the statements were of them on a 5-point scale from 1 (*not at all true of me*) to 5 (*very true of me*). For the present sample, the two items were strongly correlated (.99).

One-Week Diary Record of Cell Phone Use

This is a self-report diary record devised for the purposes of the present study. Participants reported on a 1-week period documenting their cell phone use. Using a tally chart, the diary records the number of times the participant sends a text message, receives a text message, makes a call, or receives a call on his/her cell phone. A separate page is used for each day of the week. The day is divided into three separate time periods: morning (wake up to 12 p.m.), afternoon (12 p.m. to 6 p.m.), and evening (6 p.m. to bed). A box at the bottom of each page is ticked if the participant did not use his/her cell phone during that particular day. The diary records yield a frequency count of use during the week in terms of calls made, calls received, text messages sent, and text messages received.

Language and Literacy Measures

Measure 1: Oral language. Overall language ability was measured by the core language score of the CELF–4. As per the test guidelines, the core language score was derived using the following subtests: Recalling Sentences, Formulated Sentences, Word Classes 2 (both receptive and expressive parts), and Word Definitions.

Measure 2: Reading. Reading efficiency was assessed using the full form of the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999). The TOWRE consists of two timed subtests, sight word efficiency and phonemic decoding efficiency, that can be used with individuals aged 6 to 24 years. An overall measure of reading efficiency is derived from the two subtests. This test has been shown to have good reliability (.93–.96) and concurrent validity (.89–.84).

Measure 3: Written decoding. Written decoding was assessed using the reading subtest of the Wide Range Achievement Test, Third Edition (WRAT3; Wilkinson, 1993). Individuals are presented with written words and are required to read each word aloud. This test can be used with people aged 5 to 75 years. The WRAT3 has been found to have good reliability (.92–.93) and concurrent validity (.83–.87).

Measure 4: Spelling. Spelling accuracy was assessed using the spelling subtest of the WRAT3. This test can be used with people aged 5 to 75 years. The WRAT3 has been found to have good reliability (.92–.93) and concurrent validity (.83–.87).

All four measures (oral language, timed reading efficiency, written decoding, and spelling) were strongly correlated ($r = .78–.86$); thus, a language/literacy composite was calculated (sum of scores divided by 4, Cronbach's α of .94).

Social Factor Measures

Shyness. Shyness was assessed using the 12-item Revised Cheek and Buss Shyness Scale (Stritzke et al., 2004), adapted from the 13-item Revised Cheek and Buss Shyness Scale (Cheek, 1983), which has been used widely in empirical studies of shyness. It was designed to measure tension and inhibition when with others (Cheek, 1983). Participants respond to the questions on a 5-point scale from 1 (*very untrue*) to 5 (*very true*). The maximum score is 60, and a score of 34 or above indicates shyness. The 12-item version has been shown to have high internal consistency in a sample of university students, with a Cronbach's α of .86 (Stritzke et al., 2004). The 12-item version was also found to have good internal consistency with the sample used in this study (Cronbach's α of .89).

Friendship difficulties. Quality of friendships was measured using a friendship difficulties index developed by Durkin and Conti-Ramsden (2007) based on the Friendships and Social Relationships section of the Social–Emotional Functioning Interview (SEF-I; Howlin, Mawhood, & Rutter, 2000). This section involves a detailed interview designed to examine aspects related to quality of social interactions in adolescents and adults. The interview has two versions: self-report and informant report. The self-report version was administered to the adolescents, and the informant version was administered to their parents. Each interview had three items that directly examined friendship relationships: perception of acquaintances, description of current friendships, and conception of friendships/quality of friendships. A combined self-report/parent-report friendship difficulty index is obtained by summing the 6 items. This yields a friendship index with a minimum score of 0 and a maximum score of 16. A score of 0 represents good quality of friendship. Conversely, a score of 16 represents severely restricted quality of friendship. The index has been shown to have high internal consistency in a large sample of adolescents of which the present participants are a subsample, with a Cronbach's α of .89 (Durkin & Conti-Ramsden, 2007).

Social motivation for cell phone use. The specific statements related to social motivation for interaction with peers via cell phones are described under the Cell Phone Use Interview section. The three social measures were weakly to moderately correlated (r = .18–.39). Thus, no composite measure was calculated.

Procedure

Participants were assessed and interviewed face-to-face either at school or at home as part of a wider battery. Testing took place in a quiet room with only the participant and a trained researcher present and was completed within either a morning or afternoon session. The self-report cell phone use diary was left with the adolescents with instructions to fill it in for a week and then mail it back to the researchers in a self-addressed envelope. For each adolescent this was the week immediately following the face-to-face interview. Parents had been interviewed separately at home concerning their offspring's quality of friendship as part of a wider battery of assessments in a previous phase of data collection 1 year earlier, when the adolescents were 16 years of age. The adolescents were also interviewed about their friendships at this time. Ethical approval for the study was gained from the University of Manchester.

Results

Given the number of analyses being carried out, alpha level was set at $p < .01$ for significance for all statistical tests.

General Motivation for Using Cell Phones

There were similarities across the groups of adolescents in their general motivation to use cell phones because it allowed them "a kind of freedom" (SLI M = 3.0, SD = 1.3; TD M = 3.0, SD = 1.3), $F(1, 101)$ = 0.052, p = .820, or because their life was "much better because of owning a cell phone" (SLI M = 3.0, SD = 1.4; TD M = 2.5, SD = 1.3), $F(1, 101)$ = 3.086, p = .082. However, the adolescents with SLI agreed significantly more than the TD adolescents that they used their cell phone because it is "important for my personal safety" (SLI M = 3.6, SD = 1.3; TD M = 3.0, SD = 1.3), $F(1, 101)$ = 7.471, p = .007, partial η^2 = .069.

Frequency of Cell Phone Use: Oral and Text-Based Use

The number of text messages and calls made and received in a typical day according to the interview data are presented in Table 2. Approximately half of the adolescents with SLI and TD adolescents reported that they made and received less than 5 calls per day. A proportion of adolescents in both groups did not make (SLI 23%; TD 23%) or receive (SLI 19%; TD 15%) any phone calls, or if they did so they made only a few per week/month. Around a fifth of the adolescents with SLI sent and received more than 10 text messages a day compared with around half of their TD peers. Again, there was a proportion of adolescents in both groups that did not send (SLI 21%; TD 17%) or receive (SLI 12%; TD 8%) any text messages in a typical day.

To examine the frequency (based on the interview data) with which the groups of adolescents used their cell phones for text messaging and calling, a 2 × 2 analysis of variance was conducted with one within-group

Table 2. Number of phone calls made and received and text messages sent and received per day by the adolescents with SLI and TD adolescents according to interview report.

Number	Adolescents with SLI (n = 52)		TD adolescents (n = 52)	
	Those who made/sent	Those who received	Those who made/sent	Those who received
Calls				
<5	30 (58%)	26 (50%)	24 (46%)	24 (46%)
5–10	5 (10%)	11 (21%)	14 (27%)	17 (33%)
11–20	5 (10%)	5 (10%)	1 (2%)	3 (6%)
>20	0	0	1 (2%)	0
None or a few per week/month	12 (23%)	10 (19%)	12 (23%)	8 (15%)
Texts				
<5	14 (27%)	21 (40%)	10 (19%)	11 (21%)
5–10	16 (31%)	15 (29%)	10 (19%)	12 (23%)
11–20	8 (15%)	6 (12%)	15 (29%)	13 (25%)
>20	3 (6%)	1 (2%)	11 (21%)	12 (23%)
None or a few per week/month	11 (21%)	9 (17%)	6 (12%)	4 (8%)

factor, type of use (text message or phone call), and one between-group factor, group (SLI or TD). There was a significant, medium-effect-size interaction between type of use and group, $F(1, 97) = 9.836$, $p = .002$, partial $\eta^2 = .092$. The mean number of phone calls made and received (based on the categorical, banded interview data) was identical for both adolescents with SLI and TD adolescents ($M = 2.2$, $SD = 0.8$). For text messages, the mean band score for the adolescents with SLI was 2.7 ($SD = 0.9$) and for TD adolescents was 3.3 ($SD = 1.3$). The significant interaction suggested that the preference for text messaging over phoning was not equivalent across groups: both groups showed a preference for text-based use, but this was more pronounced in the TD group. Tukey post hoc comparisons revealed a significant difference between groups for frequency of exchanging text messages ($p = .004$). As expected, given the identical means for both groups, there was no significant difference between the two groups for frequency of phoning ($p = .938$).

In addition to the interview report concerning average use during a typical day, diary records allowed examination of the frequency of use during a specific week. Diary data were available for 43 of the adolescents with SLI and 31 TD adolescents. The results mirrored those of the interview data. Adolescents with SLI and their TD peers made and received a similar number of phone calls in total, around 18 for adolescents with SLI and 26 for TD adolescents (SLI $M = 17.8$, $SD = 32.2$, range = 0–185; TD $M = 26.5$, $SD = 24.2$, range 0–113). However, a difference between groups was evident in the total number of text messages sent and received, with adolescents with SLI recording in their diaries around 39 text messages on average compared with 80 for the

TD adolescents (SLI $M = 38.7$, $SD = 57.2$, range = 0–284; TD $M = 80.0$, $SD = 80.9$, range 4–305).

Are the Motivations for Preferring the Text-Based Medium Similar Across Groups?

Adolescents with SLI and TD adolescents gave similar reasons for their preference for text-based compared with oral-based cell phone use. Both groups of adolescents thought that when compared with speaking, text messaging was quicker, cheaper, more convenient, quieter, more acceptable in public places, better for private messages, better for allowing time to think of responses, and better because pictures/symbols can be used (all comparisons $p > .1$).

Linguistic and Social Characteristics of the Adolescents: Comparing Profiles Across Groups

Table 3 presents group comparisons across the language-related and social variables measured in this study. Oral language abilities were part of the selection criteria for the groups, thus the expected differences in overall CELF–4 core language score are reported. In addition, as expected from previous research, the adolescents with SLI in this study had significantly poorer literacy skills (and hence a poorer language/literacy composite score). Adolescents with SLI were shyer and had more difficulties with friendships than their TD peers. They were also significantly less motivated to use their cell phones socially to engage with friends and plan social activities.

Table 3. Language and social measures for adolescents with SLI and TD adolescents.

Measure	Adolescents with SLI				TD adolescents				d
	M	SD	range	n	M	SD	range	n	
Language/literacy composite score	71.0	10.4	48.2–93.2	52	104.2	8.4	48.2–93.2	50	3.51
CELF–4 Core language	64.8	12.0	40–88	52	107.0	8.7	88–126	52	4.03
TOWRE Word reading efficiency	69.8	12.6	46–97	52	98.1	13.4	69–120	52	2.18
WRAT3 Reading	80.5	11.8	48–104	52	103.3	10.4	78–120	50	2.05
WRAT3 Spelling	81.1	14.2	56–111	52	104.1	10.0	70–122	52	1.87
Shyness scale score	35.2	7.5	19–47	52	26.9	8.4	12–50	52	1.04
Friendship difficulties index score	3.0	3.6	0–13	46	0.2	0.5	0–2	51	1.09
Cell phone social motivation score	3.3	1.2	1–5	51	4.2	0.9	1–5	52	0.85

Note. All comparisons $p < .001$. Variation in *n* reflects missing data on particular assessments. TOWRE = Test of Word Reading Efficiency; WRAT3 = Wide Range Achievement Test, Third Edition.

Relationship Between Language and Social Factors and Frequency of Cell Phone Use

Correlations between the adolescent characteristics (language/literacy and social factors) and frequency of text-based uses of cell phones are presented in Table 4 (for both interview and diary methods). Both interview and diary records of frequency of text messaging were significantly associated with shyness, friendship difficulties, and social motivation ($p < .01$). There was also a small association with the language/literacy measures and the composite score. There were no significant associations between the adolescent characteristics and frequency of oral uses of cell phones ($r = -.26$ to .08) using either the diary or interview data.

Which Factors Predict Frequency of Text-Based Cell Phone Use?

Because of our interest in the relative contribution of language versus social factors to frequency of text-based

use, regression analysis was carried out. The composite language/literacy score was used due to the high correlations among the individual language and literacy measures ($r = .78–.86$) and the collinearity observed when the measures were entered separately into a regression analysis (Durbin-Watson value of .00 and tolerance values of .23 for the CELF–4 core language, .20 for the TOWRE, .18 for the WRAT3 reading, and .19 for the WRAT3 spelling). For the social factors, no collinearity was observed (they were weakly to moderately correlated, $r = .18–.39$), so these variables were examined individually.

The regression analysis included the language/literacy measure based on theoretical expectations that language can bear on adolescents' communication. It is acknowledged that this inclusion was not quite warranted on strict statistical grounds given that the correlational data did not reveal a significant association at the $< .01$ level, that is, the associations were small. The measure of nonverbal IQ was not included as there were no significant associations with either interview report of text-based

Table 4. Correlation matrix for text-based frequency of use, language/literacy, and social measures.

Measure	1	2	3	4	5	6	7	8	9	10
1. Text-based frequency of use (interview data)	—	.65**	.29**	.31**	.25*	.27**	.29**	−.38**	−.29**	.52**
2. Text-based frequency of use (diary data)		—	.23**	.24*	.23*	.17	.23*	−.43**	−.35**	.39**
3. CELF–4 Core language			—	.80**	.82**	.78**	.98**	−.44**	−.57**	.38**
4. TOWRE Word reading efficiency				—	.83**	.82**	.89**	−.40**	−.54**	.31**
5. WRAT3 Reading					—	.86**	.91**	−.31**	−.47**	.34**
6. WRAT3 Spelling						—	.88**	−.28**	−.36**	.29**
7. Language/literacy composite score							—	−.42**	−.55**	.37**
8. Shyness scale score								—	.42**	−.38**
9. Friendships difficulty index score									—	−.26**
10. Cell phone social motivation score										—

Note. $^*p < .05$. $^{**}p < .01$.

frequency ($r = .00$) or diary report of text-based frequency ($r = .09$).

Hierarchical regression was conducted with the diary report (interval data) of daily frequency of text-based use as the outcome variable. The language/literacy and social measures were entered in a single step (language/ literacy composite score, shyness score, friendships difficulty index, and cell phone social motivation score), as we were interested in examining which predictor variables "won out" when pitted against each other. Would language as well as social factors predict frequency of use, or would one type of factor be more predictive than the other? This model was significant with a large effect size, $F(4, 66) = 6.498$, $p < .001$, $f^2 = .39$, and explained 24% of the variance with social motivation ($p = .024$) and shyness ($p = .016$) making the strongest contributions (see Table 5).

When this analysis was repeated using the interview report (categorical data), the same pattern of results was found, with social factors being associated more strongly than linguistic factors with frequency of text-based use. The regression model was significant with a large effect size, $F(4, 90) = 9.943$, $p < .001$, $f^2 = .44$. Overall, the model explained 28% of the variance in use. One of the independent variables contributed significantly to the prediction of text-based cell phone use, namely social motivation ($p < .001$).

Discussion

This investigation involved examining cell phone use in adolescents with persisting SLI as well as a comparison group of TD peers. Self-report measures involving interview and diary methods were used to examine various aspects of cell phone use, in particular frequency of use. The findings across the measures suggest that overall, adolescents with SLI are users of cell phone technology and that they engage with both oral uses (phoning) and text-based uses (text messaging). Further findings suggest, however, that adolescents with SLI do not exchange texts as often as their TD peers and that

Table 5. Hierarchical regression analysis for variables predicting diary report of frequency of text-based cell phone use.

Variable	B	SE B	β
Language/literacy composite score	−.432	0.480	−.118
Shyness scale score	−2.281	0.927	−.295*
Friendships difficulty index score	−5.522	2.912	−.241
Cell phone social motivation score	15.558	6.716	.263*

Note. Adj. $R^2 = .239$ for Step 1 ($p < .001$).

*$p < .05$.

social rather than language factors are associated with frequency of text-based uses in adolescence.

Cell Phone Technology Adoption

Adolescents with SLI are very much like their TD peers in the adoption of new media. Virtually all adolescents with SLI who volunteered for our study owned a cell phone and had done so for a number of years. Technological advances and the meteoric rise of cell phone availability in the past few years have made issues of restricted access for people with disabilities very likely a thing of the past (although some special need groups, for example, deaf adolescents, may still face challenges in this respect; Akamatsu, Mayer, & Farrelly, 2005). The adolescents with SLI in the present study were highly motivated to use cell phones and adopt the new technology for its convenience, freedom, privacy, and safety. Adolescents with SLI did not lag behind their peers but instead seemed to be even more aware of the advantages of cell phones, in particular with regards to safety. The reasons for this heightened awareness on the part of adolescents with SLI may relate to intrapersonal factors such as previous experience of bullying (Knox & Conti-Ramsden, 2007) or lack of independence (Conti-Ramsden & Durkin, 2008). Cell phones can be a very efficient way to contact parents at a moment's notice, for example. Other influences may be more external. Parents are also aware of the benefits cell phone use can bring, in particular in relation to keeping tabs on their offspring's activities (Williams & Williams, 2005). There is likely to be a mixture of influences involved for each individual. An encouraging finding is that the new technology may provide advantages for both young people who may feel in some ways vulnerable and also for their parents who are likely to be concerned about the ability of their offspring to manage themselves independently (Conti-Ramsden, Botting, & Durkin, 2008).

In terms of types of uses, similarities across groups in new media adoption practices were also observed. Adolescents generally preferred to use the text-based function of their cell phones. In line with previous research, both groups of adolescents participating in this study agreed that when compared with oral-based uses, text messaging is quicker, cheaper, and, in a number of ways, more convenient (Grinter & Eldridge, 2003; Haste, 2005). In adolescence, cell phones appear to be used less often in their conventional telephone mode to communicate with people. Oral-based uses of cell phones were on average half the number when compared with text-based uses.

Further examination of frequency of use nonetheless revealed a significant, medium-effect-size interaction between group and type of use. The frequency of oral-based uses of cell phones was similar for both groups of adolescents. However, young people with SLI exchanged

text messages less often than their TD peers. Given that studies have consistently found that young people exchange most of their text messages with peers (Kasesniemi & Rautiainen, 2002; Ling & Yttri, 2002), these findings suggest that young people with SLI are not using their cell phones as frequently for this interpersonal function that is so important in adolescence.

The Role of Language and Social Factors in Frequency of Cell Phone Use

The possible implications of language ability and social factors for cell phone use in adolescence were a particular focus of this study. Use of mobile technology is complex, and many factors intrinsic and extrinsic to individuals are likely to bear on the frequency with which this type of technology is used. Interestingly, with regards to oral uses of cell phones, there were no significant associations between frequency of use and any of the variables examined. Not only were there similarities in the frequency of oral uses of cell phones across groups, but factors such as language/literacy skills, shyness, friendship quality, and social motivation were not significantly associated with frequency of use. Other considerations may be more relevant to frequency of oral uses and could be usefully addressed in future research, for example, receivers' preference for oral modes of cell phone communication or type and length of communication interchange required (Lenhart, Madden, & Hitlin, 2005).

The picture was different for text-based uses. In the context of previous literature, our expectations were that social rather than language factors were likely to be associated with frequency of use. This was borne out: There were significant associations between frequency of use and all the social factors examined. In contrast, the correlation with language/literacy abilities was small. In addition, when predicting frequency of text-based uses, social factors were strong predictors, in particular social motivation. Once again, language abilities did not appear to directly influence the frequency with which cell phones were used. These patterns of findings were found for analyses based on both self-report interview data and on diary data. Consistency of the results across the two different methods suggests that our findings are likely to be a reliable, accurate indication of the relationship between linguistic and social factors and frequency of cell phone use in adolescence.

Together, the present findings suggest that the linguistic limitations of adolescents with SLI do not have a direct impact on frequency of use of cell phones in either the oral or text-based modes. It appears that adolescents with SLI do not find talking or text messaging on their cell phones difficult. The conversational nature of oral communication via cell phones and the more relaxed linguistic requirements of this new medium may in fact be more congenial to such individuals. In this study, language and literacy variables were not found to be significantly predictive of cell phone use. However, it needs to be noted that the outcome measure examined in this study was a simple frequency count. More in-depth examination of other aspects of use, for example the content of text messages, may reveal stronger effects of language and/or literacy skills (Plester, Wood, & Joshi, 2009).

In contrast, social factors do appear to affect the frequency with which adolescents are in contact with their peers via exchange of text messages. In line with previous research, the adolescents with persisting SLI participating in this study were found to be shyer (Wadman, Durkin, & Conti-Ramsden, 2008) and to have poorer quality of friendships (Durkin & Conti-Ramsden, 2007). They were also less socially motivated to communicate with their peers via their cell phones. These factors were predictive of frequency of use, that is, shyer individuals with poorer friendships who were not very socially motivated use their cell phones less frequently to exchange text messages than more extraverted individuals who have better quality of friendships and are more socially motivated to interact with their peers. Thus, the frequency of text-based uses of cell phones is more likely to reflect the social difficulties common in adolescents with SLI rather than any particular difficulty or feature of the technology itself.

The social motivation variable was a consistent predictor of text-based uses and appeared to capture (albeit indirectly) the less social nature of text messaging by individuals with SLI. This measure provided an indication of how much cell phones were used to keep in touch with friends and to plan social activities. However, it would have been informative to have more precise information regarding the young people's communication partners when talking and texting via their cell phones. Various scenarios come to mind. First, communication partners of the adolescents with SLI may themselves have language difficulties and may not be as technically savvy as typically developing adolescents. These factors may at least partly explain the lower frequency of text-based exchanges observed in the group with SLI. Second, the communication partners may have differed between the groups. Adolescents with SLI may have been engaging in relatively more contact with parents rather than with peers via their cell phones. This is consistent with the fact that adolescents with SLI were more likely than their peers to agree with the statement "cell phones are important for my personal safety." If adolescents tend to talk to their parents on their cell phones more than text them, this could partially explain the equal rates of oral cell phone use across groups but lower rates of texting in SLI observed in the study. Finally, information on texts per recipient would have been useful in examining the potential influence of number of

peers or friends on frequency of use. Future research examining such possibilities would throw light onto our understanding of the variety of factors influencing cell phone technology use in adolescents with SLI.

Clinical Implications

Adolescents of today are the adults of the future, and as such they are likely to bring their communication practices to their adult life in domestic, work, and public domains (Grinter & Eldridge, 2003). Cell phone use represents another dimension in the development of our understanding of factors affecting communication in different contexts. Thus, it is important to consider the potential implications of the data presented in this study.

On the one hand, mobile technology is clearly being embraced by young people including adolescents with marked language difficulties. As such, this technology affords a potentially attractive context for therapeutic communicative activities aimed to foster language skill in adolescents. On the other hand, the present findings add to the growing literature pointing to the social difficulties experienced by young people with SLI (Durkin & Conti-Ramsden, 2007; Howlin et al., 2000) and emphasize the need to address these as part of the package of support offered to young people with persisting difficulties. Here we want to highlight the potential role that cell phone use can have on the development of social difficulties in adolescents with SLI. We suggest that there are likely to be cascading cycles of influence in development. Social difficulties limit the opportunities that young people with SLI have to interact with their peers, which results in less frequent exchanges of text messages. For today's youth, text messaging is one of the main modes of keeping in touch with friends and planning social activities. Less frequent text messaging can therefore, in time, lessen the social experiences of adolescents with SLI by reducing their opportunities to develop social networks and to make arrangements to engage in social interaction with peers.

Acknowledgments

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Language and Social Factors in the Use of Cell Phone Technology by Adolescents With and Without Specific Language Impairment (SLI)

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