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Exploring the longitudinal relationships between the use of grammar in text messaging and performance on grammatical tasks

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Research has demonstrated that use of texting slang (textisms) when text messaging does not appear to impact negatively on children's literacy outcomes and may even benefit children's spelling attainment. However, less attention has been paid to the impact of text messaging on the development of children's and young people's understanding of grammar. This study therefore examined the interrelationships between children's and young adults' tendency to make grammatical violations when texting and their performance on formal assessments of spoken and written grammatical understanding, orthographic processing and spelling ability over the course of 1 year. Zero-order correlations showed patterns consistent with previous research on textism use and spelling, and there was no evidence of any negative associations between the development of the children's performance on the grammar tasks and their use of grammatical violations when texting. Adults' tendency to use ungrammatical word forms ('does you') was positively related to performance on the test of written grammar. Grammatical violations were found to be positively associated with growth in spelling for secondary school children. However, not all forms of violation were observed to be consistently used in samples of text messages taken 12 months apart or were characteristic of typical text messages. The need to differentiate between genuine errors and deliberate violation of rules is discussed, as are the educational implications of these findings.

Text messaging and written language skills

Text messaging is a popular activity worldwide, and the number of texts sent continues to increase annually (e.g., Ofcom, 2011). There is, however, concern about the impact that use of texting slang and abbreviations ('textisms', such as *u* for *you*; *ppl* for *people*) may have on literacy development (e.g., Crystal, 2008; Thurlow, 2003; Wood, Kemp, & Plester, 2014). There is now evidence that textism use does not appear to harm children's literacy (e.g., Bushnell, Kemp, & Martin, 2011; Coe & Oakhill, 2011; Plester, Wood, & Bell, 2008) and may even support spelling development. For example, 8- to 12-year-old children's use of textisms accounted for growth in spelling ability over an academic year

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(Wood, Meacham, *et al.*, 2011). This may be because many textisms are phonetic in nature (e.g., *c* for *see*, *2* for *to*), so their use contributes to phonological awareness and phonological processing, which in turn contribute to spelling development. However, there was no evidence that the children's initial spelling ability was predictive of increased use of textisms over time, which suggests that it is not simply the case that children who are better spellers will be more able to use creative textisms and therefore benefit from the rehearsal of such skills. Similarly, Wood, Jackson, Hart, Plester, and Wilde (2011) found that 10 weeks' textism use by children new to texting could explain variance in their spelling development beyond that explained by IQ.

Less research has examined the interrelationships between textism use and adult literacy, and these data are inconsistent. Young adults' estimates of their own textism use were linked to better informal writing for all participants, but to poorer formal writing for those with some or no college education (Rosen, Chang, Erwin, Carrier, & Cheever, 2010). Undergraduate users and non-users of textisms were found not to differ in their reading or spelling scores (Drouin & Davis, 2009). Researchers who looked at adults' actual textism use have observed negative links with some, but not all literacy skills (De Jonge & Kemp, 2012; Drouin & Driver, 2014; Grace, Kemp, Martin, & Parrila, 2014). The results obtained with children therefore may not extend to adults, and longitudinal data are needed to examine the direction of any associations.

Text messaging and understanding of grammar

One area that has received less attention is grammatical understanding. Here, we use 'grammar' in the broad sense commonly used in school lessons, in stylistic guides, and in more general settings. We include not only morphology and syntax, but also orthographic conventions about punctuation and capitalization, which require an understanding of the syntactic structure of phrases and sentences and the identity of proper nouns. We use 'understanding' to capture the levels of knowledge that people have about grammar and acknowledge that these levels may range from implicit to explicit awareness (see Gombert, 1992). For example, when texting, people might display an implicit level of grammatical awareness by producing only violations that do not compromise meaning. For formal grammatical tasks, more explicit awareness is often necessary.

Previous researchers have described the grammatical construction of instant messages sent by teenagers (Tagliamonte & Denis, 2008), and of text messages sent by adults (e.g., Bodomo, 2010; Herring & Zelenkauskaite, 2009; Tagg, 2009). Cingel and Sundar (2012) conducted one of the few studies of text messaging and grammatical task performance and found a negative association between US Grade 6–8 children's performance on an adapted Grade 9 grammar test and their use of textisms in the last three texts that they had sent. However, there are weaknesses in this study. The children were asked to code their own messages by noting how many times they used each of the five broad textism types. Unlike in previous studies, the textism-use data were not corrected for message length and therefore may not reflect participants' overall use of these types of abbreviation. Furthermore, the five categories were collapsed into 'word adaptations' (homophone use, initialisms, and omission of non-essential letters) and 'structural adaptations' (punctuation and capitalization errors). Although the structural adaptations involved grammatical changes, it was word adaptations that were negatively related to grammar performance. Moreover, no baseline testing indicated how representative the sample of students was for their age. Further research on the links between grammatical understanding and texting is required.

We have argued that there are three ways by which the use of texting language could harm grammatical understanding: through *word-level spelling*, *phrase-level spelling,* and *sentence-level conventions* (Wood, Kemp, Waldron, & Hart, 2014). English orthography is basically alphabetic, but at word-level spelling is sometimes determined by morphological status. That is, word endings with the same morphological structure are often spelled in the same way despite differences in pronunciation (e.g., the *-ed* ending of past-tense verbs *talked*, *called*, and *waited*) and words with the same pronunciation are spelled differently if their morphology varies (e.g., *tax* and *tacks*; *which* and *witch*). This is true in some other orthographies as well; for example, French (e.g., *il danse*, he dances, and *ils dansent*, they dance) and Portuguese (e.g., *comeram*, ate, and *comerão*, will eat). It takes children some time to use grammar-based spelling consistencies in their writing (Kemp & Bryant, 2003; Nunes, Bryant, & Bindman, 1997; Totereau, Thevenin, & Fayol, 1997). Prolonged exposure to the phonetic spellings of textisms could make it difficult to learn or apply grammar-based spelling rules.

At the phrase level, speech often involves combining words to create elisions such as *gonna*, *would've,* and *you're*. Through texting, users see phonetic representations of such elisions (e.g., Grace *et al.*, 2014; Plester *et al.*, 2008; e.g., English *shuda;* Spanish *tkro* for *te quiero*, I love you (Alonso & Perea, 2008); French *qq1* for *quelqu'un*, someone (Anis, 2007)). People might subsequently find it difficult to learn or remember the correct spellings of the full forms.

Finally, the appropriate use of orthographic and punctuation conventions at the sentence level is often rejected during texting. Across languages, it is common to omit punctuation (Anis, 2007; Bieswanger, 2007; Herring & Zelenkauskaite, 2009; Ling & Baron, 2007) and capitals (De Jonge & Kemp, 2012; Rosen *et al.*, 2010; Varnhagen *et al.*, 2009). Conventional punctuation may also be replaced with multiple exclamation or question marks (Grace, Kemp, Martin, & Parrila, 2012) or emoticons (De Jonge & Kemp, 2012; Provine, Spencer, & Mandell, 2007). Individuals who do not adhere to conventional punctuation and capitalization in text messages may also use them less frequently in formal writing.

The types of 'errors' discussed above are referred to as grammatical 'violations' here, because such written forms may be produced either in error, or deliberately, to save time or effort, or for comic or social effect. Drouin and Driver (2014) have distinguished textisms of omission (such as missing punctuation or capitalization) and more deliberate textisms (such as accent stylization, e.g., *wiv* for *with*, or emoticons). These types of textisms did show some of the predicted relationships to poorer and better literacy scores, respectively, in Drouin and Driver's sample.

Recently, we (Wood *et al.*, 2014) analysed concurrent relationships between children's and adults' naturalistic text messaging and their performance on standardized tests of written language processing and grammatical knowledge, plus an assessment of understanding of how grammar is represented within English orthography. We found no association between the children's scores on the grammar, spelling or orthography tasks, and their tendency to make one of the six categories of grammatical violations in their text messages. However, there was a significant negative relationship between the adults' violation of punctuation and capitalization and their performance on the test of written grammar. This relationship remained after controlling for individual differences in IQ and spelling ability.

The concurrent data obtained by both Cingel and Sundar (2012) and Wood *et al.* (2014) cannot be used as evidence of cause and effect, and there is also no way of knowing how representative these violations may be over time, especially as individuals may write the same words in different ways even within the same message (De Jonge & Kemp,

2012). In this study, we followed up 210 of the original participants from Wood *et al.* (2014) 1 year later. This paper summarizes the longitudinal relationships observed between the grammatical violations that the participants made when text messaging and their performance on written and spoken tasks of receptive grammar over the course of the year. Spelling and orthographic processing were assessed to examine whether these factors were also related to grammatical violations when texting over time.

The following primary research question was considered: *Is the tendency to make specific types of grammatical violation associated with significant change in participants' scores on measures of grammar, orthography, or conventional spelling over the course of one calendar year?* There have been no published longitudinal studies of the relationship between grammatical violations when texting and the development of individuals' understanding of grammar, orthography, or spelling. Although spelling development has been found to be positively associated with textism use generally in previous longitudinal work (Wood, Meacham, *et al.*, 2011), this work did not enable the examination of relationships between grammatical violations and spelling.

A supplementary question of interest was whether the participants' tendency to make grammatical violations when texting was 'stable' over the course of 1 year. The assumption that the tendency to violate grammar when texting is stable over time has not been tested empirically. We therefore looked for evidence of the tendency to make specific types of violations at Time 1 and again at Time 2. If the tendency to make grammatical violations was not found to be stable over the year, this would highlight the need for research to capture more thoughtfully the full range of factors that impact texting behaviour over time.

Method

Participants

Two-hundred and forty-three participants were recruited from the West Midlands of England: at Time 1, there were 89 primary school children (mean age 9.9 years; range 8.6–10.9), 84 secondary school children (mean age 12.8 years; range 11–15.9), and 70 undergraduate students (mean age 20.8 years; range 18–30). All participants owned their own mobile phones. There was some attrition during the study, resulting in a Time 2 sample of 83 primary school children, 78 secondary school children, and 49 undergraduates. In a check of the undergraduates, we found no significant differences on any of the Time 1 measures between those who stayed in the study and those who dropped out.

Test battery

Wechsler Abbreviated Scales of Intelligence (WASI; Wechsler, 1999)

This assessment comprised four subtests that together produced a measure of the participants' general cognitive abilities (IQ score). The internal reliability (Cronbach's alpha) for each subtest with this sample was vocabulary .903; similarities .847; block design .847; matrix reasoning .890.

Test of Receptive Grammar II (TROG II; Bishop, 2003)

This measure assessed participants' understanding of spoken grammar and required them to pick a picture (from a choice of four) that represented a sentence that the

researcher said aloud. Standardized scores were used in the analyses. The sample alpha was .922.

Pseudoword Orthographic Choice Task (based on Mitchell, Kemp, & Bryant, 2011)
This task tested participants' written grammatical performance by requiring them to use the structure of a sentence to choose the grammatically appropriate spelling for a pseudoword written in two (orthographically plausible) ways. Sixty-four pseudowords were presented in eight different grammatical contexts (see Wood *et al.*, 2014, for a full list of items), each one governed by a conventional spelling rule. For example, the infinitive verb spelling *trox* is the appropriate choice in the sentence *Would you like to trox/trocks with me?*, whilst the third-person singular verb spelling *fies* is appropriate in the sentence Jim *fies/fize nearly every day*.

Participants were given 64 written sentences. For each sentence, one form of a pseudoword was represented by three dots (so as not to bias participant spelling), and a printed choice of two spellings was given for a different grammatical form of the pseudoword, for example, *Mary brought one . . . We still need 10 more thacks/thax*. The researcher read aloud each sentence (e.g., 'Mary brought one/θæk/. We still need 10 more/θæks/') and asked participants to circle which spelling they thought was most appropriate. Participants received one point for each correct answer. This task was administered in small groups, and the sample alpha was .882.

Wordchains (Guron, 1999) with articulatory suppression
The Wordchains task was used to measure orthographic processing ability. Participants looked at series of letter strings that comprised several words presented together without any spaces. Participants were given 3 min to mark the boundaries between words as quickly as possible and were given one point for each of the 120 'wordchains' that they segmented correctly. The participants were also required to say the syllable 'la' repeatedly during the activity so that the contribution of phonological processing was minimized during the task. The internal reliability of the task with this sample using this procedure was .970.

Wide Range Achievement Test IV (WRAT IV; Wilkinson & Robertson, 2006) – Spelling Subtest
This standardized assessment of spelling is suitable for children and adults and was administered in groups. The sample alpha was .939.

Coding the grammatical violations in text messages
Participants were asked to copy all the messages that they had sent within a recent 2-day period, exactly as they had written them. The text messages were coded for the number and nature of grammatical violations that were observed. For example, *im* would be coded as both *missing contraction apostrophe* and *i for I* (see Table 1). We counted six broad categories of text violation: *Unconventional orthographic forms* (e.g., using symbols such as emoticons in place of traditional punctuation such as question marks), *punctuation and capitalization violations* (using standard punctuation incorrectly), *missing words* (e.g., *u comin?*), *grammatical homonyms* (e.g., using *there/their/they're* incorrectly), *ungrammatical word forms* (e.g., *they is* for

Table 1. Grammatical violations in coded messages

Category of violation and violation types	Example
Unconventional orthographic forms	
Ellipsis	. . .
Start of sentence emoticon	:D Hi there!
Start of sentence kiss	x love you
End of sentence emoticon	☺ (instead of punctuation)
End of sentence kiss	x (instead of punctuation)
End of sentence initialism	LOL, LMAO (instead of punctuation)
More than one question mark	Are you coming out later???
More than one exclamation mark	It was so awesome!!!
More than one emoticon	☺ :D :x (instead of punctuation)
More than one kiss	xxx (instead of punctuation)
Punctuation and capitalization violations	
Mid sentence missing full stop/comma	It was ace are you coming out later?
End of sentence missing full stop	I am going out later
Missing question mark	Are you going out later
i for I	i will be out later.
Missing proper noun capitals	I am going to see tom tonight.
Missing start of sentence capitals	it will be a great night.
Missing contraction apostrophe	Im not coming out.
Missing possession apostrophe	Robs books are blue.
Unnecessary apostrophe	These shoe's are comfy
Missing words	
Missing pronoun/subject	Am going out later
Missing verb	I going out later.
Missing function words (e.g., *do*, *with*)	You want to come with me?
Missing word endings (e.g., *-ed*, *-ing*)	I am go to school.
Missing other	campin later (could be: Are you camping later?/I am camping later/I will see you at camping later)
Grammatical homonyms	Their going to town too buy sweets.
Ungrammatical word forms	Does you want to go out later?
Word/verb reduction	Tryna, hafta, wanna, gonna

they are) and *word reduction* (e.g., writing *hafta* for *have to*). The number of times these types of violations occurred was divided by the total number of words used in all the messages sampled, to provide a measure of use of grammatical violation relative to message length.

General procedure

All children were recruited and assessed at school, over several days. Undergraduates were recruited by advertising the study in their classes, and students completed assessments on campus outside of scheduled lessons. All assessments were conducted between January and July 2011 and then, with the exception of the WASI, were re-administered between January and July 2012, so that 12 months elapsed between the two assessment points for each participant.

Table 2. Mean improvement scores for participants' performance on the written language tasks, and Time 1 IQ scores and proportion of grammatical violations, by group (*SD* in parentheses)

Variable Name	Primary school (*n* = 83)	Secondary school (*n* = 78)	Undergraduates (*n* = 49)
Time 1 measures			
WASI IQ (standard score)	103.4 (17.4)	98.4 (14.3)	106.6 (12.6)
TROG II (standard score)	91.5 (12.9)	92.6 (15.3)	95.7 (15.3)
WRAT 4 spelling (standard score)	105.3 (12.9)	103.8 (11.6)	107.4 (17.6)
Wordchains (standard score)	102.2 (16.3)	100.8 (14.5)	93.7 (10.6)
Orthographic choice (max 64)	38.1 (6.4)	39.7 (8.8)	53.5 (9.0)
Proportion of grammatical violations			
Unconventional orthographic forms	0.034 (0.116)	0.105 (0.121)	0.067 (0.049)
Punctuation and capitalization violations	0.337 (0.242)	0.283 (0.172)	0.097 (0.098)
Missing words	0.111 (0.116)	0.125 (0.139)	0.065 (0.050)
Grammatical homonyms	0.004 (0.016)	0.002 (0.011)	0.002 (0.007)
Ungrammatical word forms	0.008 (0.018)	0.005 (0.018)	0.007 (0.017)
Word reduction	0.003 (0.014)	0.012 (0.028)	0.006 (0.010)
Time 2 measures			
TROG II (standard score)	96.3 (13.2)	95.0 (12.4)	100.6 (8.0)
WRAT 4 spelling (standard score)	105.3 (12.5)	105.5 (13.4)	110.6 (10.5)
Wordchains (standard score)	102.8 (15.7)	103.3 (11.9)	97.8 (12.6)
Orthographic choice (max 64)	38.3 (6.0)	40.7 (8.8)	55.2 (9.1)
Change measures			
TROG improvement (standard score)	4.8 (13.1)	2.4 (15.0)	4.9 (14.1)
WRAT spelling improvement (standard score)	0.0 (9.4)	1.7 (10.6)	3.2 (15.9)
Wordchains improvement (standard score)	0.5 (16.9)	2.6 (13.4)	4.1 (9.6)
Orthographic choice improvement	0.2 (7.5)	1.0 (7.0)	1.7 (5.9)

Note. TROG, Test of Receptive Grammar; WASI, Wechsler Abbreviated Scales of Intelligence; WRAT, Wide Range Achievement Test.

Results

Performance on outcome variables over time

The participants' performance on the outcome measures at Time 1 was subtracted from their Time 2 performance to produce growth scores indicating improvement over time (see Table 2). The greatest improvement was observed in the adult sample across the measures, although the primary school children also showed comparable improvement over time on the TROG II. This finding is perhaps linked to the fact that the adult participants were at university and therefore were more likely than the children to engage in extended writing tasks and receive feedback on written expression, including spelling and grammar. The improvement in orthographic processing can also be seen as an artefact of the more extensive reading and writing experience that undergraduates engage in relative to children. Furthermore, the measures were standardized on a general population rather than a student sample and so this educational experience is unlikely to be reflected in any age adjustment. Given that the orthographic choice task was not standardized, it is perhaps surprising that little improvement in scores was noted for all three age groups.

Grammatical violations when texting

The participants' text messages at Time 1 and Time 2 were coded for evidence that they used any of the six categories of grammatical violation. For the analyses, we considered the data from each age group separately, as previously we found some evidence that the three age groups showed different patterns of association between grammatical violation and literacy variables when analysed concurrently (Wood *et al.*, 2014). The most common type of violation for each of the three age groups was *punctuation and capitalization violations*, followed by *missing words* and *use of unconventional orthographic forms* (see Table 2).

Longitudinal patterns of association

Zero-order correlations (Kendall's Tau *B*) were calculated between the participants' tendency to make each of the different types of grammatical violation at Time 1 and their performance on the four outcome variables (TROG II, orthographic choice, orthographic processing, and spelling) at Time 2. We also included growth scores for these variables in this analysis (see Table 3).

There was relatively little association between the initial text messaging variables and the outcome variables. The primary school children's use of ungrammatical word forms was positively linked to spelling ability 12 months later, and their use of unconventional orthographic forms was also positively linked to the development of orthographic processing over time. There was a negative association between violations of conventional punctuation and capitalization, and performance on the Time 2 measures of orthographic processing and spelling for these children. However, there was no evidence of any negative associations between the children's grammatical violations when texting and growth in performance in the main outcome variables over the year and so there is no cause for concern in relation to the concurrent negative correlations observed at Time 2.

The secondary school children's use of word reduction when texting was positively associated with Time 2 spelling scores. The omission of punctuation and capitalization, and the use of ungrammatical word forms, were both positively associated with growth in spelling ability.

For the adult participants, the use of word reduction was positively associated with spelling ability at Time 2, but negatively associated with growth in orthographic processing ability. Although missing punctuation and capitalization was negatively associated with TROG II and orthographic choice scores at Time 2, it was also negatively associated with IQ.

Regression analyses were conducted based only on those texting violations that were significantly correlated with growth in either TROG II, orthographic choice, spelling, or orthographic processing scores. That is, for the primary school children, we regressed use of unconventional orthographic forms onto growth in performance on the orthographic choice task; for the secondary school children, we conducted a multiple regression using capitalization and punctuation errors and use of ungrammatical word forms as the predictor variables, and growth in spelling as the outcome variable. Both of these regression models were not significant. The only significant predictive relationship found was within the adult sample, where use of ungrammatical word forms accounted for 10.2% of growth in performance on the orthographic choice task, $R^2 = .102$, $F(1, 47) = 5.322$, $\beta = .319$, $p = .026$. A second regression that used word reductions as a predictor for growth in orthographic processing skills was not significant.

Table 3. Correlations (Tau *B*) between grammatical violation variables and outcome variables within the primary (*n* = 83), secondary (*n* = 78), and adult samples (*n* = 49)

	Time 1 violations					
	Unconventional Orthographic Form	Missing Cap&Punc	Missing words	Grammatical homonyms	Ungrammatical Word Form	Word Reduction
Primary school						
T2TROG	.000	−.120	−.060	−.106	−.070	.014
T2Choice	.084	−.063	−.178	−.087	−.158	.064
T2Orth.P.	.099	−.163*	.020	.130	.141	.027
T2Spelling	.109	−.216**	−.006	.009	.236**	.058
GrowthTROG	−.020	.003	−.061	−.100	−.083	−.001
GrowthChoice	.108	−.002	−.003	.118	.016	.112
GrowthOrth.P.	.176*	−.015	.064	.083	.069	.003
GrowthSpelling	−.050	−.059	−.063	.006	.116	−.033
Full IQ	−.110	.013	−.021	−.078	−.100	.117
Secondary school						
T2TROG	−.015	−.010	−.033	−.085	.025	.057
T2Choice	.054	.128	.001	−.044	−.213	−.114
T2Orth.P.	.113	−.035	−.132	−.169	.031	.113
T2Spelling	−.048	−.006	−.013	−.015	.010	.188*
GrowthTROG	−.041	−.014	.013	−.026	−.035	−.032
GrowthChoice	.065	−.014	−.003	−.075	−.125	−.050
GrowthOrth.P.	−.038	.107	−.075	.070	.050	.081
GrowthSpelling	−.096	.158*	−.080	.014	.187*	−.044
Full IQ	.172*	−.010	−.121	−.036	−.054	.070
Undergraduates						
T2TROG	.143	−.293**	−.104	.031	−.199	.049
T2Choice	.114	−.401**	−.042	−.218	−.165	−.005
T2Orth.P.	.058	−.107	.078	.095	−.033	−.195
T2Spelling	.089	−.203	−.062	−.059	−.080	.317**
GrowthTROG	−.031	−.038	−.035	−.045	−.203	.045
GrowthChoice	.000	.172	.225	.255	.319*	.130
GrowthOrth.P.	−.003	.081	.137	.184	.017	−.247*
GrowthSpelling	−.133	−.051	.014	.193	.029	.091
Full IQ	.112	−.291**	.014	−.069	.037	−.016

Note. T2TROG: Time 2 TROG (standard score); T2Choice: Time 2 orthographic choice (raw score); T2Orth.P: Time 2 wordchains (standard score); T2Spelling: Time 2 WRAT spelling (standard score); GrowthTROG: TROG improvement (standard score); GrowthChoice: orthographic choice improvement (raw score); GrowthOrth.P.: wordchains improvement (standard score); GrowthSpelling: WRAT spelling improvement (standard score); Full IQ: WASI IQ (standard score); TROG: Test of Receptive Grammar; WASI: Wechsler Abbreviated Scales of Intelligence; WRAT: Wide Range Achievement Test. *p < .05; **p < .01.

'Stable' versus 'unstable' use of grammatical violations

We split participants into groups for each violation type based on whether they either did or did not make that type of violation at least once in their texts. This grouping was performed separately for the Time 1 and Time 2 data (see Table 4). The most characteristic violations observed for the sample as a whole (and within each age group) were punctuation and capitalization errors and missing words. Very few participants

Table 4. Contingency table showing level of agreement between grammatical violation groupings at Time 1 versus Time 2 for the whole sample

	Whole sample Time 2		Primary school Time 2		Secondary school Time 2		Undergraduates Time 2	
	Yes	No	Yes	No	Yes	No	Yes	No
Time 1 unconventional orthographic forms								
Yes	69	52	12	16	20	31	37	5
No	26	62	14	41	8	19	4	2
Time 1 punctuation and capitalization violations								
Yes	190	17	69	12	74	4	47	1
No	1	1	1	1	0	0	0	0
Time 1 missing words								
Yes	126	38	38	21	45	14	43	3
No	32	13	15	9	15	4	2	0
Time 1 grammatical homonyms								
Yes	2	17	1	5	0	3	1	9
No	7	183	2	75	2	73	3	35
Time 1 use of ungrammatical forms								
Yes	7	38	4	13	1	9	2	18
No	19	145	1	65	7	61	9	19
Time 1 word reduction								
Yes	20	29	1	5	5	15	14	9
No	38	123	14	63	12	46	11	14

confused words like *there* and *they're* or used ungrammatical word forms or word reduction. The only age-group-based variations in this pattern are seen in the primary school children, who were less likely to use unconventional orthographic forms than the other two groups, and the adults who tended to make more word reductions.

We conducted Kappa analyses to consider whether the people who made these violations in the sample of their messages at Time 1 also made them at Time 2 (see Table 4). We found that use of unconventional orthographic forms ($\kappa = .264$, $N = 209$, $p < .005$), violation of punctuation and capitalization ($\kappa = .084$, $N = 209$, $p = .036$), and word reduction ($\kappa = .167$, $N = 209$, $p < .015$) were stable over time.

Discussion

Our central research question was whether the tendency to make particular types of grammatical violations when text messaging was related to changes over time in children's and adults' scores on tasks of grammar, orthographic processing, and spelling. We found that the most common violations were violations of punctuation and capitalization, the use of unconventional orthographic forms, and the omission of words.

In terms of our central question, correlations revealed a sparse pattern of significant relationships. With respect to grammar, there was no evidence of any relationship between performance on the TROG II and texting violations with the exception of the adult data. Similarly, the only significant relationship between growth in the orthographic choice task scores and grammatical violations whilst texting was found in the adult group and was positively related to the use of ungrammatical word forms. However, very few participants used ungrammatical word forms (e.g., *does you*) or confused grammatical homonyms (e.g., *they're/there/their*). Word reduction (e.g., *wanna*) was observed consistently only within the adult age group. These types of violation could be considered most closely associated with conventional grammar and are typically cited in media discussion as characteristics of young people's lack of grammatical ability. However, it seems from our results that these types of violation are not made frequently and, when they do occur, are not clearly linked to performance on formal tests of grammar. This finding conflicts with the concurrent self-report data presented by Cingel and Sundar (2012) and underscores the need to use standardized assessments and more detailed typologies of young people's textisms.

With respect to written language skills, Drouin and Driver (2014) suggest that textisms of omission (such as missing apostrophes) may be associated with poorer literacy, whereas textisms of addition (such as emoticons or creative re-spellings) may be used more by those with stronger literacy skills. These authors found some evidence for such associations, and our results also show some correlations in support of this pattern, across the different age groups. Amongst primary school children, for example, those who used more ungrammatical word forms and more unconventional orthographic forms (both of which would have been classified as textisms in previous studies of spelling) showed better Time 2 spelling and growth in orthographic processing, respectively, echoing the positive associations between textism use and spelling skills reported in previous studies (e.g., Coe & Oakhill, 2011; Plester, Wood, & Joshi, 2009; Plester *et al.*, 2008). In contrast, punctuation and capitalization violations in this age group were associated with poorer performance on Time 2 spelling and orthographic processing.

The patterns of significant correlations for the adolescents and adults show that text-based grammatical violations were positively related to spelling outcomes, but

negatively related to the measures of orthographic choice (written grammar) and orthographic processing. Orthographic processing, however, is not the same as spelling; both have an orthographic component, but the relationship between use of grammatical violations and spelling scores is still at least partially mediated by phonological skills. The orthographic processing task was used here was purely a test of visual processing, as the articulatory suppression removed the participants' ability to process the wordchains phonologically. It is possible that this distinction may be linked to the different directions of association observed in these two tasks.

The secondary school children showed more evidence of association between grammatical violations and growth in the outcome variables than the primary school children did. It is possible that the ways in which they compose their text messages is linked to their developing sense of self and individuality, as many of the violations are likely to be committed knowingly for social purposes. However, the overall lack of a strong association between the use of grammatical violations and literacy skills was confirmed in regression analyses. Moreover, there was some evidence from Table 3 that grammatical understanding is as influenced by general cognitive ability as it is by engagement with text messaging. The inclusion of a measure of general ability, as well as the longitudinal design of this study, further differentiates this study from earlier published work that has suggested that grammatical understanding may be harmed by children's texting behaviours (e.g., Cingel & Sundar, 2012).

Our secondary research question was concerned with the 'stability' of participants' production of grammatical violations over a year. Three categories (two of which were the most frequently used) were found to be stable: the use of unconventional orthographic forms and of word reduction, and the omission of conventional punctuation and capitalization. Further research is needed, which is based on a frequent and repeated sampling of messages, to enable a sensitive categorization of violations into stable and unstable forms and to relate this pattern to assessments of the participants' understanding of grammar. Only through such detailed methods would it be possible to gain insight into the existence of any transfer effects from informal to formal domains of language competency (e.g., Rosen *et al.*, 2010).

It appears that the kinds of grammatical violations made in text messages can vary over time. This is in line with the observation that adolescents and adults abbreviate the same words in different ways, even within their own messages (De Jonge & Kemp, 2012). The variation in use of grammatical violations over time may suggest that such violations are not necessarily indicators of ignorance, or that carelessness observed in messages at one point in time is characteristic of a general lack of attention and care when texting at other times. Instead, people might have an overall tendency to violate some aspects of conventional writing in their text messages. However, they might also deliberately vary their use of some word forms, depending on context. These results suggest that caution should be exercised in interpreting concurrent data as representative of individuals' text messaging behaviour at other points in time.

Limitations

Notwithstanding the benefits of longitudinal research of the type reported here, there are a number of important limitations to the present study that need to be acknowledged in understanding the results obtained here. The first important limitation is that the sample sizes obtained within the individual age groups are quite modest, and caution therefore needs to be exercised when arguing that these data appear to suggest no

consistent link between poor attention to grammar when texting and the development of grammatical understanding. It is possible that the study design lacks sufficient statistical power to detect what could be some quite subtle effects. Another important limitation relates to the way in which 'stability' was explored in this paper. That is, a great deal can impact an individual user's texting behaviour between two time points so far apart. A more sensitive approach to exploring the concept of stability would be to repeatedly sample texts from the same users over a shorter time period. This would also enable a richer sample of the individuals' text messaging behaviour in terms of the individual violations used. It would be useful to see more studies that offer comprehensive documentation of textism use over an extended period. This could be used to test empirically whether the use of 2-day 'snapshots' of text messages is representative of more general texting behaviour.

Conclusions

From these results, it seems likely that young people's use of grammatical violations in texting reflects more than just their language and literacy skills. The use of kisses, emoticons, and multiple punctuation marks might have more to do with one's tendency to feel or to display emotion and affection, than with one's grammatical or orthographic prowess. Similarly, the inclusion or omission of conventional punctuation and capitalization might be determined more by the sophistication of self-correcting phone technology (e.g., Grace *et al.*, 2012) than by the skill of the writer. Other factors determining the incidence of grammatical violations might include time constraints when texting, message recipient, and the importance the writer attaches to using standard English when texting. All of these factors might be distinct from an individual's grammatical, orthographic, and spelling abilities and could explain the lack of a clear pattern of associations between textism use and literacy skills observed in adults (Drouin, 2011; Grace *et al.*, 2014; Rosen *et al.*, 2010).

Our results suggest that the impact of 'lazy' language use when texting may have been overstated (e.g., Woronoff, 2007). Our findings reinforce the need to differentiate between the deliberate violation of grammatical or orthographic convention and genuine lack of understanding. Teachers should continue to teach their students the conventional rules of formal written language, whilst encouraging classroom discussion about the different registers of language and awareness of the contexts in which it is essential to apply standard conventions and when these conventions may be relaxed (Roschke, 2008; Turner, 2009). The finding that the use of grammatical violations does not appear to be linked to changes in grammatical skills over time adds to the growing body of evidence that there is no need for panic about the effects of textism use on the language skills of children, adolescents, or adults.

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