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SMS4Deaf – Self-report Reflections on SMS as a Mode for Psychology Research with the Deaf

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Abstract

Purpose: Text messaging (Short Messaging Service, SMS) is ubiquitous in Australia. It may prove a cheap and convenient method allowing bidirectional communication between participant and psychological researcher. A strength of applying SMS as a research tool is its inclusiveness, as it may be used to communicate with both hearing and deaf participants. This paper explores how the Australian deaf community engages with SMS, and how this engagement may be applied to using SMS to communicate with deaf participants in a psychological research setting.

Methods: Sixty six hearing impaired participants aged 20-89 years, ranging from moderately to profoundly deaf took part by way of questionnaire (paper, online text, or online Auslan translation). At the end, they had the option to provide their mobile number and be sent a questionnaire via SMS.

Results: Most participants owned mobile phones, and used SMS daily. 60% believed that using SMS for research is a good idea. However, this did not translate into volunteering to participate in research using SMS – of the half who provided their mobile telephone numbers for subsequent participation, there was only a 17% response rate. Pearson's Chi-squared tests, Spearman's correlation, and logistic regression did not reveal any significant differences between those who did and did not offer their mobile telephone number in terms of mobile ownership, daily SMS usage, degree of deafness, or confidence with written English.

Conclusions: Though many indicated willingness to participate in research via SMS by providing their mobile numbers, a very low response rates to SMS questionnaires indicates that SMS may not be the most engaging method for research with this sample.

Keywords: SMS; Text messaging; Mobile telephone; Deaf

Introduction

Text messaging (Short Messaging Service, SMS) heralds an important opportunity for psychology researchers. It may prove a cheap, convenient, bidirectional communication tool between participant and psychological researcher. Its greatest strength is the ubiquity of mobile telephone ownership and usage in Australia [1], allowing unprecedented access to participants throughout the course of the day, with minimal disruption to their thoughts and behaviours. The potential for SMS as a means of communicating with deaf participants is of particular social importance as a mainstream [2] portable communication medium and the first mobile telecommunications technological advancement that has truly connected people across the divide of hearing and hearing impaired [3,4]. SMS is a research mode with the added benefit of communicating with both hearing and deaf participants in the same research and in the same way. The current paper evaluates the potential for SMS as a tool for research with the deaf community. Following an exploration of factors that may impact upon mobile telephone ownership and usage within the Australian deaf population, current SMS language and usage in the deaf community is investigated to inform how SMS communications should be phrased in a research context. A final important consideration is whether the deaf community endorses SMS as a psychological research mode.

Since its introduction, SMS functionality has been a major factor in the proliferation of mobile phone ownership in Australia [5]. Australian SMS usage has been increasing dramatically, with 20,205 million SMS sent in 2005 increasing to 36.3 billion sent in 2011 [1,6]. Mobile phones, and their SMS functionality, are readily adopted by deaf individuals, as well as their immediate family and support network [3,7]. Uptake of SMS outstrips that of other text-based communication options, such as email or instant messaging, in deaf communities [2]. Many deaf people buy a mobile telephone solely for its SMS functionality [8]. In Australian research targeted at the larger deaf community, over 90% owned a mobile telephone [3], and over half of that sample listed SMS as the most useful aspect of their mobile phone. In 2004, SMS usage was estimated to be higher in the deaf than in the hearing population [7]. As in the wider non-deaf Australian population, SMS is used more frequently by the younger demographic of teenagers and young adults [2]. Aside from the benefits of SMS often cited in research with non-deaf participants including its availability, portability, convenience, cost-effectiveness and ease of use [2,3,9], SMS is uniquely useful to deaf individuals for communications typically carried out by voice call including hailing taxis, contacting roadside assistance for breakdowns, and coordinating purchases and

banking [3]. This high mobile ownership and SMS usage in the deaf community strongly suggests that this population in general does indeed have the capacity to participate in psychological research by way of SMS.

Participant age is one factor commonly associated with mobile ownership and SMS engagement [10-12]. An additional issue specific to the deaf community is the point in time in which hearing was lost in terms of language acquisition: pre-lingually (at birth, or before age 3), or post-lingually at a later time in life. Pilling and Barrett [2] found that pre-lingually deaf individuals were significantly more likely to use SMS than post-lingually deaf individuals, especially if a signed language was their preferred language. The structural similarity between Australian sign language and SMS in terms of brevity and grammar [7] might underlie the relationship between a preference for signed language and greater SMS usage. Pilling and Barrett [2] do note that the relationship between SMS usage and whether participants were pre- or post-lingually deaf may be an age effect, as they also found that older individuals used SMS less, and their sample contained a disproportionately low number of pre-lingually deaf participants in older age groups (50+). The current study investigates whether age is a confounding factor in this relationship by controlling for age, and comparing pre- and post- lingual deaf individuals in a younger age bracket. It is hypothesized that, particularly those aged 25 or under, SMS usage will be higher among those who were pre-lingually deaf than those who are post-lingually deaf, and SMS usage will be higher among those who state sign language as a primary or preferred communication option than those who do not.

In older adults, the time point of hearing loss is significant in terms of exposure to other text-based communication methods. Participants aged 25 or under at the time of writing the current paper would have been no more than ten years of age when SMS functionality was introduced in Australia, so it may reasonably be assumed that SMS has always been a choice for text-based portable communication for this group. Adults aged 30 and over who were born deaf, or lost their hearing, before 1995 were exposed to text-based communication methods other than SMS, in both static and mobile forms. The Teletypewriter (also known as TTY), was a text-based communication system developed specifically for the deaf in the 1960s [7]. Deaf individuals were first exposed to text-based mobile phone communication system in the late 1980s with the introduction of early mobile phones, which were capable of acting as TTY terminals. This was short lived, as the analogue telecommunications network that supported this was completely phased out in favour of a digital network system in 2000 [8]. The demise of mobile TTY was ameliorated by the introduction of SMS in Australia in 1995, during the transition from analogue to digital infrastructure. TTY, and the National Relay Service, is still in use by way of desktop TTY machines. As noted by Pilling and Barrett [2], there is less impetus to learn SMS when an adult is already using a technology that fulfils the same role. It may be that older individuals who lost their hearing prior to 1995 would have been less motivated to making the transition to SMS than those who lost their hearing after 1995, as they were already using TTY. It is therefore hypothesised that in deaf Australian adults aged 30 and over, SMS usage will be associated with the point in their life when they lost their hearing, even when the relationship between SMS usage and age is controlled for. Specifically, those who lost their hearing after 1995 are more likely to own a mobile telephone, and use SMS more frequently, than those who lost their hearing prior to 1995.

This is helpful to researchers wondering who amongst the Australian Deaf community may communicate with psychology researchers by way of SMS. Another important issue is how it should be done. One of the primary distinctions between SMS and other communication methods is its brevity, which in turn leads to a specific style of language. Text speak is a dialect of written English that creatively reinvents words according to the need for brevity enforced by the 160 SMS character limit. These reinventions often rely on "alphanumerish", the phonological similarity between text and numbers, e.g. the similarity between the sound of the number "8" and the word "ate". Given that additional length can increase the cost of sending an SMS, a researcher working to a budget should establish whether these shortenings are common in everyday SMS usage within the deaf community, and thus can be used to minimise the cost of conducting research. Power et al. [3] noted that phonologically based abbreviations might be difficult for deaf people to interpret. This suggestion assumes lack of exposure to the sound of written words, and so could be demonstrated by comparing those individuals with mildly impaired hearing (who can hear some speech) to those with profound deafness (who cannot hear any speech whatsoever). It is hypothesised that profoundly deaf individuals will have more difficulty interpreting phonological similarity-based SMS abbreviations than moderately deaf individuals, and that pre-lingually profoundly deaf individuals will have more difficulty interpreting phonological similarity-based SMS abbreviations than post-lingually profoundly deaf individuals. This is not to say that deaf individuals will use fewer of all classes of abbreviations. Indeed, it is likely that signing deaf individuals will have their own repertoire of abbreviations when using SMS.

Whilst brevity in sign language is best conceptualised as the minimisation of movement rather than word length, common movement shortening practises in Auslan (Australian Sign Language) are akin to abbreviation in written English. Examples of this include lexicalised finger spellings, finger spelling abbreviations, and single manual letter signs [13]. Lexicalised finger spellings are the repetition of single letter signs in order to represent full words (i.e. T-T for Toilet, or D-D for Daughter), or finger spellings of abbreviations (i.e. J-A-N for January, or A-D-V for Advertisement). Single manual letter signs are where the first letter of the English word is used instead of the whole word, i.e. W for Week, or Y for Year. It is therefore hypothesised that signing deaf individuals will employ initialisms, stemming from lexicalised finger spelling, and single manual letter sign abbreviations in their SMS.

A final and important consideration when discussing the possibilities of any research with the deaf community is their opinion of the medium. Participant perception of a research mode is instrumental in its success or failure when used for research [13]. Just as everyday SMS usage forms an informative baseline for researchers considering its usage as a mode for research; it may be that everyday SMS usage will inform participant opinions regarding the use of SMS in the capacity of psychological research participant. SMS should also be explored in the context of other research modes, such as paper, online, or email communication to delineate general opinion of usefulness and preference. It is hypothesized that a higher self-reported use of SMS, and a more positive attitude toward using SMS for research, will be associated with a greater likelihood of volunteering to participate in SMS research.

Methods

Participants

Over the course of six months, participants were recruited through the following organizations and groups, primarily by way of an email being forwarded to group members: Canberra Deaf Club; Deafness Forum; Deaf Australia; Better Hearing; Sydney Cochlear Implant Centre; DeafCanDo; Deafness Resource Centre; Victorian Deaf Society; Western Australia Deaf Society; ASLIA; Able Australia; Deaf Society of NSW; the Shephard Centre; the ACT Deafness Resource Centre; and, on Facebook: Auslan Matters; Canberra Deaf Club; and I'm just deaf, not an alien! The only inclusion criterion was that participants had to be deaf to some degree. Consent was implied by return of survey, and no incentive for participation was offered. The final sample consisted of 66 participants, aged 20-89 (Mean age=47), 60% were female.

Materials

This study consisted of an initial questionnaire, followed by an optional SMS component. The questionnaire was created for this study, and included demographic questions relating to gender, age, hearing status, preferred language, mobile phone ownership (whether one or more mobiles were owned, and whether that mobile was a smart phone) and text messaging usage in terms of average SMS sent per day. To give context to this, participants also reported how often (never, daily, weekly, or monthly) they used their mobile telephone for other purposes, such as voice calls, email, music players, or as a clock to tell the time. Participants were asked to rate their written English confidence in general, and then their written English confidence specifically when using SMS, on a sliding five point scale from 'not at all confident' to 'very confident'. There were then three primary lines of inquiry, with participants asked to respond in both single-option choices (i.e. good/bad, yes/no) for quantitative analysis, and open-ended text boxes for a qualitative response.

Would you rather complete a questionnaire via SMS, email, or post?

Do you think using SMS for research is a good or bad idea?

Is SMS good for Deaf people? Why or why not?

The next questions referred to text speak, specifically asking whether participants find it difficult to read, and which forms of text speak they themselves use. Participants were presented with a list of forty commonly used text speech phrases drawn from. The questions concluded with an invitation to complete follow-up questions via SMS, where participants willing to do so provided a mobile number. This was used as a behavioural measure of willingness to participate in research via SMS.

This questionnaire was distributed in three forms - a paper response to be posted to the researcher, online questionnaire with questions written in English, or online questionnaire with questions presented as an embedded video of an Auslan interpreter (one video per question). Participants could choose which form they wished to respond to. Equivalence could not be statistically evaluated due to highly unequal number of responses in each form - the majority (84%) participated using the online version, 15% to the video version, and only one participant responded by paper. Data from the three response forms were pooled for analysis.

The SMS portion of the study consisted of the 20-item, 7-point likert scale Ruminative Thought Styles (RTS) questionnaire, and follow-up questions asking for ratings of how clear the RTS instructions were, and how physically difficult it was to type responses to the SMS, on a 5-point likert scale.

Procedure

This study involved a self-report online survey, and behavioural outcome component. Participants were presented with information about the study, and invited to participate by completing the correlational questionnaire either online (in English or Auslan formats), or by post. Those who indicated willingness to participate in the SMS component provided their mobile telephone numbers via this survey. The SMS component occurred within a week of completing the questionnaire, beginning with an initial text scheduled for arrival at 2:00 pm in order to control for the possible effect that time of day might have on response rates, or response delay. This initial text was followed by four more SMS scheduled to arrive at 2:15 pm, each containing five of the RTS items (because the whole 20 items cannot fit into a single message), and a fifth the following day at 2:00 pm containing follow-up questions about the RTS instruction clarity and ease of responding.

Statistical analysis

The majority of the current data is categorical in nature, or not normally distributed, leading to the use of non-parametric alternatives to more commonly used statistics. Spearman's rank correlation coefficient (denoted in text as ρ) is a non-parametric measure of correlation. It provides measure of the degree of relationship between two variables, and is more robust against violations of normality (allowing non-normal and discrete distributions) than the more commonly used Pearson's correlation coefficient, which is not used in the current paper. Similarly, the Wilcoxon signed-rank test is a non-parametric alternative to the t-test, used when the underlying variable of interest is not normally distributed. It is denoted in text as W.

Logistic regression models the relationship between an independent variable (that may be categorical or continuous) and a binary dependent variable. This relationship can be expressed as an Odds Ratio (OR), which is the ratio of the odds of an event occurring to it not occurring. Logistic regression models are particularly helpful when a causal, continuous predictor is to be examined. However, where causality is not of interest, and one wish to test if two categorical variables are significantly related, a chi-square test is more appropriate.

Pearson's Chi-squared test is a method for analysis of categorical data where a chi-square distribution approximating the data is used to test the null hypothesis that the observed data could have occurred by chance. It does not comment upon the causal aspects of that relationship, but is useful in correlational designs like the current study. Given the relatively small sample size available for analyses, the size of some cells in several chi square tests was quite small (n less than 5). This can be problematic as it threatens the reasonableness of using a chi-square distribution to approximate the discrete distribution of the test statistic. In these cases, monte carlo p value simulation will be used. This involves simulating randomly generated samples with the same n in accordance with the hypothesis being tested to produce a reference distribution, and deriving conclusions from this [14-16].

For open-ended responses, emerging themes were read by the researcher and coded in the style of a grounded theory approach to extract categories from the data. Two independent raters then counted incidences of those common themes. Agreement between researchers was quantified by way of a square weighted Kappa statistic. This gives an indication of agreement between observers, on a scale of 1 meaning perfect agreement, .5 meaning half agreement, and 0 meaning chance level agreement.

Results

All 66 respondents were included in analysis. The majority (88%, n=59) had lived in Australia their whole lives. Forty five percent (n=30) reported English as the language they used most each day, 47% (n=31) using Auslan most, and 8% (n=5) using another language (New Zealand Sign Language, British Sign Language, and lipreading) most. Most (68%, n=45) of participants were profoundly deaf, with only 3% (n=2) of participants reporting they could easily hear a spoken conversation, 5% (n=3) were moderately deaf, and 24% (n=16) were between moderately and profoundly deaf. 58% (n=39) of participants were pre-lingually deaf (all of which from birth), while 42% (n=27) were post-lingually deaf. Post-lingually deaf individuals had been deaf between 3 and 72 years, (Mean=33, SD=18). Refer Figure 1 for a breakdown of year reported Deaf, in the context of the historical progression from TTY to SMS.

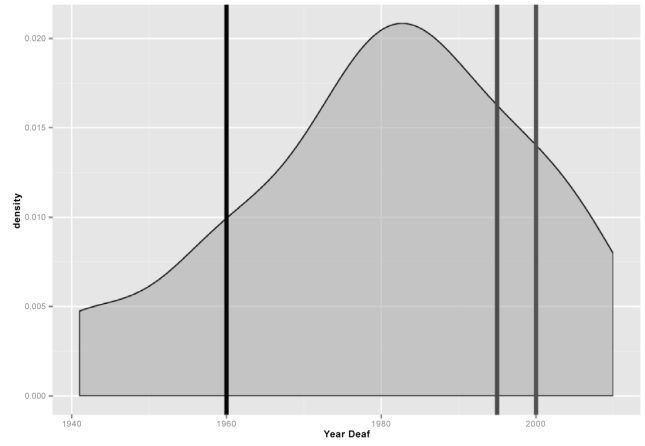

Figure 1: Density plot of the year of Deafness onset in individuals not born Deaf. The boundary marked by lines indicates meaningful events in text-based communication availability; 1960, when TTY was first introduced (black); 1995, when the national relay service for TTY was established (grey, left); and 2000, when support for TTY on mobile handsets was abolished by a move to digital infrastructure (grey, right).

Daily mobile usage in the australian deaf community

Most (97%, n=64) of the sample owned a mobile phone, with 23% (n=15) owning a cell phone, 8% (n=7) a web phone, and 66% (n=44) a smart phone. Those who reported owning a mobile were experienced mobile users, having owned a mobile for up to 15 years, with an average length of mobile ownership of 12 years. Spending between $0 and $200 (Mean=$48, SD=$30) on mobiles per month, participants were active users of their mobile phones for a variety of purposes. While the majority (67%, n=44) of participants reported never using their mobiles for voice calls (6% reported using mobiles for voice calls monthly, 14% weekly, and 13% daily), most used their mobiles daily for email, and to tell the time (72% [n=48] and 78% [n=52] respectively). A fair number (64%, n=42) also used their mobiles for other purposes on a daily basis, including browsing the internet, banking, as an alarm, and communicating with non-signing people via written notes.

Only one participant reported they never used SMS, with the vast majority (91%, n=60) stating they used SMS on a daily basis. Participants reported a daily average of sending between 0 and 200 (Mean=16, SD=27) SMS per day. Over half of participants were confident in their written English ability in general, and more were confident in their written English ability in terms of SMS (62% [n=40] and 70% [n=46] respectively). As would be expected, there was a significant correlation between confidence in written English in general, and written English for SMS (ρ=0.77, p<0.00). Eighty six percent of participants believed that SMS was good for Deaf people in general. Five themes emerged from corresponding open-ended question asking why this is so: convenience, social factors, cost, communication, and other (Table 1).

Theme	Count	Kappa	Example responses
Convenience	27	0.97 (p=<0.01)	"SMS is very convenient for deaf people and very mobile! Can be use anywhere and anytime!"
Social factors	19	0.96 (p<0.01)	"Yes its easy to communicate and keep in touch with friends and family."
Cost	3	1 (p<0.01)	"Good and bad / Good as sms is quick and effective. / Bad with increasing number of words comes with increased costs."
Communication	50	0.95 (p<0.01)	"Yes of course it perfect for deaf community used sms as we can't used voice so sms help us to contact each other like going out, workplace, some doctor or dentist also nabs to book an interpreter! if no sms what can we do in our world?"
Other	13	1 (p<0.01)	"Yes in case of emergency, tty is not mobile."

Table1: Count refers to n of individuals who mentioned this theme in their open-ended response. In the interests of readability, counts are only reported for observer 2. The accompanying square weighted Kappa statistic gives an indication of agreement between observers, on a scale of 1 meaning perfect agreement, .5 meaning half agreement, and 0 meaning chance level agreement.

The hypothesis that in deaf individuals, particularly those aged 25 or under, SMS usage would be higher in post-lingually deaf and those who preferentially use sign languages was not supported. Neither pre- or post- lingual onset of deafness, nor preference for signed languages over English, significantly associated with self-reported SMS usage on a daily basis across the whole sample (W=219 p=.45 and W=328 p=.62, respectively) or in individuals aged under 25 (W=8, p=.315 and W=9, p=.359 respectively). Chi square tests with monte carlo p value simulation of self-reported confidence in written English for SMS was not significantly associated with preference for English or a signed

language ($\chi 2$ =4.10, p=.14), or pre- or post- lingual Deafness ($\chi 2$ =.47, p=.90).

The hypothesis that in deaf Australian adults aged 30 and over, SMS usage will be associated with the point in their life when they lost their hearing, even when the relationship between SMS usage and age is controlled for, was not supported. First, the relationship between age and SMS usage was explored in the 55 participants aged over 30. The prediction that those who lost their hearing after 1995 are more likely to own a mobile telephone was not statistically examinable, as only two participants in the 30- and-older bracket did not own a mobile phone. Analysis of daily SMS usage proceeded with non-parametric tests, as Agostino tests revealed reported number of SMS sent per day was significantly positively skewed (z=2.5, p=0.01). Spearman's ρ revealed a significant negative correlation between age and number of SMS sent daily (ρ =-0.32, p=0.02), indicating that older individuals in the 30-and-older age group sent fewer SMS per day on average, than younger individuals in the 30-and-older age group. Turning to the point of deafness onset in this age group, just over half (56%) were Deaf before 1995. The vast majority of those Deaf before 1995 (84%), and after 1995 (91%) used SMS daily. Wilcoxen tests did not reveal a significant difference in average number of SMS sent per day between participants who were Deaf before, or after, 1995 (W=319, p=0.34; Figure 2).

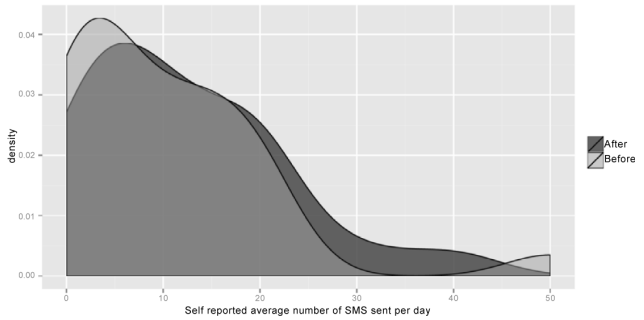

Figure 2: Density plot of the self-reported average number of SMS sent per day, grouped by whether individuals were Deaf before or after 1995, when the National Relay Service TTY was introduced in Australia.

Although 42% of participants said they find it difficult to read when people use text speaks, 55% said that they used abbreviations or shortenings when sending SMS. Reasons given by those who did not use abbreviations included a general dislike for abbreviations, self-confessed linguistic pedantry, and abbreviations being "overrated". Those who did not use abbreviations were conscious of their common use in SMS ("I don't use abbreviations, I'm sure I drive everyone mad!"), and some demonstrated a willingness to learn because of this ("I do not use the abbreviations when sending an SMS. However I'll learn more about it if they are becoming frequent to be used", "sometimes it is hard but when you learn you get used to it. Even hearing children use abbreviations/shortenings as it is cheaper and quicker.").

Across participants, 77 different text speak terms were reported as commonly used (Table 2). Though there were more examples of non-phonological than phonologically-based text speak (69% phonologically-based), the count of individuals using phonologically-based text speak was only slightly lower than the count for non-phonologically based text speak (47% and 53% of all occurrences of text speak usage respectively). The hypothesis that signing deaf individuals will employ lexicalised finger spelling, and single manual letter sign abbreviations in their SMS was not supported. The only recurrently used single letter signs were "c" and "u", both commonly used in the wider hearing Australian population [12].

Overall, participants correctly interpreted 67% of the SMS abbreviations they were presented with. Though correct interpretation count of phonologically and non-phonologically based significantly positively correlated (ρ=.80, p<.001), participants correctly interpreted significantly more non-phonological similarity based SMS abbreviations than phonological similarity based SMS abbreviations (W=1280.5, p<.001). While there was not a significant difference between the correct interpretation counts within subtypes of phonological similarity-based abbreviations, there was a significant difference within non-phonological similarity-based abbreviations, with participants correctly interpreting more contractions than shortenings (Table 3). There was no significant difference in correct interpretation of either shortening or contractions between individuals who preferentially used sign language rather than English (W=611, p=.35 and W=648, p<.114 respectively).

The hypothesis that pre-lingually profoundly deaf individuals will have more difficulty interpreting phonological similarity-based SMS abbreviations than non pre-lingually profoundly deaf individuals was not supported (W=198, p=.237). Similarly, the hypothesis that profoundly deaf individuals will have more difficulty interpreting phonological similarity-based SMS abbreviations than moderately deaf individuals was not supported (W=417.5, p=.451).

Txtspk	Meaning	Count	Type	Txtspk	Meaning	Count	Type
nurries	no worries	1	Stylisation*	plse	please	2	Contraction
2	to	5	Homophone*	thks	thankyou	1	Contraction
4	for	3	Homophone*	tmw	tomorrow	9	Contraction
&	and	1	Homophone*	tnt	tonight	2	Contraction
2day	today	3	Homophone*	txt	text	1	Contraction
2moro	tomorrow	1	Homophone*	ur	you're	2	Contraction
2morrow	tomorrow	1	Homophone*	wk	week	1	Contraction
2nite	tonight	3	Homophone*	wld	would	1	Contraction
b	be	3	Homophone*	yr	year	1	Contraction
b4	before	4	Homophone*	ystrdy	yesterday	1	Contraction
c	see	5	Homophone*	lol	laugh out loud	7	Initialism

cu	see you	3	Homophone*		people's names	1	Initialism
g8	great	1	Homophone*	T	today	1	Initialism
gr8	great	1	Homophone*	v	very	1	Initialism
l8	late	2	Homophone*	am	morning	3	Shortening
l8er	later	2	Homophone*	arvo	afternoon	1	Shortening
r	are	4	Homophone*	aug	august	1	Shortening
u	you	17	Homophone*	bro	brother	2	Shortening
w8in	waiting	1	Homophone*	def	definitely	1	Shortening
luv	love	3	N.spelling*	fri	Friday	1	Shortening
nite	night	1	N.spelling*	jan	january	1	Shortening
sum	some	1	N.spelling*	min	minute	1	Shortening
tix	tickets	1	N.spelling*	mon	Monday	1	Shortening
wot	what	1	N.spelling*	morn	morning	2	Shortening
fb	facebook	1	Acronym	oct	october	1	Shortening
ily	I love you	1	Acronym	pm	afternoon	1	Shortening
jmo	just my opinion	1	Acronym	poss	possible	1	Shortening
wtf	what the fuck	1	Acronym	re	are	1	Shortening
bck	back	1	Contraction	sat	Saturday	1	Shortening
bday	birthday	2	Contraction	sept	septembe r	1	Shortening
brb	be right back	3	Contraction	sun	Sunday	1	Shortening
cnr	corner	1	Contraction	ta	thankyou	2	Shortening
cya	see you	2	Contraction	thur	Thursday	1	Shortening
hw	how	1	Contraction	tom	tomorrow	1	Shortening
msg	messag e	1	Contraction	tue	Tuesday	1	Shortening
n	and	2	Contraction	uni	university	1	Shortening
pls	please	1	Contraction	wed	Wednesd ay	1	Shortening

Table 2: Text speak reported as commonly used by the current sample, count being the number of individuals who reported using that particular text speak (as a proxy for commonality of use). * indicates text speak that is phonologically based; N.spelling is non-conventional spelling.

	Mean	SD	Skew z	Wilcoxen test	Correlations
(A) Phonological similarity 11.98	5.27	-1.527		A	a1
(a1) Letter/number homophones	6.52	2.26	-2.96*	W=2396 p=.317	-
(a2) Accent stylisation	5.47	3.52	-0.594		.67**
(B) Non-phonological similarity 14.98	5.25	3.259**		B	b1
(b1) Shortenings	6.97	2.77	-2.604*	W=1427 p<0.001	-
(b2) Contractions	8.02	2.74	-3.480**		.51**

Table 3: Summary statistics of count of correct interpretations of SMS abbreviations, grouped by linguistic type. Summary of Skew z refers to outcomes of D'Agostino skewness tests. * significant at p=.05; ** significant at p=.001.

SMS as a tool for research in the australian deaf community

60% of participants believed that using SMS for research is a good idea. Themes emerging from open-ended responses were speed, convenience, communication, and other (Table 4). There was some division in comments relating to the way in which SMS may be seen as a means of including the Deaf community in psychological research, as can be seen from these contrasting responses.

"Deaf people and people who have Auslan as their mother language should have their right to have each and every questions explained via Auslan. Text/SMS does not allow this therefore it is breaching their human right to have information in their language."

"I'm a staunch supporter of research and anything that may help the hearing impaired sounds like a good idea to me!"

Theme	Count	Kappa	Example responses
Speed	6	1	"Quick, questions are written"
Convenience	20	0.84	"My access everywhere and anytime !!"
Communication	24	1	"Can get to many more Deaf/HI people. Not all deaf access email or can read too well, so sms is useful"
Other	30	0.92	"As long as the result of the research is published and sent to deaf people."

Table 4: Count refers to n of individuals who mentioned this theme in their open-ended response to the question "Do you think using SMS for research is a good or bad idea?". In the interests of readability,

counts are only reported for observer 2, however the accompanying square weighted Kappa statistic gives an indication of agreement between observers. In the interests of brevity, Counts are reported for observer 2 only.

Interestingly, a number of participants indicated that the viability of SMS as a tool for research with Deaf individuals was dependent on the brevity of the response, due to issues of richness of communication and the pragmatic cost of sending long responses by SMS. Specifically, several stated that it would be suited to multiple choice style questionnaires.

"It could be useful for poll questions. Quick responses."

"for short research, fine... but long one, not too good idea"

"If it was only a couple of questions, then SMS may be ok. Email or link to on-line survey easier." "If its a short survey - ok ok.. But prefer to keep SMS for relevant correspondence not for other uses such as surveys - as it would mean extra charges for lengthy SMS."

"Good idea if questions are multiple choice only and does not require writing a response."

"If the research is entirely multiple choice, or questions requiring only once answer, then conducting the research via SMS would probably work well."

Given the choice of completing questionnaires via SMS, email, or by post, 85% of participants indicated they would prefer to use email, and 15% by SMS. Common themes emerging in open-ended responses were speed, physical difficulty of responses, cost, and other, are presented in Table 5.

Theme	Count	Kappa	Example responses
Speed	18	0.96	"It's quicker as the keyboard is larger and I check my emails several times a day."
Physical factors	44	1	"Easier for typing purposes. Screen on mobile too small."
Cost	4	1	"Cost too much to use mobile"
Other	22	1	"Extent of text available, less prone to mishearing. Record of what was said or not said."

Table 5: Themes mentioned by individuals asked "Would you rather complete a questionnaire via SMS, email, or post? What are your reasons?" Count refers to n of individuals who mentioned this theme in their open-ended response to the question. Example responses refer to those who nominated a preference to email, but counts are for themes mentioned across all nominated preferences. In the interests of readability, counts are only reported for observer 2, however the accompanying square weighted Kappa statistic gives an indication of agreement between observers. In the interests of brevity, Counts are reported for observer 2 only.

The majority of open-ended responses discussed the benefits of email rather than the detriments of SMS as a tool for psychological research. However, there were some indications that the intrusiveness SMS in their daily lives led to a concern with the potential for research.

"SMS is a pain in the arse. There is no way I can control it's intrusion into my time."

"Because SMS is an irritant. [...] day to day situations where SMS controls you, email is definitely the best way for me to manage my time."

The hypothesis that a higher self-reported use of SMS, and a more positive attitude toward using SMS for research, would be associated with a greater likelihood of volunteering to participate in SMS research was not supported. Positive or negative attitude toward using SMS for research was not significantly associated with whether or not participants gave their mobile phone number either as the sole predictor (OR=.47, z=-1.38, p=.16), or in a model with self-reported daily SMS usage (OR=.44, z=-1.45, p=.14). Similarly, self-reported daily SMS usage was not significantly associated with whether or not participants gave their mobile phone number either as the sole predictor (OR=1.01, z=.803, p=.42), or in a model with positive or negative attitude toward using SMS for research (OR=1.01, z=.59, p=.553). These results should be interpreted with caution, as residual variance indicated that logistic regression model fit was poor overall (as indicated by significant deviance and likelihood ratio tests, $\chi 2$ $p \approx 0.02$ for all discussed models).

Of the 30 individuals who provided their mobile telephone numbers for subsequent participation, there was a 17% response rate. Fourteen participants responded in some manner, but only five of those responses involved an attempt to complete the RTS. Though the sample of respondents is too small for statistical analyses, the follow-up information from those who did respond in some manner indicates that the low response rate was not due to difficulty typing the text to send the SMS response (only one participant found it very difficult to type the text to respond to the SMS, three found it somewhat difficult, and five very easy), or confusing instructions (four participants rated the instructions as clear, five as very clear). Responses such as "Hi i t is imposibl 4 me 2 remembr al questns 2 b able anser them" indicate that factors not measured by the current study, such as the size of participant's mobile telephone screen (and thus the amount of text that is visible at any given time), may impact on the participant's willingness and ability to respond to research SMS.

Discussion

In line with the findings of Power et al. [3] and Harper and Clark [8], mobile phone ownership and daily SMS usage was very high in the current sample. It may be that the dramatic uptake of SMS among the deaf population noted by Pilling and Barrett [2] has resulted in near saturation of daily SMS usage within the deaf community. The majority of respondents reported a positive view of SMS in daily life, affirming that, as in Akamatsu et al. [9] and Bakken [4], SMS is very important for communication, particularly as a means of bridging the communication divide between hearing and non-hearing people. This may be due to its convenience, also mentioned my many participants, as the portability of SMS renders it useful for situations where email or TTY are not available, but immediate text-based communication is required. Results were in line with observations in the broader literature that there are age based differences in mobile phone usage [10,11], with older individuals generally using SMS less than younger individuals [15]. Likely due to the sheer ubiquity of SMS usage in the current sample, there was no support for either hypothesis that current daily SMS would be related to historical point where individuals became deaf, in terms of linguistic development in those aged under 25 or the historical context of SMS development in those aged over 30, beyond age-based differences in SMS usage.

Predictions that the deaf community, particularly the signing deaf, would use text speak in an idiosyncratic way were not supported. Though around half of the current sample found text speak difficult to read, many participants used it, employing the same repertoire of text speak as the wider population [12]. Participant attributes such as pre- or post- lingual onset of Deafness, and degree of Deafness, did not significantly impact on correct rate of interpretation of phonologically based SMS abbreviations, though as predicted by Power et al. [7], participants were better at in interpreting non-phonologically-based abbreviations. Contrary to expectations, both signing and non-signing participants had significantly more difficulty interpreting shortenings than contractions. Though at face value contractions and shortenings seem similar, shortenings are more likely to have multiple interpretations than contractions, i.e. the shortening "mon" could be taken as either "month" or "monday", while the contraction "mnth" is more clearly "month". Context is an important factor in selecting the correct shortening interpretation. Given that participants reported using a number of shortenings in their everyday SMS behaviour, it is likely that the difficulty participants had with interpreting shortenings in the current study were due to their being presented context-free. Despite qualitative comments indicating a willingness to learn how to use abbreviations, and the relatively common use of text speech in everyday SMS activities, almost half of the sample indicated they found text speak difficult to read, and participant interpretation of SMS abbreviations illustrated several errors. It is therefore recommended that, in the interests of clarity, text speak abbreviations be avoided when using SMS as a tool for research with the Deaf community. If they must be used, then it is recommended that researchers only consider non-phonologically based types of text speak, preferably contractions, and possibly shortenings if the surrounding context renders their meaning clear.

Just over half of participants reported a positive view of using SMS as a tool for research with the deaf community, with the most notable caveat being that it is most suitable for research which is brief (e.g. polls, or short multiple choice questions). Open-ended responses referring to the speed with which participants could respond to the researcher were mentioned less than issues of convenience, and communication, notably, the inclusivity of SMS as a tool for research that may be applied to both deaf and non-deaf populations. The theme of inclusivity was mentioned by several participants, and it should be noted that not all viewed SMS as sufficiently inclusive, as it does not allow participants to use their first language, such as Auslan, when participating. It is important that researchers are aware of this cultural sensitivity, particularly when recruiting for Deaf participants when conducting research that uses SMS.

The majority of participants stated that they would rather participate in research via email, rather than via SMS, primarily due to physical factors such as the smallness of the mobile telephone screen, and difficulty of typing on a mobile compared to using a keyboard, and concerns about the potentially intrusive nature of SMS. This linked with many participants stating that it would be quicker for them to send an email response than it would be to send an SMS response. These issues are not unique to the Deaf sample, and may prove barriers in the general population. The physical difficulties of sending an SMS must also apply to using the mobile phone for email, something that a large portion of the sample reported doing daily, though email may be differentiated as it can be engaged with either on a mobile phone or a computer. It would be interesting for future research to disentangle email use per se, from email use specifically on a mobile, or on a computer, to fully explore the difference between email and SMS usage in a deaf sample. Very few participants mentioned cost as a factor in their response mode preference. A further theme emerging from open ended responses was control - participants cannot control when an SMS is received, but can control when to check their email, thus rendering email a less demanding and intrusive mode of communication. These results indicate that though SMS is a more positively perceived method of research communication than post, if a researcher has the option of using email or SMS to obtain data, particularly if they seek to collect data remotely in general, rather than moment data, email should be used.

This preference for email was not related to willingness to volunteer for participating in research via SMS. The hypothesis that a higher self-reported use of SMS, or a more positive attitude toward using SMS for research, would be associated with a greater likelihood of volunteering to participate in SMS research was not supported. The current study could not find any difference between those who did and did not provide their mobile numbers to complete follow-up questions via SMS. Promisingly, almost half of the sample provided their mobile telephone number to complete follow-up questions via SMS. Less promisingly, the response rate to the SMS questionnaire was very low. Further research is clearly needed to investigate why actual participation in SMS research was so limited. One possibility is that the timing of sending the SMS survey was inappropriate – future research may investigate this by sending the SMS survey at varying times of day and comparing response rates. Another possibility is that the SMS survey content was simply not interesting to participants. This could be investigated with pilot testing to identify topics of low and high interest specifically to the deaf community. Surveys of varying levels of interest could be matched for wording and length, administered, and response rates compared.

The current study had a number of limitations. Despite ongoing efforts to widen the reach of the survey via online, paper and Auslan alternate versions, the final sample was still relatively small. This in turn could have diminished the likelihood of finding significant relationships during analyses. Further, despite efforts to increase accessibility by offering an Auslan translation of survey instructions, the current survey methodology was limited in that it involved written responses, creating a possible selection bias for participants who felt their written English was of sufficient standard to participate. This was reflected in the generally high self-reported confidence in written English in the sample. This may result in higher levels of SMS usage in the current sample than the broader Australian deaf community, as a low standard of written English may both lower the likelihood of participating in a study such as this, and minimise usage of SMS. Whilst it is reasonable to assume that participants with insufficient written English skills to complete a paper or online survey will also have insufficient skills to complete an SMS questionnaire, results from the current study can only be interpreted as applying to the portion of the Australian deaf community with sufficient written English to participate in research which requires a written response, such as online, SMS, or postal studies.

Conclusion

Due to the ubiquity of mobile phone ownership, and common daily use of SMS in the current sample, these results tentatively support the assertion that there is the capacity within the Deaf community to participate in research via SMS. However, researchers should be aware that SMS is not necessarily a completely inclusive tool for research with the Deaf community due to its reliance on written English, which

excludes deaf individuals with low literacy, and may raise issues of perceived discrimination against those who communicate primarily through Auslan. Given participant preferences for research modes, if a researcher is planning to undertake research using written English with the Deaf community, they should carefully consider whether email could yield comparable data. If SMS is to be used, researchers should avoid the use of text speak, and if they must use text speak due to message length or budgetary constraints, only use non-phonological abbreviations. Analyses indicated no particular guidelines on which portions of the deaf community may be best suited to volunteer for research via SMS, as the individuals in this sample who did volunteer to complete follow-up questionnaires via SMS could not be distinguished from those who did not on any expected criterion, including attitude toward SMS as a tool for psychological research, or demographic characteristics specific to the Deaf community. Despite the apparent potential of SMS as a tool for research stemming from its ubiquity in everyday usage, and inclusivity across the divide of hearing and non-hearing participants, the low response rates in the current study suggest SMS is not as viable as predicted with the Australian deaf community. Future research should explore whether the preference for email as a research mode within this community might translate into superior participation behaviour.

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