The effect of bilingualism on communication efficiency in text messages (SMS)

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Abstract

The widespread use of cell phones has led to the proliferation of messages sent using the Short Messaging Service (SMS). The 160-character limit on text messages encourages the use of shortenings and other shortcuts in language use. When bilingual speakers use SMS, their access to multiple sources of vocabulary, sentence structure, and other language devices would appear to provide additional resources for addressing the character limits imposed on SMS, perhaps by increasing the available pool of short phrases and words. In two studies, the benefits of having multiple languages to draw on during text messaging was evaluated. Study 1 was an archival study in which a corpus of text messages from English−Spanish speakers was analyzed for message length. The results showed that individual messages involving code switching were longer than messages written in only one language. Study 2 was an experimental study in which English−Spanish speakers and English-only speakers played a texting game devised to encourage efficiency in SMS communication. The results from the game revealed that messages from English−Spanish players were no shorter than messages from English-only players. Overall, the data from the two studies provide no evidence that bilingual users of SMS draw upon their multiple languages to increase communication efficiency. Language switching during SMS does not appear to be a means of dealing with character limits.

Keywords: text messages, SMS, bilingual, code mixing, code switching, United States, multilingual

Introduction

The widespread use of cellular telephones has led to the proliferation of messages sent using the Short Messaging Service (SMS). The first text message was sent in 1992, and recent estimates put the number of mes-

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sages sent worldwide in 2008 at more than 2 trillion (2008 Global Key Trends and Statistics in the Telecoms Industry 2008; Ho 2008; Leberecht 2008). The functions of texting appear to be dominated by friendship maintenance (Deumert & Masinyana 2008; Thurlow 2003). The 160-character limit on text messages encourages the use of shortenings and other variations on language use. After examining the messages generated by older teenagers, Thurlow (2003) outlined three sociolinguistic maxims affecting texting. The first was brevity and speed, mostly evidenced by abbreviations (e.g., THX) and minimal use of capitalization and appropriate punctuation. The second was paralinguistic restitution to mark emphasis and emotional states. The use of emoticons (e.g., smileys) served this purpose but were less frequent than capitalization (e.g., DAMN) and multiple punctuation (e.g., What??!!!). The third maxim was phonological approximation that was evidenced by messages containing 'ello' (for 'hello'), 'goin' (for 'going'), 'bin' (for 'been') and similar non-standard spellings of words.

Recent studies indicate that bilingual speakers continue their code switching behavior when sending text messages (Deumert & Masinyana 2008; Haggan 2007). Deumert & Masinyana collected all text messages sent during one week by 22 first language isiXhosa (a South African language) speakers who were also competent in English. The researchers found that, while 61 percent of the SMS corpus was comprised of messages written in English, there was a significant percentage of the messages that mixed the two languages (23 percent). In Haggan's survey of Kuwaiti SMS users, 40.6 percent of the respondents indicated that they chose to produce messages that were a mixture of Arabic and English in some form. (In Kuwait, English is a well-established second language.) When bilingual speakers use SMS, their access to multiple sources of vocabulary, sentence structure, and other language devices would appear to provide additional resources for addressing the character limits imposed on SMS. Bautista (2004) suggested that bilinguals could use code switching to maximize their communication efficiency (i.e., using the fewest possible characters or keystrokes to convey a message) in the domain of text messages. Thus, she proposed that the combination of technology and multilingualism could produce a new function for code switching. In essence, multilingual texters might have the option of choosing the shortest words and phrases from each language, perhaps mixed together, to reduce the number of characters or amount of keypressing required to deliver a message. Bautista (2004) provided the following English−Tagalog example:

> I was flying from Manila to a place in Mindanao where cases of kidnapping were rampant. A friend texted me:
> 'Don't get kidnapped.' (The Tagalog alternative is: Huwag kang magpapakidnap. − much longer to type out using a phone's number pad.)

> And I replied:
> 'Walang magra-ransom.' (The alternative in English is: No one will pay ransom [for me] – again, much longer to type out.) (p. 230)

Data from the study by Deumert & Masinyana (2008), though not collected to test Bautista's (2004) hypothesis, hint that actual texting behavior is not strongly consistent with the hypothesis. When measuring message length using the average number of words, the researchers reported that mixed language text messages contained more words than isiXhosa-only messages and only one less word per message than English-only messages. When measuring message length using the average number of characters, mixed language messages contained more characters than single-language messages. However, no study has directly tested Bautista's hypothesis that multilingualism can increase efficiency in text messages. The purpose of the present study was to test Bautista's hypothesis directly using both a naturalistic study of text messages from bilingual texters and an experimental study using bilingual participants. In the naturalistic study, existing text messages were collected from English–Spanish bilingual college students (Study 1). In the experimental study, bilingual and monolingual users were forced to generate messages during a texting game that encouraged efficiency in communication (Study 2). Keystroking efficiency in messages could occur in primarily two ways. At the level of individual text messages, having to type fewer characters could decrease the total time spent typing. This is the kind of efficiency seen in Bautista's examples above. On the other hand, at the level of entire exchanges, producing fewer albeit longer messages, also could result in a reduced overall number keystrokes and hence decrease the total time spent typing. In the naturalistic study, the data collected were individual text messages (10 from the participant's inbox and 10 from the outbox) and entire exchanges were not necessarily captured in these data. Therefore, it was tested whether individual mixed language messages were shorter – hence, more efficient – than single-language messages. In the experimental study, entire exchanges were captured in the text message data while the participants played the texting game. In this case, the analyses tested whether individual messages were shorter with bilingual participants than with monolingual participants and whether fewer overall messages were required to play the game for bilinguals than for monolinguals.

Study 1: Texting efficiency in naturally-occurring text messages

In Study 1, college students who were English–Spanish bilingual speakers were asked to provide their last 10 sent text messages and their last

10 received text messages for analysis. If naturally occurring messages sent and received by bilingual speakers are examined, then Bautista's hypothesis makes specific predictions when mixed language messages are compared to monolingual messages. For a typical person, if mixed language messages reflect a significant degree of communication efficiency, then it is predicted either that mixed language messages will contain fewer words on average than monolingual messages or that mixed language messages will have fewer characters on average than monolingual messages or both.

The participants

Twenty-six bilingual participants were recruited from introductory psychology courses at a four-year university in Southern California. Students who spoke both English and Spanish and who were regular SMS users were asked to participate. Flyers posted in a university hallway were used to recruit the participants. The mean age of the sample participants was 20.1 years old (sd = 2.6), and the ages ranged from 18 to 28 years old. All participants had to be proficient at sending text messages, defined as having been sending and receiving text messages for at least one year (self-reported). The self-reported ethnic backgrounds of the participants were 33.3 percent Chicana/Chicano, 40.7 percent Hispanic, 11.1 percent Latina/Latino, and 22.2 percent Mexican-American. The sample contained 21 females (80.8 percent) and 5 males (19.2 percent). All but two of the participants learned to speak Spanish as their first language (92.3 percent); however, only four of the participants reported that Spanish was the language that they spoke most frequently (15.4 percent). Eighteen of the participants (69.2 percent) reported that English was the language most frequently spoken, while three participants (11.5 percent) reported that English and Spanish were spoken equally often and one participant (3.8 percent) reported that the most frequently spoken language was 'Spanglish.' All participants provided informed consent prior to beginning the study.

The materials and procedure

A questionnaire was created that asked about the participant's demographic background, their texting behavior, and their language background. Each participant arranged a specific meeting time with the experimenter. During the meeting time, the participant shared her cell phone with the experimenter and gave permission for the experimenter to copy the last 10 incoming and the last 10 outgoing messages from the text messaging system. Participants were given the option of not allow-

ing particular messages to be copied. (Only one student withheld a portion of her messages.) After the experimenter copied the text messages, the participant was given the questionnaire to complete.

The results of study 1

Five hundred and sixty-five text messages were analyzed in total. 'Bilingual' messages were defined as messages that contained both English and Spanish words or abbreviations. All 26 participants (100 percent) had some English-only messages in their texting logs; 17 of the 26 participants (65.4 percent) had some bilingual (mixed) messages in their logs; 9 of the 26 participants (34.6 percent) had some Spanish-only messages in their logs. Inspection of the individual messages revealed that they were dominated by conversations with friends, romantic partners and immediate family members, in that order. Here is an example of an exchange between a study participant and what he described as a 'friend of a friend.' This is an example of English-only messages showing the original grammar, style, punctuation and other language elements.

(1) Participant: 'who's this'
Friend of a friend: 'lol its alexs friend he told me to hit u up'
Participant: 'oh okay…u dnt have 2 if u dnt want 2'
Friend of a friend: 'Who said I didn't want 2? U don't want me 2?'
Participant: 'Nah it was cuz u made it sound like alex said 2 do so'
Friend of a friend: 'Do u mind?'
Participant: 'No' (conversation continues …)

Here is an example of a conversation containing both English-only and Spanish-only messages. This is a conversation between a female participant and her friend about the celebration of Valentine's Day:

(2) Friend: 'Well I hope u dont how was ur valentine?'
Participant: 'ME FUI A COMER' [I went to eat.]
Friend: 'Con el galanaso' [With a handsome man?]
Participant: 'NO CON UNA GALANA' [No, with a lady.]
Friend: 'Oh! Handle it!'
Participant: 'YES AND U?'
Friend: 'I had a blast'
Participant: 'LET ME GUESS … WITH BRIAN' (conversation continues …)

Note that although this conversation contains a switch between languages and then a switch back, the study analyzed only switches within individual messages due to the problem that most of the conversations collected in the study were incomplete. Therefore, the second, third and fourth messages were coded as Spanish-only and the rest of the messages in this conversation were coded as English-only. The following conversation shows examples of bilingual messages (as well as English-only and Spanish-only) exchanged between two friends engaging in casual discussion:

(3) Friend: 'Ill see into that So que aces' [I'll see into that. So what are you doing?]
Participant: 'Pues me voy a meter a banar alrato. Y tu que haces?' [I am about to take a bath. And you, what are you doing?]
Friend: 'Watching naruto' ['Naruto' is an English-only TV show.]
Participant: 'Awesome! yeah shippuden rules'
Friend: 'Yeah shippuden rules Sssooo did u finish ur shower'
Participant: 'Yea'
Friend: 'Chochina' [Nasty.]
Participant: 'Wat? Im a cocina 4 takin showers? I don't get it'
Friend: 'Nah I'm just kidding josh I'm sayin ur a cochina that's y u took a shower I try to say it in a' (message cut off …)

Many abbreviations were found in the text message data, some of which can be seen in these three sample conversations. However, almost all of the abbreviations involved shortenings of English words. Only a small number of cases of shortenings of Spanish words were found, even in conversations containing mostly Spanish messages. Amongst the many examples of abbreviations in English were 'k' (okay), 'lol' (laughing out loud), 'plz' (please), 'cuz' (because), 'u' (you), 'ttyl' (talk to you later), 'tho' (though), # (number), 'n' (and), '2' (to), 'hav' (have) and 'r' (are). Other ways of reducing the number of characters to be typed in English included eliminating punctuation (seen above), eliminating spaces between words (e.g., '1hr') and eliminating entire words (e.g., 'we going' [we are going]). These were rarely seen to involve Spanish words. The two abbreviations that were noticed involving Spanish words were 'vacas' (*vacaciones* or vacations) − used once − and 'q' (*que* or what) − also used one time.

The data were configured as a between-subjects design, with all English messages grouped together, all Spanish messages grouped together,

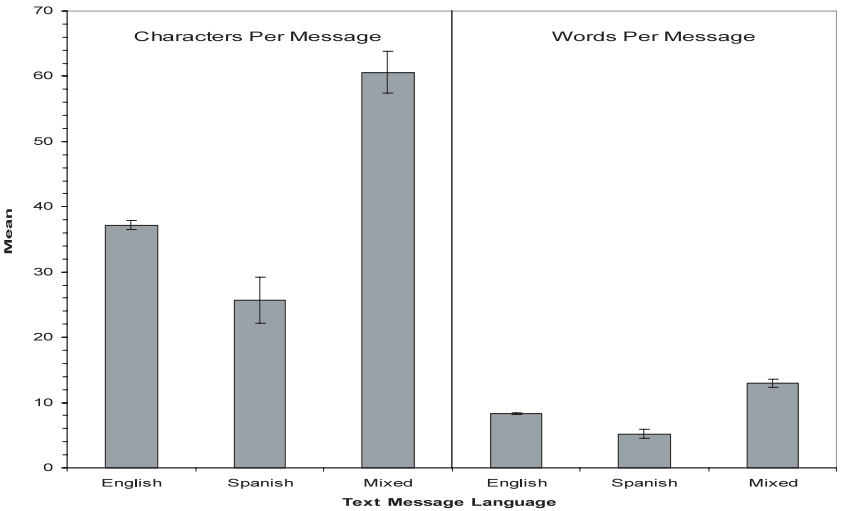

Figure 1. *Lengths of text messages sent using one language or mixed languages in naturally-occurring SMS usage. Note: Error bars show standard errors.*

and all mixed messages grouped together. This resulted in three groups of messages: 410 English, 34 Spanish, and 121 mixed. The numbers of characters in each message were counted and the three groups compared in average character length (Figure 1). The mean numbers of characters for the three message types were: mixed 60.6 (*sd* = 35.5), English 37.2 (14.2), Spanish 25.7 (20.3). An Analysis of Variance (ANOVA) showed that there was a significant effect of message type, F (2, 49) = 7.61, p <0.005. Post-hoc Least Squares Difference (LSD) tests revealed that the mixed mean differed significantly from the English and Spanish means, but that the latter two did not differ from each other. Hence, mixed messages were significantly longer than monolingual messages when length was defined using character counts. A second analysis was done using the number of words in the message as the measure of message efficiency (Figure 1). As with the character count analysis, messages were grouped together according to language type (mixed, English, Spanish). The mean lengths defined by the numbers of words per message were: mixed 13.0 (*sd* = 7.1), English 8.3 (3.3), and Spanish 5.2 (4.0). An ANOVA revealed that there was a significant difference in message length depending upon the language type, F (2, 49) = 8.25, p <0.005. Post-hoc LSD tests found that the mixed group was significantly different than both the English and Spanish groups, but that the latter two did not differ from each other. Hence, mixed messages were longer than monolingual messages when length was defined by words.

Since bilingual messages, as defined here, could not be single-word messages, the English-only and Spanish-only categories were possibly padded with single-word messages that the bilingual category did not include. Examination of the messages revealed that 30 English messages (7.3 percent of all English messages) were one word long and four Spanish messages (11.8 percent) were one word long. To examine the influence of the single-word messages upon the results, the statistical analyses were recalculated after single-word messages were excluded from the message corpus. The main results did not change. Bilingual messages had the most characters per message (60.6, $sd = 35.5$), followed by monolingual English messages (39.4, $sd = 13.6$), followed by monolingual Spanish messages (26.5, $sd = 19.6$). Further, bilingual messages contained the most words per message (13.0, $sd = 7.1$), followed by monolingual English messages (8.8, $sd = 3.2$), followed by monolingual Spanish messages (5.3, $sd = 3.9$).

With today's technology, SMS users can send messages that run on for more than 160 characters, which effectively are sent and appear as one message, although based on their lengths, such messages are more than one message long (and users pay for more than one message). Such run-on messages did occur in the message corpus generated from the participants, and a count of these messages by language type revealed that bilingual messages were more likely to be run-on messages. There were seven BI run-on messages, two ME run-on messages and one MS run-on message. This result is consistent with the relatively large average character and word lengths for BI messages overall.

Study 2: Texting efficiency in an artificial texting game

Assessing the possibility that bilingualism increases texting efficiency by analyzing naturalistic text messages did not produce results consistent with that hypothesis. In fact, mixed language messages were less efficient − longer in both characters and words − than monolingual messages. However, there is the possibility that the conditions under which the naturalistic messages were sent and received did not foster communication efficiency. In other words, although the 160-character limit during texting places pressure on users to be efficient, the particular circumstances for sending and receiving the collected messages might not have placed enough emphasis to require bilinguals to draw upon two languages to increase efficiency. Therefore, Study 2 was conducted in such a way as to create an environment in which efficient text messaging was encouraged. Pairs of bilingual or monolingual speakers were asked to participate in a texting game. The texting game encouraged text messaging efficiency by placing time pressure on participants to complete their

text-based discussions quickly. A second purpose of Study 2 was to provide a setting in which communication efficiency would be evident even if it occurred at a level other than individual messages (such as by reducing the number of messages required to make a point). If Bautista's hypothesis is correct, then it was predicted that bilingual pairs would be more efficient than monolingual pairs at playing the texting game. Further, it was predicted that, within the messages generated by the bilingual pairs, messages containing mixed codes (both English and Spanish) would contain fewer characters or fewer words than messages containing only English or only Spanish.

The participants

The participants were 76 students at the same university in Southern California. Students participated in pairs. Almost all of the participants were undergraduate students recruited from introductory psychology courses. The few participants that were not from the course were friends that came to the study with a student in a course to form a pair. There were 22 English-only monolingual pairs and 16 English−Spanish bilingual pairs. Language background was self-reported. The average age of the monolingual pairs was 23.2 years (*sd* = 5.8) and the average age of the bilingual pairs was 21.2 (4.2). All participants had to be proficient at sending text messages, defined as having been using text messages for at least one year (again, self-reported). The monolingual group was 82.1 percent female and 17.9 percent male; the bilingual group was 71.4 percent female and 28.6 percent male. The modal self-reported ethnic background from the monolingual group was African American (46.4 percent); the next most reported ethnic backgrounds were Asian (14.3 percent) and White (14.3 percent). The remaining members of the monolingual group reported ethnic backgrounds of Black (3.6 percent), Caucasian (10.7 percent), Mexican-American (3.6 percent), or Mixed (7.1 percent). The modal self-reported ethnic background in the bilingual group was Hispanic (39.3 percent), followed in descending order by Mexican-American (35.7 percent), Latina/Latino (14.3 percent), and Chicana/Chicano (10.7 percent). All but two of the bilingual participants learned to speak Spanish as their first language (93.8 percent); however, only five of the participants reported that Spanish was the language that they spoke most frequently (15.6 percent). Sixteen of the participants (50.0 percent) reported that English was the language most frequently spoken, while 11 participants (34.4 percent) reported that English and Spanish were spoken equally often. All participants provided informed consent prior to beginning the study.

The materials and procedure

The questionnaire from Study 1 was used. This questionnaire contained items about the participant's texting history, personal demographic information, and language background. A cellular telephone game was constructed that was based on guessing words from their definitions. One user was given a target word from a categorized list and asked to text the other user clues about the word without explicitly texting the word. The other user was required to guess the word. To encourage efficiency in messages, a time limit was placed on completion of each 10-word list (10 minutes) and participants were asked to try to correctly guess as many words as possible within the time limit. To foster bilingual participants to draw upon their vocabularies from both languages, the word lists for bilingual pairs were constructed in alternating, English–Spanish versions of the words on the monolingual pairs' word lists. Further, prior research suggests that code switching can be facilitated by the introduction of uncomfortable or emotion-laden topics (Bond & Lai 1986), with bilingual speakers switching to their second language to emotionally distance themselves from the topics. In anticipation that bilingual speakers who were native Spanish speakers might converse entirely in Spanish, topics for the word lists were chosen to facilitate code-switching into English. Therefore, the topics for word lists were of a potentially uncomfortable nature (sex and bodily functions) (see Table 1). Additionally, environmental cues were placed in the experimental room to encourage some discussion in Spanish. These cues include the display of images from Mexican-American culture and the playing of music from Latino culture during the introductory portions of the study. Finally, during the study, bilingual participants were spoken to in a combination of English and Spanish by the Experimenter.

Each participant pair arranged a specific meeting time with the experimenter. After being given practice with the texting game, the two participants in the pair were separated into adjacent rooms where they could neither hear nor see the other participant. Two rounds of the game were played. In the second round, the participants switched roles, with the participant who guessed the target words in the first round becoming the player to provide definitions in the second round. Immediately after completing the game, one of the participants' cell phones was collected and all text messages sent and received during the game were viewed and typed into a word processing document. Finally, the questionnaires were administered to the participants.

The results of study 2

Interactions between participants in the texting game revealed that bilingual participants did indeed engage in code switching between messages

Table 1. *Lists of phrases from texting game in Study 2.*

	Language	
List topic	English	Bilingual
Having sex	Masturbation	Masterbación
	Oral sex	Oral sex
	Condom	Condón
	Vagina	Vagina
	Breast	Pecho
	Penis	Penis
	Orgasm	Orgasmo
	Testicles	Testicles
	Sperm	Esperma
	Erection	Erection
Bodily functions	Vomit	Vomito
	Burp	Burp
	Fart	Pedo
	Menstrual cycle	Menstrual cycle
	Sweat	Sudar
	Constipation	Constipation
	Impotence	Impotencia
	Heartburn	Heartburn
	Urine	Orina
	Diarrhea	Diarrhea

The phrases in the bilingual lists alternate between English and Spanish.

and within messages. Most of the exchanges during the game were short, involving only a message or two describing the concept to be guessed and one to two guesses of the correct phrase. Here is an example exchange between two bilingual players showing code-switching within text messages:

(4) Player 1: 'Ready *cuando tomas mucho maly a las 7' [Ready, when you drink too much bad {stuff} at 7.]
Player 2: 'Throw up'
Player 1: 'Almst *lo que sale" [Almost. Whatever comes out.]
Player 2: 'Vomito'
Player 1: 'Yeah nxt wrd gas *por la boca' [Yeah. Next word. Gas out of your mouth.]
Player 2: 'Erupto' [Burp]
Player 1: 'Translate'
Player 2: 'Burp' [game continues …]

Here is another sample exchange between two bilingual players. This exchange demonstrates cases of code switching between messages.

(5) Player 1: 'Que pasa cuando estas caliente?' [What happens when you get hot?]
Player 2: 'Sudo' [I sweat.]
Player 1: 'Wat do women go through every month?'
Player 2: 'Period. Menstrual cycle'
Player 1: 'Que hacen los frijoles?' [What do beans do to you?]
Player 2: 'Me hacen sufrir' [They make me suffer.]
Player 2: 'Gas … Pedos' [Gas … Farts.] (game continues …)

Bilingual players in the texting game did not generate more correct answers in the allotted time than the monolingual players. The mean number of words correctly guessed by the bilingual pairs was 3.7 (sd = 1.86), while the mean number of words correctly guessed by the monolingual pairs was 4.7 (2.06). The difference between the two means was not in the expected direction and it was not statistically significant, t (33) = 1.48, p = 0.15. Figure 2 graphically shows the results of the remaining analyses. It was predicted that bilingual players would generate fewer characters per message as a result of increased communication efficiency. However, the mean numbers of characters per message were nearly identical for the two groups (bilingual: 27.7 [sd = 8.92], monolingual: 27.3 [6.87]). The difference between the means was not statistically significant, t (33) = −0.129, p = 0.898. Further, it was predicted that the bilingual pairs, being more efficient, would require fewer messages than the monolingual pairs to correctly guess each target word. The mean number of messages per target word for the bilingual pairs was 4.4 (sd = 3.2), while the mean number for the monolingual pairs was 3.8 (2.7). There was not a statistically significant difference between the groups, t (33) = −0.56, p = 0.58.

To further check on the effect of code switching in the study, the text messages from each bilingual pair were examined to determine the frequency of switches between English and Spanish. This included switching codes both within messages and across messages. The mean number of switches per pair was 3.81 (sd = 2.48). A post-hoc analysis was performed on the bilingual pairs' data comparing code switching frequency to three measures of efficiency. Computation of a Pearson correlation coefficient between the number of switches and the number of target words guessed correctly resulted in an r (14) of −0.34, p = 0.098. Apparently, switching languages more frequently was associated with reduced efficiency, rather than increased efficiency, though this effect was only marginally significant. The correlation between the switch count and the number of characters per text message resulted in an r (14) of 0.24, which was not significant, p = 0.183. Further, the correlation between the switch count and the number of text messages per target word resulted

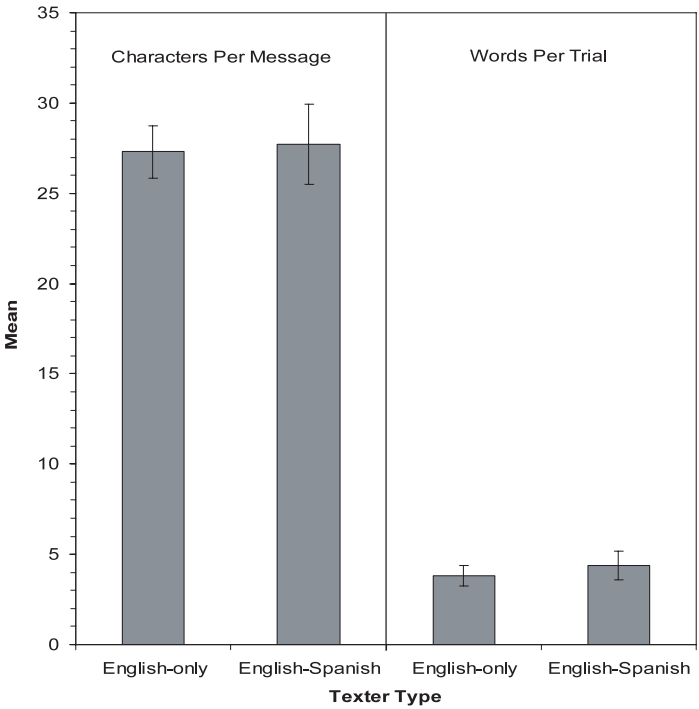

Figure 2. *Performance in a texting game in which one player ascertained a target word from the other player's clues on each trial. Note: Error bars show standard errors.*

in an r (14) of −.40, which was not significant, $p = 0.218$. Therefore, it seems as if increased code switching is not associated with increased efficiency, although it should be kept in mind that these calculations are based on a small sample size (16 pairs of participants).

As an additional analysis, the text messages from the bilingual pairs were analyzed in the same way that messages from Study 1 were analyzed. Messages were sorted into monolingual English, monolingual Spanish, and bilingual groups. There were 163 ME messages, 51 MS messages and 33 BI messages. The average character lengths were 25.5 for ME messages ($sd = 12.8$), 15.5 for MS messages ($sd = 6.6$) and 34.9 for BI messages ($sd = 14.0$). (There were no run-on messages during the texting game.) There was a statistically significant difference across message types, $F(2,25) = 5.95$, $p < .01$, with post-hoc tests showing that bilingual messages were longer than monolingual Spanish messages but no other differences were significant. The average word lengths were 5.1 for ME messages ($sd = 2.7$), 2.9 for MS messages ($sd = 1.3$) and 6.9 for

BI messages (*sd* = 3.3). There was a statistically significant difference across message types, $F(2,25) = 4.80$, $p < .05$, with post-hoc tests again showing that bilingual messages were longer than monolingual Spanish messages but no other significant differences. In sum, there was not any evidence that bilingual messages were shorter (i.e., more efficient) than monolingual messages. Fifty-one of the monolingual English messages were one-word messages (31.3 percent) and 20 of the Spanish-only messages were one-word messages (39.2 percent); many of these were the one-word answers from the texting game. Re-analysis of the average character lengths and the average word lengths without the single-word messages across the three types of messages did not reveal any significant differences by language type.

Discussion

The purpose of this study was to test the hypothesis that multilingualism increases text messaging efficiency by allowing multilingual users to draw from multiple languages to choose short words and phrases. In Study 1, naturally occurring text messages were examined from the cellular telephones of English−Spanish speakers and texters. The original prediction for Study 1 was that mixed language messages would be more efficient than monolingual messages. In examining the messages from English−Spanish bilingual cellular phones, when efficiency was defined by the number of characters in a message, mixed language messages were not more efficient than monolingual messages. When efficiency was defined by the number of words in a message, the same result was found. Thus, the prediction for Study 1 was not true in the data. In Study 2, a texting game was created that encouraged users to use efficient text messages. The prediction for Study 2 was that bilingual communicators would be more efficient than monolingual communicators. When efficiency was defined either by character count or word count, bilingual communicators were not more efficient than monolingual communicators. Thus, the prediction for Study 2 was not true in the data. Further, bilingual messages (those showing code switching) within the bilingual communicators' messages were no shorter either by characters or by words than monolingual messages sent by the bilingual communicators.

The present results do not preclude the possibility that bilingual texters are capable, if they choose to do so, of increasing their efficiency by selecting short words and phrases from their multiple language resources. In the studies reported here, participants might have chosen not to do so. Nevertheless, the lack of support found for Bautista's (2004) hypothesis that text messaging efficiency is increased in multilingual speakers suggests that, at least in text messaging (SMS), bilingual com-

munication does not increase efficiency when efficiency is defined as a minimization of characters or words (that presumably reduces keystrokes). However, some limitations of the present project should be acknowledged. First, efficiency in text messaging might occur at the level of concepts, involving more efficient transmission of meanings, rather than at the level of keystrokes. This type of efficiency was not measured in the two studies here. Second, the selection of Spanish speakers from the southern California area might have predetermined the results to some degree. Although Spanish, compared to English, generally has longer words and for present purposes might not be an effective language for increasing communication efficiency, there is likely to be significant heterogeneity within the category of English–Spanish bilinguals, and it could be that the results of a similar study in New York, Chicago or Florida would be very different

Third, there was not a high rate of code switching in Study 2, and the lack of texting efficiency in that study could be due to reduced mixing of languages by the bilingual participants. In fact, it cannot be ruled out in either study that English–Spanish bilinguals in the United States (the population from which the current samples of participants were drawn) may not have had access to developing proficiency in reading and writing in Spanish despite having learned Spanish as their first spoken language. The drastically unequal numbers of messages in each language category in the studies (mostly English-only messages) is consistent with this possibility. The tasks in the current studies are written tasks – not spoken – and it had been only assumed by the authors that oral language proficiency in Spanish would be correlated with texting proficiency in Spanish.

Fourth, there is the possibility that the setting or context of texting influenced language choice in both studies, thereby reducing the number of bilingual exchanges. In Study 1, the participants were almost all university students and much of their time spent texting might have occurred in university settings where English is the expected language of use. In Study 2, despite the efforts of the authors to encourage code switching, the university setting of the experiment might have curtailed bilingual exchanges to some degree. Finally, there is the possibility that more switches between English and Spanish might have occurred in Study 2 if a specific effort had been made to recruit close friends as participant pairs who might not otherwise have to engage in cautious English-dominated conversations of the type that might be expected of only acquaintances in a university setting.

Text message research suggests that language choice in text messaging depends on factors other than efficiency, such as the topic of conversation (Deumert & Masinyana 2008). Herring (2007) listed a number of

factors that can influence technology-mediated language use, dividing them broadly into technological factors (such as those that might drive efficiency in text messaging) and social/situational factors. Studies of synchronous or near-synchronous forms of computer-mediated communication show that language choice is affected by situational and social factors. In the realm of online chatting, language mixing has been associated with 'creativity' in interpersonal communication (i.e., using elements of one language to enhance the effectiveness of another) (Fung & Carter 2007), increased comprehension, affirmation of identity, support of affective expression (Ferreira da Cruz 2008), and social ties (Paolillo 2001). Warschauer *et al.* (2002) stated that code switching in online communications occurs with topics that are personal or have personal meanings. Warschauer *et al.* also noted that code switching online occurs often in greetings, humorous or sarcastic expressions, expressions related to food or holidays, and religious expressions. Androutsopoulos (2006) collected news stories, discussion group posts, and user names from diasporic websites in Germany, finding that language mixing and code switching in posts had various functions some of which related to establishing identity.

While the purpose of the present studies was not to determine the exact functions of code switching in SMS, it was clear from studying the messages from Study 2 that some, but not most, of the language mixing was motivated by the texting game itself, e.g., cases where 'senders' in the game used language choice as a cue for 'receivers' to know the desired language of the target word. The functions of language mixing in Study 1 were unclear, but some functions of language mixing such as establishment of cultural identity or clarification of messages to increase comprehension would seem to be relevant to the sample messages collected. Code switching research outside of technology-mediated communication suggests a range of functions of language switching, but communication efficiency usually is not one of the suggested functions. These earlier studies, combined with the results from the present studies, do not provide support for the idea that efficiency is one of the functions of bilingual code switching while communicating via SMS.

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