Bilingual children's gesture use

Lisa Smithson, Elena Nicoladis, and Paula Marentette
University of Alberta / University of Alberta, Augustana Campus

Previous studies have shown that bilinguals use more manual gestures than monolinguals (Pika et al., 2006; Nicoladis et al., 2009), suggesting that gestures may facilitate lexical retrieval or may reduce the cognitive load on working memory during speech production. In this study, we tested the generalizability of these findings by comparing the use of gestures in three groups of children (English monolinguals, Mandarin Chinese-English bilinguals, and French-English bilinguals) between 7 and 10 years of age as they retold two short stories about a cartoon. The bilingual children were asked to retell narratives in both languages. The results showed that the French-English bilinguals used significantly more gestures than the Chinese-English bilinguals. With respect to gesture rates accompanying speech in English, the monolinguals did not differ from either bilingual group. The bilingual children's use of gestures was generally not correlated with our measures of working memory (narrative length and speech rate). These results suggest that culture may be a more important determiner of gesture rate than bilingualism and/or working memory capacity.

Keywords: bilinguals, lexical access, speech production, gesture use, representational gestures

While speaking, people often gesture, or deliberately move their hands to express some aspects of meaning (Kendon, 2004; McNeill, 1992). Gestures probably serve a variety of communicative and cognitive functions (see Goldin-Meadow, 2000; Kendon, 1994, 1997, 2004; McNeill, 1992, for reviews). These functions may benefit the speaker, the listener or both, and are generally thought to be linked to basic socio-cognitive processing. If so, then how gestures are used should generalize across cultural groups (cf. So, 2010). The present study will test how frequently bilingual children use gestures in a story-telling context with particular emphasis on the generalizability across languages/cultures. As we will elaborate below, previous studies have shown that bilinguals gesture more than monolinguals, a finding generally interpreted in terms of cognitive effects of bilingualism. Before specifying

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the research questions for this study, we review how gestures might play a role for the speaker and how bilingualism might impact gesture frequency.

Gestural functions for the speaker

A variety of gestural functions for the speaker have been proposed. One important function of gestures may be that they play a role in the processes by which speakers package what they wish to say (Kita, 2000). In particular, representational gestures or gestures that represent features and actions of an object or character that the speaker refers to (McNeill, 1992) may aid speakers in constructing meaning (Kita, 2000). For example, accessing words or linguistic constructions can be aided by gesture production (Krauss & Hadar, 1999).

In a similar manner, some researchers have proposed that gestures can help hold information in visuospatial working memory as speakers construct their message (Morsella & Krauss, 2004). By holding information in visuospatial working memory, gesturing may allow an individual to avoid overloading verbal working memory during speech (Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001). According to Morsella and Krauss (2004), by maintaining spatial representations in visuospatial working memory, gestures continually activate prelinguistic sensory motor features of intended words thereby facilitating speech. In support of this proposal, restrictions imposed on speakers regarding the use of gesture is associated with verbal dysfluencies (Rauscher et al., 1996) and reduced imagery (Rimé, Schiaratura, Hupet, & Ghysselinckx, 1984), whereas when speakers (children, in the study cited) are instructed to gesture, this has been shown to enhance working memory performance (Stevanoni & Salmon, 2005). One aim of the present study is to test whether measures of individuals' working memory, as measured by narrative length and speech rate, predict bilingual children's gesture use.

If one function of gesture is to aid in the construction of messages to be spoken, then speakers who have greater challenges in accessing language may produce more gestures than those who have fewer. This should be the case with bilinguals relative to monolinguals since bilinguals may have greater difficulty accessing words relative to monolinguals, depending upon their proficiency in both languages (Gollan & Acenas, 2004; Yan & Nicoladis, 2009). In addition, it is more difficult for bilinguals to access words in their second or weaker language relative to their first or stronger language (Costa, 2004). Bilinguals might therefore gesture more than monolinguals and gesture more when speaking their weaker language than their stronger (Krauss & Hadar, 1999). We briefly review the evidence for each of these predictions in turn.

Gesture production among bilinguals vs. monolinguals

Several studies have found support for the first prediction, namely, that bilinguals should gesture more than monolinguals. For example, one study showed that English-Spanish and French-English bilingual adults gestured more than English monolinguals in a narrative context (Pika, Nicoladis, & Marentette, 2006). This study did not have monolingual comparison groups for French and Spanish so they could not tell whether the greater use of gestures among the bilinguals was due to their bilingualism or due to their proficiency in a high-gesture-frequency language (i.e., French or Spanish). A study by Marcos (1979) revealed that bilinguals tend to produce more gestures in their weaker language. Another study compared the gesture use of French-English bilingual children between the ages of four and six years with both English and French monolinguals of the same age (Nicoladis, Pika, & Marentette, 2009). Children in this study were asked to watch a cartoon and retell the story. This study showed that the bilinguals gestured more than both groups of monolinguals, with no difference in the rate of gestures between the monolingual groups. The results of this study suggested that it is the knowledge of two languages that is associated with a high gesture rate rather than knowledge of a particular language. Another study on intermediate second-language English adults whose first language was Chinese suggests that even learning a second language can lead to a higher gesture rate during a narrative task (Nicoladis, Marentette, & Yin, under review). In comparison to monolingual English speakers, the second language learners used more gestures when speaking English. However, there was no difference in the gesture rate between these speakers in Chinese and Chinese monolinguals. There was also no difference between the rate of gestures used by the English and Chinese monolinguals. These studies suggest that bilinguals do, in fact, gesture more than monolinguals. Since gesture production is thought to facilitate speech production, these findings suggest that bilinguals may rely disproportionately on gestures to facilitate communication.

The aforementioned studies have not considered the possibility of cultural or specific language effects on gesture frequency in part because gestures are sometimes linked to general cognitive and/or linguistic processing so there should be minimal differences across languages/cultures (e.g., McNeill, 1992). While some researchers have pointed out the possible effects of culture on gestures (see Kita, 2009, for a review), the possibility that some languages or cultures might be associated with particularly high rates of gesture use has rarely been considered (cf. Pika et al., 2006). So (2010) showed that Mandarin speakers in Singapore gestured less than American English speakers, suggesting that there are cultural differences in gesture frequency. Another recent study with adult bilinguals supports this suggestion (Nicoladis, Nagpal, & Marentette, in preparation). This study compared

the use of gestures on a story-telling task among four groups of bilingual adults, all of whom spoke English as a second language. The first language of the adults was Mandarin Chinese, Hindi, French, or Spanish. The Hindi- and Chinese-speaking adults produced fewer gestures in both their first language and English than the French- and Spanish-speaking adults. These results suggest that gesture frequency could be related to cultural norms. Recall that Nicoladis et al. (2009) found no difference between French and English monolinguals on their rate of gesture use. The participants in that study were aged between four and six years. It is possible that the effects of a high-gesture-frequency language or culture are only observed after the preschool period.

Language proficiency and gesture production

Bilinguals' proficiency is linked with frequency of usage (Gollan, Montoya, Cera, & Sandoval, 2008). According to Holle and Gunter (2007, p. 1175), "iconic gesture can facilitate the processing of a lesser frequent word meaning" and therefore, iconic gestures may be used to a greater extent among bilinguals in their weaker language to facilitate language processing. However, findings have been inconsistent from study to study (see review in Nicoladis, 2007). While some studies have shown greater use of gestures in bilinguals while speaking their weaker language (e.g., Nicoladis, Pika, Yin, & Marentette, 2007), others have shown greater iconic gesture use while speaking the stronger language (Gullberg, 1998). Still other studies have shown no difference between languages in the rate of gestures (e.g., Sherman & Nicoladis, 2004). There were no obvious differences between tasks in these studies: all were based on asking bilinguals to tell a story in their two languages to different people. One possible reason for the lack of consistent findings relative to proficiency is that individuals' style of speaking or telling a story outweighed any proficiency effects (Gullberg, 1998; Nagpal, Nicoladis, & Marentette, 2011). That is, these studies have shown similarities in the manner and frequency with which bilinguals use gestures in both of their languages and these similarities may outweigh any effects of proficiency.

One factor contributing to individual styles as well as differences between monolinguals and bilinguals in gesture use could be working memory. Many researchers have argued that gestures are grounded in visuospatial working memory (Trafton, Trickett, Stitzlein, Saner, Schunn, & Kirschenbaum, 2006). Bilinguals have been shown to have more complex neural activation patterns than monolinguals when participating in working memory tasks (Ardila, 2003). Processing information in the second language, especially when the second language is less developed than the first, seems to put an extra load onto working memory. Speaking two languages could therefore, lower the efficiency of verbal working memory

for bilinguals (Ardila, 2003). The reduced efficiency of verbal working memory could lead bilinguals to rely strongly on visuospatial working memory to hold information in mind while constructing a linguistic message. In support of this notion bilinguals have been shown to be more proficient than monolinguals at spatial and mental imagery tasks (McLeay, 2003). Bilinguals' greater reliance on visuospatial working memory could explain their greater use of gestures relative to monolinguals. If this reasoning is correct, visuospatial working memory capacity might predict how frequently both monolinguals and bilinguals gesture and whether there is a stronger correlation between visuospatial working memory and gesture use in bilinguals than in monolinguals.

In sum, previous research has shown that bilinguals gesture more than monolinguals. This has been found even when bilinguals are fairly balanced in their languages (Nicoladis et al., 2009). However, these studies have not addressed the possibility that some specific languages or cultures might be associated with higher gesture rates (such as French or Spanish speakers) than others (such as Chinese or Hindi speakers). In contrast, previous research has shown inconsistent effects concerning the gesture production of bilinguals in either their stronger or weaker languages, perhaps due to differences among individuals in storytelling style. Working memory capacity, particularly visuospatial working memory, could be one factor underlying individual differences in storytelling style.

This study

This study addressed three research questions related to bilingual and monolingual children's gesture use: (1) Do bilinguals gesture more than monolinguals? (2) Among bilinguals are the gesture rates and narrative lengths comparable across languages? (3) Do proxy measures of working memory predict gesture production? These questions will be elaborated upon in the following paragraphs.

Do bilinguals gesture more than monolinguals?

The primary purpose of this study was to test the generalizability of the finding that bilinguals gesture more than monolinguals by comparing the rate of gestures of French-English and Chinese-English bilinguals to that of English monolinguals. It was hypothesized that if bilinguals gesture more than monolinguals (Nicoladis et al., 2009), then both bilingual groups should gesture more than the English monolinguals and at equivalent rates to each other. It was alternatively hypothesized that, bilinguals who speak a language associated with a high-gesture frequency (i.e., French) might gesture more than the English monolinguals while

those who speak a language associated with a low-gesture frequency (i.e., Chinese) might gesture at an equivalent rate to the English monolinguals.

Among bilinguals are the gesture rates and narrative lengths comparable across languages?

A secondary purpose of this study was to see if bilingual children of this age have started to use similar gestures rates and story lengths in both of their languages, as has been reported among adults when relaying narratives (Gullberg, 1998; Nagpal et al., 2011). If so, we expected to see correlations between both languages of bilinguals in terms of gesture rate and story length. Bilingual children within the age range of seven to ten years often show a mismatch in their storytelling abilities, usually telling a story better in the language of schooling than in the language of the home (Strömqvist & Verhoeven, 2004; Ucelli & Paéz, 2007). Therefore, it is also possible that if there are no correlations between bilinguals' two languages, they would show a more developed story-telling style in the school language (i.e., French for the French-English bilinguals and English for the Chinese-English bilinguals).

Do proxy measures of working memory predict gesture production?

Finally, given that bilinguals' gesture frequency can be highly similar across their two languages within this age range, we tested the possibility that individual working memory capacity might be related to their gesture rate. Telling a story about a cartoon requires a narrator to rely crucially on imagery (Rubin, 1995). Retaining visual and spatial information temporarily depends upon the activation of visuospatial working memory (Baddeley, 2003); therefore individuals who have superior visuospatial working memory abilities may tell longer narratives. The results from Smithson and Nicoladis (in preparation) indicated that visuospatial working memory was a unique predictor of narrative length among adult English monolinguals. However, among bilinguals visuospatial working memory was not significantly correlated with narrative length (in either language). The length of the story was used as one of our proxy measures of visuospatial working memory. In addition, according to Smyth and Scholey (1996), speech rate (calculated as the number of words produced per second) has been shown to be associated with visuospatial working memory in spatial tasks. Therefore, speech rate was also used as a proxy measure of visuospatial working memory. To test for a possible role of visuospatial working memory, we correlated the length of the story (word tokens) and speech rate with gesture rate.

Method

Participants

A sample of 10 English monolinguals, 10 French-English (FE) bilinguals, and 10 Chinese-English (CE) bilinguals were included in this study. The English monolingual and the French-English bilingual children were recruited through personal contacts in after-school programs. The Chinese-English bilinguals were recruited through personal contacts and snowball sampling (i.e. participants recommended other individuals in the community who might also be interested in participating in the study). All of the participants were living in Edmonton, Alberta at the time that this study was conducted. According to parental report, the FE bilingual children were nearly equally proficient in both languages, whereas the CE bilingual children were more proficient in English.

All of the children were thought to be typically developing according to their teachers and parents. The English monolinguals spoke no more than a few words of any language other than English and were all enrolled in English schools. The FE bilinguals all heard French from at least one parent, starting from birth, and they all attended French schools (i.e., not French immersion schools which are designed to accommodate children with no French background). The source of English in the FE bilinguals varied for the children: some had a parent who spoke exclusively English with them and some heard English only from peers and outside sources. The age of first exposure to English varied from birth to two years. There were no salient differences in performance in the present study, related to either source of English or age of first exposure so they were treated as a group. The CE children all heard Chinese at home from both parents and attended English language schools. The source of their English included their parents (who often spoke both languages to their children), siblings, and peers. The age of first exposure to English also varied between birth and two years of age. Again, there were no obvious differences in performance relative to their source of or age of first exposure to English. Two conditions were required in order for a child to be considered bilingual: (1) Parental report confirmed that the child was fluent in both languages (2) The child was able to relay narratives in both languages.

All of the participants included in this study were older than six years of age, as a study with younger children showed no difference between French and English monolinguals on their gesture rate (Nicoladis et al., 2009). The participants aged in a range from 7–9 in the English monolingual group, from 7–9 in the FE bilingual group, and from 6–10 in the CE bilingual group. The average age of the participants in the English monolingual group was 8.32 (SD = 0.36), in the FE bilingual group was 8.10 (SD = 0.57), and in the CE bilingual group was 8.00 (SD = 1.33).

There were four boys and six girls in the monolingual group, five boys and five girls in the FE bilingual group, and six boys and four girls in the CE bilingual group.

Materials

Two segments of Pink Panther cartoons (one entitled 'In the Pink of the Night' and the other 'Jet Pink'), were shown to the children. The cartoons are approximately eight minutes in length in total. In the first video, Pink Panther is being woken up by a cuckoo bird. The Pink Panther tries desperately to silence the cuckoo bird. Eventually the Pink Panther ends up becoming friends with the bird. In the second video, Pink Panther decides that he wants to be a famous pilot. He gets into an airfield for military jet airplanes and proceeds to take off and fly around a city until finally, he gets ejected from the plane. The characters in these cartoons do not produce any intelligible speech and therefore the videos are suitable to participants of all language backgrounds.

Procedure

Participants were asked to watch the Pink Panther cartoons alone in a testing room. When the videos were finished, the participants were asked to retell the stories to an observer as they were videotaped. They were not given a time limit for their retellings. The bilingual participants had two sessions in order that they could retell the stories in each language to an adult native speaker. The second session was held within approximately one week of the first. The order of the two language sessions was counterbalanced, with participants assigned to the two orders randomly. There were no significant differences on any of the dependent variables based on the order of the language sessions. Monolinguals did not tell the story twice since research has shown no significant differences in gesture production with respect to the order of narrative sessions (Nicoladis, Pika, & Marentette, 2009).

Transcription and coding

All of the videos of children retelling stories in English were transcribed using standard English orthography by a native English speaker. The French retellings were transcribed using standard French orthography by a native French speaker. The Mandarin retellings were transcribed in pinyin by a native Mandarin speaker.

To count word tokens, orthographic words were taken as a single word. Previous studies have shown that comparing word tokens in French and English in orthographic words yields a valid cross-linguistic comparison (Goodz, 1989). In Chinese, we transcribed compound words as single orthographic words, as this

orthographic technique yields similar cross-linguistic results for English and Chinese with adults (see Nicoladis et al., 2007).

Three types of gesture were coded during the analysis of the videos: iconic, deictic, and conventional (loosely based on McNeill, 1992). Iconic gestures make use of shapes or actions to represent an object. Deictic gestures are pointing gestures towards a person or an object. Conventional gestures are recognized by adults without the need of speech. When a gesture could not be clearly identified it was labelled as an unknown gesture. Only iconic gestures were analyzed in this study, as these are the gestures most closely linked with constructing a linguistic message (Kita, 2000).

Data analysis

Iconic gesture rate was calculated as the number of iconic gestures produced throughout the narrative production for the two stories, divided by the number of word tokens used throughout the two stories and subsequently multiplied by 100 (this number was multiplied by 100 for interpretability purposes).

Speech rate was calculated as the number of words produced per second.

Results

Gesture rate

Figure 1 summarizes the average rate of gestures the children used. We first analyzed the children's use of gestures in English, using a one-way ANOVA between language groups. Iconic gesture rate differed across language groups, $F(2, 27) = 4.851$, $p < 0.05$, $\eta^2 = 0.264$. This significant effect was further analyzed using Tukey's HSD comparisons ($p < 0.05$). The only significant post-hoc effect was that Chinese-English bilinguals used significantly fewer gestures than French-English bilinguals ($p = 0.012$).

A one-way ANOVA was also used to analyze iconic gesture rate between French and Chinese for the two bilingual groups. The rate differed across language groups, $F(1,18) = 6.916$, $p = 0.017$, $\eta^2 = 0.278$.

Paired-samples t-tests were conducted to analyze whether there was a difference between the bilinguals' two languages in iconic gesture rate. No difference was found for either the FE bilinguals, $t(9) = -1.046$, $p = 0.323$, or the CE bilinguals, $t(9) = -1.038$, $p = 0.326$.

Some of the participants did not use iconic gestures at all. Among the English monolinguals, two participants did not use any iconic gestures. Among the FE

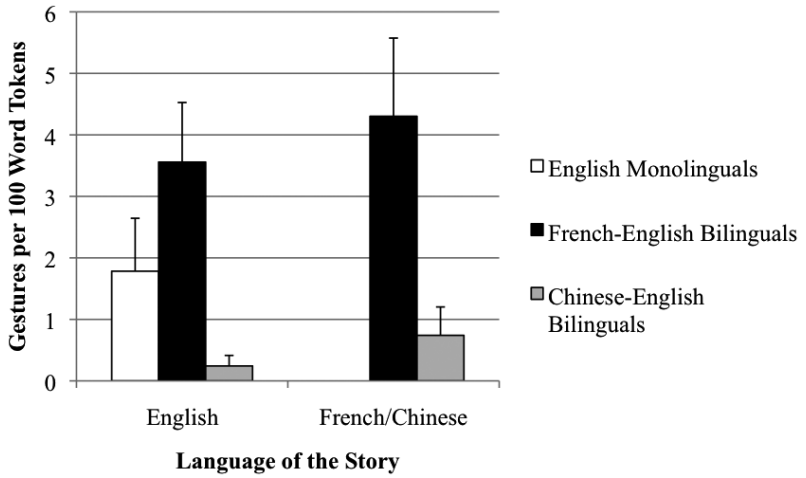

Figure 1. Average Rate of Iconic Gesture Use by Language and Language Group
Error bars represent standard error

bilinguals, one child didn't gesture in either session and one person didn't gesture in the French session. Among the CE bilinguals, five participants did not use iconic gestures in either session (two participants did not use gesture in the English session, and one did not use iconic gestures in the Chinese session). There were no significant differences in age among the gesturers and the non-gesturers in any language group. All participants, regardless of whether or not they produced gestures, were included in the analyses (unless otherwise specified).

Speech rate

The English monolinguals had an average speech rate of 1.91 (SD = 0.46) words per second, the French-English bilinguals 1.87 (SD = 0.39), and the Chinese-English bilinguals 1.83 (SD = 0.40) in English. A one-way ANOVA was used to analyze speech rate between language groups in the English sessions. No significant effects were found, $F(2, 27) = 0.104$, $p = .901$, $\eta^2 = 0.008$.

In the other languages, the FE bilinguals used an average of 1.77 (SD = 0.79) words per second in French while the CE bilinguals used an average of 0.89 (SD = 0.45) in Chinese. A one-way ANOVA was also used to analyze speech rate between language groups in their other languages. Speech rate differed across language groups, $F(1, 18) = 9.299$, $p = 0.007$, $\eta^2 = 0.341$. Mandarin-English bilinguals had significantly lower speech rates than French-English bilinguals in their non-English languages. The speech rate for monolingual French speakers and monolingual Mandarin speakers for this age group and task was not examined in the current study.

A paired-samples t-test was conducted to analyze whether there was a difference in speech rate for the bilinguals in their two languages. No difference in speech rate was found for the FE bilinguals, $t(9) = 0.413$, $p = 0.689$. For the CE bilinguals, a significant difference was found $t(9) = 7.437$, $p < 0.001$, wherein CE bilinguals spoke faster during their English session.

In all of the language groups, we compared the speech rate of the gesturers and the non-gesturers (except for the FE bilinguals in English because only one child did not gesture) with independent samples t-tests. The only difference was for the FE bilinguals in French, $t(8) = 2.399$, $p = 0.043$. In this group, the gesturers had higher speech rates ($M = 2.01$, $SD = 0.62$, $N = 8$), than non-gesturers ($M = 0.79$, $SD = 0.77$, $N = 2$).

Word tokens used to tell the story

In their English stories, the English monolinguals used an average of 382.90 ($SD = 189.43$) word tokens, the French-English bilinguals 387.80 ($SD = 162.75$), and the Chinese-English bilinguals 453.40 ($SD = 171.03$). A one-way ANOVA was used to analyze word tokens between language groups. No significant effects were found, $F(2, 27) = 0.507$, $p = 0.608$, $\eta^2 = 0.036$.

In the other language, the French-English bilinguals used an average of 465.60 ($SD = 173.78$) words in French and the Chinese-English bilinguals an average of 377.10 ($SD = 162.45$) in Chinese. A one-way ANOVA was also used to analyze word tokens between language groups in their other languages. No significant effects were found, $F(1,18) = 1.384$, $p = 0.255$, $\eta^2 = 0.071$.

A paired samples t-test was conducted to analyze whether there was a difference in word tokens used to tell the story for the bilinguals in their two languages. No difference in word tokens was found among the FE bilinguals $t(9) = -0.815$, $p = 0.436$, or for the CE bilinguals, $t(9) = 1.343$, $p = 0.212$.

In English, there were no significant differences on word tokens between the gesturers and the non-gesturers for any language group. The FE bilingual gesturers used more words in French ($M = 527.38$, $SD = 126.80$, $N = 8$) than the non-gesturers ($M = 218.50$, $SD = 81.32$, $N = 2$), $t(8) = 3.201$, $p = 0.013$. The CE bilingual gesturers used more words in Chinese ($M = 501.50$, $SD = 154.49$, $N = 4$) than the non-gesturers ($M = 294.17$, $SD = 112.01$, $N = 6$), $t(8) = 2.479$, $p = 0.038$.

Correlations across languages and between dependent variables

To see if the bilinguals used a consistent story-telling style in their two languages, we correlated their gesture rate, speech rate, and word tokens in their two languages (see Table 1). The only correlation to reach significance was the positive correla-

Table 1. Correlations on Story-telling Variables between Languages for Bilinguals

	French-English	Chinese-English
Iconic gesture rate in both languages	0.833**	0.078
Speech rate in both languages	0.140	0.563
Word tokens in both languages	−0.609	0.421

** $p < .01$

Table 2. The correlation coefficients between age/working memory measures and iconic gesture rate

	English Monolinguals	French-English (English)	Chinese-English (English)	French-English (French)	Chinese-English (Chinese)
Word tokens	0.662*	−0.291	−0.125	0.503	0.473
Speech rate	−0.014	−0.207	−0.241	0.171	0.448
Age	−0.758*	0.309	−0.293	0.187	0.334

* $p < .05$

tion for the gesture rate between the two languages for the French-English bilinguals. This indicates that the French-English bilinguals used similar gesture rates in both languages whereas this was not the case for the Chinese-English bilinguals.

Table 2 summarizes the correlations between gesture rate on the one hand and word tokens, speech rate, and age on the other. The only correlations to reach significance were for word tokens and age for the monolinguals. Among the monolinguals, older participants used fewer iconic gestures than younger participants; however, this was not the case among French-English bilinguals or Chinese-English bilinguals in any of their languages.

Discussion

The primary purpose of this study was to test the generalizability of previous findings showing that bilinguals gestured more than monolinguals in school-aged children (e.g., Nicoladis et al., 2009). The results showed that the French-English bilinguals gestured more than the Chinese-English bilinguals. In their English sessions, the monolinguals did not differ from either bilingual group. These results show a similar pattern to Nicoladis et al. (in preparation), showing that French-English bilingual adults (French first language) gesture more than Chinese-English

bilingual adults (Chinese first language). These findings suggest that bilingualism alone does not lead to a higher gesture rate (cf. Nicoladis et al., 2009) and that cultural or linguistic norms might be important in predicting gesture rate. That is, French may be characterized as a high-gesture-frequency language relative to Chinese (Nicoladis et al., in preparation). English may fall somewhere in between (Nicoladis et al., under review). In addition, it has been argued that "American culture is a relatively high-gesture culture and Chinese culture is a relatively low-gesture culture" (So, 2010, p. 1335). Consequently, the very low rate of gesturing among Chinese-English bilinguals may best be explained by cultural influences. The results are in line with anecdotal reports we have heard from Chinese-English bilinguals living in Canada, suggesting that cultural influences may discourage the use of hand and arm movement when engaging in conversations in formal settings. This cultural difference may explain the low rate of iconic gesture production among this group of participants. This cultural difference may be most salient among younger children. In a study by So (2010), it was found that among adult Mandarin-English bilinguals (from Singapore), the representational gesture rate transferred from English to Mandarin, and these bilinguals produced more gestures than their Mandarin monolingual counterparts (from China), but comparable gesture rates to their English monolingual counterparts (from America). However, these results need to be interpreted with caution since each language group was recruited from a different country and it is therefore difficult to disentangle the effects due to bilingualism from the effects due to culture.

The differences between cultures in frequency of gesture use may emerge after the age of about five years. Recall that Nicoladis et al. (2009) found no difference in gesture rate between French and English monolinguals between four and six years of age. In contrast, the results with the children in this study (aged between seven and ten years) showed a greater use of gestures by the French speakers relative to the Chinese speakers. Other cultural effects with gesture production are observable in infancy (e.g., Iverson, Capirci, Volterra, & Goldin-Meadow, 2008). One possible reason for this apparent late effect is that children are still developing their basic story-telling abilities in the preschool years (Singer & Singer, 2006) and children must have some basic mastery of a rhetorical style in order for cultural norms with regard to gesture frequency to emerge. If this reasoning is correct, then, preschool French-English bilingual children may gesture more than monolinguals either because they have precocious development of visuospatial working memory (which we will discuss further below) or because they have grasped the cultural norm of high gesture use among French speakers earlier than French monolinguals. However, as French monolingual children were not included in this study, the second possibility cannot be tested here. Longitudinal data and the inclusion of monolingual control groups for each language could help distinguish between these possibilities.

A secondary purpose of this study was to test whether there was any consistency in children's story-telling abilities in their two languages. One measure of story-telling ability is narrative length, as this measure reflects discourse competency (Minami, 2008). In a study by Minami (2008), evaluators' ratings of the quality of narratives were strongly predicted by narrative length. According to this gauge of narrative quality, the results of this study indicate that the Chinese-English bilinguals told better stories in English, their language of schooling, replicating previous findings (Strömqvist & Verhoeven, 2004; Ucelli & Paéz, 2007). The French-English bilinguals showed no significant difference between their two languages on the story-telling measures even though French was their language of schooling. Even so, only the rate of gestures was correlated between languages. This result suggests that children may adopt a cultural norm with regard to frequency of gesture use even before using a consistent story-telling style across languages (Gullberg, 1998; Nagpal et al., 2011). Here again, longitudinal data would be useful to test this interpretation.

Lastly, we tested the possibility that working memory capacity might predict how frequently the children used gestures. Consistent with this prediction, for monolinguals the mean number of word tokens was positively correlated with iconic gesture rate, suggesting that their visuospatial working memory capacity could be related to how frequently they use gestures. The negative correlation between gesture rate and age in the monolinguals could also be supportive of effects of working memory capacity, as working memory capacity increases with age (Gathercole, Pickering, Ambridge, & Wearing, 2004). These findings are consistent with many theoretical models that assume that spatial working memory underlies the production of iconic gestures (Trafton et al., 2006). However, the results of this study suggest that this relationship between spatial working memory and gesture frequency might be limited to monolinguals.

We found no evidence that working memory capacity predicted the frequency of gesture use for the bilinguals in either of their languages. One possible reason for the lack of correlations for the bilinguals could be that the effects of culture are simply greater than the memory effects. Another possible reason is based in the development of working memory. According to Gathercole et al. (2004), verbal working memory and visuospatial working memory undergo a "sizable expansion in functional capacity throughout the early and middle school years to adolescence" (p. 177). The extra cognitive burden upon verbal working memory among bilinguals (Ardila, 2003) may explain why this relationship between visuospatial working memory and iconic gesture rate was not found among bilinguals. Furthermore, recall that our measures of working memory were speech rate and word tokens. Although no significant differences were found with respect to word tokens, Chinese-English bilinguals had significantly lower speech rates than

French-English bilinguals (in their Chinese and French sessions respectively). The Chinese-English bilinguals spoke faster during their English session than during their Chinese session. This may be an indication that they are less proficient in Chinese rather than being revealing of their visuospatial working memory capacity; however, future studies using a monolingual Chinese control group would be necessary to demonstrate this. In any case, the results of the present study point to the possibility that gesture rates among bilinguals fluctuate according to cultural and linguistic factors that may interact with spatial cognition (cf. Kita, 2009). Alternatively, it is possible that the measures we used for working memory capacity are too indirect to detect consistent effects across the language groups. More direct measures of working memory may yield significant results.

In closing, we have shown that bilingualism alone does not lead to a high gesture rate in a storytelling context. Instead, cultural norms of gesture frequency may be more important in explaining how frequently gestures are used (So, 2010). We have argued that these cultural norms may interact with development and on-line processing relative to working memory. In other words, how speakers use gestures in the construction of their message may be dependent on cultural norms for gesture use. Data from a greater variety of cultures and ages are essential to verify these observations.

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Author's address

Lisa Smithson
Department of Psychology
University of Alberta
P2–17 Biological Sciences Building
Edmonton AB
T6G 2E9
Canada

smithson@ualberta.ca

About the authors

Lisa Smithson is a graduate student in the department of Psychology at the University of Alberta. Her research centres on gesture production, language, and working memory among children and adults.

Elena Nicoladis is an Associate Professor at the University of Alberta, specializing in the language and gesture development of monolingual and bilingual children.

Paula Marentette is a Professor of Psychology at the Augustana Campus of the University of Alberta. Her research focusses on gesture and its relationship to both spoken and signed languages in children and adults.