

SOME GESTURES DEVELOP IN CONJUNCTION WITH SPOKEN LANGUAGE DEVELOPMENT AND OTHERS DON'T: EVIDENCE FROM BILINGUAL PRESCHOOLERS

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ABSTRACT: In past studies, different kinds of gestures have shown different developmental trajectories, with iconic gestures being acquired after words and other gestures before. Similarly, when speech is missing or weak, iconic gestures are rarely used in compensation. These results suggest that iconic gestures are less independent of speech than other kinds of gestures. The present study tested this idea in French-English bilingual children who showed unequal proficiency in their two languages. Eight children between the ages of 3;6 and 4;11 were videotaped in two separate free-play sessions, one in each language. Their use of gestures was coded. The results showed that the children used a higher rate of iconics in their more proficient language but the use of other kinds of gestures did not differ by proficiency. These results suggest that the relationship between iconic gestures and speech is closer than that of other kinds of gestures with speech and cannot therefore be used in the preschool years as a compensatory strategy for weak proficiency.

KEY WORDS: bilinguals; preschoolers; gestures; speech-gesture system.

Gestures are often produced in conjunction with speech. McNeill (1985) has argued that the connection between speech and gesture is so strong that the communicative system is more aptly labeled the speech-gesture system (see also Riseborough, 1982). In recent years, researchers have questioned how and why gestures and speech are related.

Many researchers have argued that gesture and speech emerge from the same underlying representation of meaning, with gesture and speech each contributing slightly differently to the encoding of meaning (e.g., Caspell, McNeill, & McCullough, 1999; Cohen & Borsoi, 1996; McNeill, 1985).

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As Kendon (1994) said, "they [gestures] arise, along with speech, as an integral part of an individual's communicative effort and, from the point of view of the producer of the utterance, it is by that effort that they are shaped" (p. 193). Support for the argument that gesture and speech share a representation comes from a variety of sources. For example, McNeill (1985) found that iconic gestures, or gestures that resemble the referent (as in flapping the hands to indicate a bird flying), were often produced concurrently with a similar meaning word by adults in a story-telling situation. Other studies have shown that the form of iconic gestures can change slightly depending on the language being spoken, with the gesture taking on characteristics of the way information is encoded in a particular language (e.g., Kita & Ozyurek, under review).

While many researchers agree that gestures and speech share a common representation, it is not clear whether the unit of speech is the lexical level (e.g., Krauss, 1998) or something larger (e.g., Kita, 2000). There is certainly evidence that gestures aid the process of lexical access. For example, Krauss and his colleagues have shown that the duration of symbolic gestures associated with words is related to the amount of time it takes for a speaker to access the word (see Krauss, 1998). Frick-Horbury and Guttentag (1998) showed the lexical access facilitation most dramatically by asking college students to recall low frequency words in an attempt to induce a tip-of-the-tongue effect. Students were included in one of two conditions, either they were allowed free movement of their hands or their hand movements were restricted. The students with restricted movements recalled significantly fewer words than those who were allowed free movement. Most of the students' gestures in the tip-of-the-tongue state were iconic gestures (see also Hadar & Yadlin-Gedassy, 1994, for similar results with aphasics). These results showing that iconic gestures facilitate access to spoken words suggest that the underlying symbol may have multiple modality pathways. In other words, symbols have both a spoken and gestural component in fluent speakers (see also Kita, 2000).

There is little agreement about the function of gestures. Some researchers have argued that gestures serve to facilitate speech production (see Cohen & Borsoi, 1996). The idea that gestures facilitate speech production would explain the results showing that the use of gestures facilitates lexical access (e.g., Frick-Horbury & Guttentag, 1998). It could also explain the fact that blind people have been shown to gesture, even when speaking with other blind people (see Goldin-Meadow, 2000). And finally, it could explain why children produce longer utterances when they use iconic gestures than when they use no gestures (Nicoladis, Mayberry, & Genesee, 1999). In contradiction to the argument that gestures serve to

facilitate speech production, other researchers have argued that gestures are primarily an aid to the interlocutor's understanding. For example, Beattie and Shovelton (2000) showed that while iconic gestures generally occur when transitional probabilities (i.e., word combinations that are relatively unexpected given the sentence frame to that point) are low, they do not generally co-occur with hesitation. On the basis of these results, they suggest that gesture serves primarily a communicative function—the iconic gestures serve to make the speaker's meaning to the interlocutor clearer, particularly when an unexpected word is used. The communicative function of gestures has further been noted by Kendon (1994): "Sometimes a gesture is used because the speaker does not have another mode of expression available, but as often it is because a way is being sought to make the expression more complete or more vivid and more attractive to others, among other possibilities" (p. 194).

It should be noted that it is entirely possible that gesture serves both to help a speaker access words as well as to make his or her meaning clear to the interlocutor. In fact, in most conversations, it is probably a moot point whether a speaker's meaning is retrieved by the listener or by the speaker himself/herself. Gestures, like language in general, may have multiple functions (see also Goldin-Meadow, 2000).

The present study will examine how different kinds of gestures and speech are related in bilingual preschool children. Bilingual children are often more proficient in one language than another, usually because they spend more time hearing one language than another (e.g., Genesee, Nicoladis & Paradis, 1995). Their unequal proficiency can allow us to sort out how proficiency is related to gesture use and can shed light on whether gestures are used to compensate for weak proficiency. The study is guided by the following four research questions:

1. Is the rate of children's gesture use related to proficiency in each language?
2. Do children create longer utterances with iconic gestures?
3. Do children use gestures with no accompanying speech to compensate for low proficiency?
4. Do children use iconic gestures in cases of word finding difficulty?

In order to understand the importance of these questions, it is important to understand how gestures and speech relate to each other in development and whether or not gestures can ever compensate for speech. I turn next to a brief discussion of each of these issues.

Gesture Development

The following review focuses on the development of preschool children's empty-handed gestures, specifically conventional gestures, points and iconic gestures.¹ The premise is that different kinds of gestures show different developmental trajectories.

Conventional gestures are gestures that are meaningful within a cultural context and can usually be used without language, such as waving good-bye, holding a finger to one's mouth to indicate a desire for quiet or holding up an index finger to indicate the number one. These gestures appear fairly early on in development (Bates, Thal, Whitesell, Fenson, & Oakes, 1989). For example, Guidetti (2001) reported that conventional gestures, such as 'bravo' and 'goodbye,' were produced by children as young as 16 months of age. These gestures were usually accompanied by vocalizations in children aged between 16 and 36 month olds, although the vocalizations were not necessarily words. Nicoladis et al. (1999) found that conventional gestures did not necessarily decrease in children between the ages of 2;0 and 3;6, although the rate of use varied. They concluded that the use of conventional gestures in the early preschool years is dependent on what children are talking about.

Deictic gestures are gestures that indicate a specific instance of an object or event and/or a static location. In many cultures, deictic gestures usually consist of pointing the index finger, although this is not true across all cultures (Wilkins, 2002). Pointing has thought to be an important entry point into language: "infant's gestural signalling has been proposed as a crucial precursor of their later verbal communication" (Masur, 1982, p. 23). Researchers have noted that children start pointing around the age of nine months, usually before they are using words (Bates, Benigni, Bretherton, Camaioni & Volterra, 1979; Blake, 2000; Masur, 1982). Most of children's early points are accompanied by vocalization (Masur, 1983). At this step in development, pointing may allow children to play more active roles in communicative interactions (Bates, Bretherton, Snyder, Shore, & Volterra, 1980; Blake, 2000). Some research has suggested that children's pointing in spontaneous play decreases as children become older (Zinober & Martlew, 1985). However, in a study with a larger number of children, children's number of points was shown to increase between 16 and 36 months in cross-sectional study of 30 French-speaking children (Guidetti, 2001). In any case, pointing remains the most frequent kind of gesture used in free-play sessions between the ages of 2;0 and 3;6 (Nicoladis et al., 1999).

Iconic gestures are gestures that depict a referent, such as moving the index finger and middle fingers backward and forward to indicate walking.

This description of iconic gestures would extend to what have been called symbolic gestures that are used by preverbal children, such as flapping a hand to indicate a butterfly (Acredolo & Goodwyn, 1985; 1988). However, iconic and symbolic gestures seem to have different sources. Iconic gestures are thought to be created on-line (McNeill, 1992) while children's symbolic gestures may have been learned from parents (Caselli, 1990). To the extent that children's symbolic gestures are learned from parents, they might be better classified as conventional gestures. Iconic gestures appear in children's productions as early as two years of age and are usually accompanied by similar-meaning speech (McNeill, 1985; Nicoladis et al., 1999). Children's use of iconic gesture has been shown to be related to their language proficiency, rather than simply getting older. In a longitudinal study from 2;0 to 3;6, Nicoladis et al. (1999) showed that for five French-English bilingual boys, their rate of iconic gestures correlated with their proficiency in each language as measured by MLU (Mean Length Utterance; the average number of words per utterance). Bilingual children act as their own controls for age and the use of iconic gestures could not be attributed to their getting older. These results suggest that children as young as two years already have symbols that are accessed by a combination of gesture and speech. What changes as children's proficiency in a language increases is the frequency with which iconic gestures are used.

In sum, some gestures appear before spoken words in development, notably conventional gestures and points. There is little evidence of a change in the rate of use of these gestures as children get older within the preschool years. In contrast, iconic gestures emerge after children can speak and develop in conjunction with morphosyntactic complexity between 2;0 and 3;6. Taken together, these results suggest that conventional and deictic gestures can be acquired somewhat independently from speech while iconic gestures are dependent on speech in development.

Do Gestures Compensate for Absent or Weak Speech?

As different kinds of gestures show different developmental trajectories, it might also be reasoned that different kinds of gestures might serve different functions when speech is absent or weak. Evidence for and against a compensatory role of gestures has been reported with the elderly, aphasics, deaf people not exposed to sign language, and bilinguals. These populations are of interest because speech is absent or weak and so gesture may play a compensatory role. Both the elderly and aphasics can experience varying degrees of language loss. Deaf people who have not been exposed to sign language have great difficulty acquiring speech. Bilinguals

often know one language better than another and so may have difficulty expressing meaning in their weaker language.

There is a trend across studies on a putative compensatory role of gestures suggesting that iconic gestures² are more dependent on competent speaking abilities than deictic or conventional gestures. Iconic gestures are rarely used when speech is absent or weak. For example, deaf children who have been trained to speak use few iconic gestures (González, 1996). Furthermore, elderly people have been found to use fewer iconic gestures than young people (Cohen & Borsoi, 1996), presumably as their spoken proficiency starts to drop off. Finally, Gullberg (1999) reported that intermediate second language learners (five with French as their first language and five with Swedish as their first language) used more iconic gestures when telling a story in their first language than in their second language. These results suggest that the use of iconic gestures is intimately related with spoken proficiency.

When gestures have been shown to have a compensatory role for weak or absent speech, the gestures are usually deictic or conventional gestures. This holds true for home signs, gestures used systematically in communication by profoundly deaf children who are not exposed to sign language. Most of the children's early home signs are points and conventional gestures and only later in development more iconic home signs appear (de Villiers, Bibeau, Ramos, & Gatty, 1993; Goldin-Meadow & Morford, 1985). Furthermore, Broca's aphasics can still use points and conventional gestures (Broca, 1861; Hanlon, Brown & Gerstman, 1990). Finally, both intermediate (Gullberg, 1999) and advanced (Sherman & Nicoladis, 2001) second language learners use more deictics in their second language than in their first.

To sum up, then, it seems that gestures can sometimes compensate for missing or weak speech. Deictic and conventional gestures are more likely to be used than iconic gestures in compensating for missing or weak speech (see also Feyereisen & van der Linden, 1997). While adults' iconic gestures have been shown to aid lexical retrieval in adults (e.g., Frick-Horbury & Guttentag, 1998), it should be noted that this has been observed in adults who are fully competent speakers. Iconic gestures may only be separable from spoken language when a spoken language (or a symbolic system of communication, such as home signs) has been acquired.

This Study

The above review of the literature has pointed to the possibility that conventional and deictic gestures are more independent from speech than

iconic gestures. In children, the connection between iconic gestures and speech seems to be particularly close (e.g., Nicoladis et al., 1999) and it is only adults who have been reported to use iconic gestures without speech to access symbols (e.g., Frick-Horbury & Guttentag, 1998). The purpose of the present study is to test the idea that different kinds of gestures are related to speech in different ways. Furthermore, this study can start to look at when children can access symbols with the use of iconic gestures alone. To address these issues, this study focuses on four specific research questions, as follows.

1. Is the rate of gesture use related to proficiency in each language?

Previous research has shown that for younger children, the use of iconic gestures is correlated with MLU while the use of deictics and conventional gestures is not (Nicoladis et al., 1999). If this is true for the slightly older children in this study, then they will show the same pattern of correlations. Alternatively, the children might have established their language abilities well enough to be able to separate gestures (including iconic gestures) from spoken words, in which case no correlations would be observed. In order to examine the relationship between children's gesture use and proficiency, the present study not only looks at the children's MLU but also a measure of comprehension vocabulary in both languages. If gesture use is related to proficiency in general, we should see the same pattern of correlations regardless of which measure of proficiency is used (see O'Reilly, Painter, & Bornstein, 1997).

2. Do children create longer utterances with iconic gestures?

Nicoladis et al. (1999) showed that young children produced longer utterances accompanied by iconic gestures than with utterances accompanied by deictic or conventional gestures or utterances with no gestures. These young children may have been increasing the complexity of their symbolic representation and produced longer utterances with more complex symbols. The older children in the present study may still be increasing the complexity of their symbols and therefore we should see longer utterances produced with iconic gestures relative to those produced with deictics, conventional gestures or no gestures.

3. Do children use gestures with no accompanying speech to compensate for low proficiency?

One possible way in which bilingual children might use gesture to compensate for weak proficiency is by gesturing without speech. For ex-

ample, a French-English bilingual child with weaker French than English might use more gestures without speech to communicate to a French speaker than to an English speaker. Previous research has shown that this was not the case for children younger than 3;6 (Nicoladis & Genesee, 1996, 1997). The older children in the present study may be more sensitive to their interlocutor's conversational needs and may therefore use more gestures when trying to communicate with someone who speaks their weaker language.

4. Are iconic gestures used in cases of word finding difficulty?

One of the reasons that Nicoladis et al. (1999) found that young children could create longer utterances with iconic gestures than with no gestures is that iconic gestures allow them to access words more easily (as was the case for the adults in Frick-Horbury & Guttentag, 1998). It is therefore possible that we will see iconic gestures occurring frequently in instances of word finding difficulty (or in word finding difficulty followed by successful word retrieval). To my knowledge, this possibility has not yet been examined in preschool children.

As I have shown that the kind of gesture might make a difference in how gesture and speech are related, the above research questions will be answered in focusing on conventional gestures, deictics and iconic gestures separately. These three gesture types have been found to be the most frequent in preschool children's gestures (Nicoladis et al., 1999).

Methods

Participants

Eight French-English bilingual children from middle class to upper middle class homes participated in this study. Each child is identified by a pseudonym. All children lived in or around Edmonton, Alberta, Canada. This city is located in a primarily English-speaking part of Canada and has a small and active French-speaking community. The children's exact ages are summarized in Table 2; the average age of the children was 4;3 (4 years and 3 months).

Unlike the children in Nicoladis et al. (1999), the children were not all bilingual because they were members of one parent-one language families. According to parental report, there were a variety of sources of the two languages for these children. Four children were addressed primarily in French in their homes by both parents (Julie, Nicole, Stéphane, and Aidan).

Of these, three children (Julie, Nicole, and Stéphane) attended a French daycare; these children learned English from extended family, friends and the outside community in general. Aidan attended an English daycare. Three children were in one parent-one language families (Hélène, Jason, and Anthony). In all three families, the mother spoke primarily French with the children and the father primarily English. Hélène and Anthony attended English daycares while Jason was in French daycare. David was addressed primarily in English in his family (although occasionally in French by his mother and more often by his older brother) and had been attending French daycare since the age of 19 months.

Most of the children were only children (Hélène, Jason, Julie, Stéphane, and Aidan) at the time of this study. Both Nicole and Anthony had recently had younger siblings, under a year old at the time of this study. David was the younger child by a little over a year.

Procedure

The children were videotaped in two separate sessions: once in a French context and once in an English context. Each session was approximately one hour long, yielding a total of two hours of videotape of each child. These sessions were scheduled on different days within a week of each other. To create these contexts with such a heterogeneous sample of bilingual children, we tried to simulate a situation where the children would naturally hear each language. Table 1 summarizes the children's conversational partners for each language. For example, Nicole heard French in her family and at daycare and English from the general environment. We filmed her French session with her mother and her English session with an unfamiliar adult playmate who is a native speaker of English. Aidan's mother explained that they sometimes spoke English when they had English-speaking guests, so both sessions were filmed with the mother. At the start of the English session, the mother asked Aidan to speak English for the videotaper's benefit. This strategy worked quite well: 99.3% of Aidan's utterances were in English-only in the English session and 99.1% of his utterances were in French-only in the French session.

The context of the videotaped session was free play. The only limitation we placed on the interactions is that we asked the adult interlocutors to avoid reading books. We did this in order to get a sample of everyday conversation. The activities chosen by the child and the interlocutor varied from child to child and session to session. For example, Nicole spent much of the English session building a Lego house with the English-speaking playmate. She spent much of the French session playing with playdough

TABLE 1

Conversational Partners for the Children

Child	French session	English session
Hélène	Mother	Father
Jason	Mother	Father
Julie	Mother and father	Grandmother
Nicole	Mother	Unfamiliar adult playmate
Stéphane	Mother	Unfamiliar adult playmate
Anthony	Mother and father	Cousin
David	Unfamiliar adult playmate	Mother
Aidan	Mother	Mother

and talking about her baby sister. Jason and his mother spent much of the French session straightening up Jason's room. In Jason's English session, he and his father spent time playing with cars and playing restaurant.

Transcription and Coding

The speech recorded on the videotapes was transcribed according to CHAT conventions by a native speaker of English who was also fluent in French (MacWhinney, 2000). All the French transcripts were checked for accuracy by a native speaker of French and any corrections he suggested were accepted. Each utterance was coded for language (i.e., French-only, English-only, either, mixed or unintelligible; following Nicoladis et al., 1999). French-only and English-only utterances consisted of words exclusively in each language respectively. Either-language utterances consisted of words that could belong to either French or English (e.g., "oh," "okay," and proper names that showed little phonological change by language). Mixed-language utterances contained both French and English words. Only the children's French-only and English-only utterances are analyzed in the present study.

The children's gestures were coded as conventional, deictic or iconic. The coding indicated whether the gesture accompanied a spoken utterance or was produced in the absence of speech. Most of the conventional gestures included flipping hands to indicate that something was gone or that the speaker did not know something. Most of the deictic gestures were points with the index finger, although Nicole produced one deictic with her foot. A randomly chosen transcript was coded by a second coder. The

agreement as to where there were gestures was 75% (Phi coefficient = .851) (much of the disagreement was based on whether to count non-points as deictic gestures) and the agreement on the category of the agreed-upon gestures was 95%. To create a final transcript for the checked transcript, all gestures coded by one coder or the other were included, so all the non-pointing deictic gestures were included as deictic gestures.

Language Dominance

Because the children heard their two languages from a variety of sources, it was particularly important to determine which language (if either) was their dominant language (Genesee et al., 1995). Three variables were used to determine the children's dominant language: Mean Length of Utterance, number of utterances in each language, and the Peabody Picture Vocabulary Test. Mean Length of Utterance (MLU) was determined by the total number of words (not morphemes) used in French or English divided by the total number of utterances used in each language respectively.³ Words were used rather than morphemes because this allows closer numbers in English and French (see Nicoladis et al., 1999). The number of utterances was the total number of utterances the children said in French-only and English-only respectively across the two videotaped sessions. The

TABLE 2

Language Dominance Measures by Child

Child	Age	MLU		# utts.		PPVT	
		French	English	French	English	French	English
Hélène	3;6	1.70	3.36	162	804	47	47
Jason	3;7	2.12	3.91	43	943	61	44
Julie	3;10	4.03	3.12	180	474	57	42
Nicole	4;0	4.01	2.16	357	421	57	12
Stéphane	4;7	3.32	1.38	361	192	87	16
Anthony	4;8	2.88	3.84	98	409	44	39
David	4;8	3.50	4.14	298	350	54	79
Aidan	4;11	4.69	4.01	450	439	87	83

MLU: Mean Length of Utterance.

#utts.: Number of utterances in two hours of videotape.

PPVT: Peabody Picture Vocabulary Test.

Peabody Picture Vocabulary Test (PPVT) is a standardized test of comprehension vocabulary (Dunn & Dunn, 1997). The children were administered Version A in English and Version B in French translation according to the instructions given in the testing manual. As the PPVT has not been standardized for bilingual children, the raw scores are reported. These measures are summarized for each child in Table 2.

Using the language that was greater on two out of three (or three out of three) dominance measures as each child's dominant language, there were four English dominant children and four French dominant children. Hélène, Jason, Anthony and David were classified as English dominant while Julie, Nicole, Stéphane and Aidan were classified as French dominant. The dominance groups corresponded quite nicely to those children who heard only French at home and those who heard any English at home at all (even if they had one francophone parent). The French dominant children heard only French at home and the English dominant children heard some English at home.

Results

Gesture Use and Language Proficiency

Table 3 summarizes the number of each kind of gesture used by each child with either French or English. The children most frequently used deictic gestures (71%), then conventional gestures (15%), then iconics (14%). There was a tendency for the number of gestures used in each language to correlate with the number of utterances in each language, particularly for deictics, for both English, $r(6) = .852$, $p < .01$, and for French, $r(6) = .826$, $p < .05$. The correlation with iconics was positive but not significant in both languages; for English $r(6) = .692$ and for French, $r(6) = .168$. With conventional gestures, the correlation was negative and not significant for English, $r(6) = -.212$, and positive and not significant for French, $r(6) = .388$. Because there was a tendency for children to use more gestures in a particular language when they talked more in that language, the following analyses are performed on the rate of gesture per utterance in a particular language (following Nicoladis et al., 1999).

Table 4 summarizes the correlation coefficients between the rate of gesture use (i.e., the number of gestures per utterance in each language for each child) and the two proficiency measures (for each child). As can be seen in this table, neither measure of proficiency was significantly correlated with rate of gesture use in either language.³ However, MLU (a mea-

TABLE 3

Number of Gestures by Gesture Type, Language and Child

	Conventional gestures		Deictics		Iconics	
	French	English	French	English	French	English
	Hélène	0	10	14	41	0
Jason	0	3	2	120	0	17
Julie	4	13	15	48	16	4
Nicole	10	19	43	28	5	0
Stéphane	2	3	17	9	6	0
Anthony	0	13	7	38	1	18
David	7	17	13	14	7	1
Aidan	0	1	39	31	2	4

sure of production proficiency) was more highly correlated with rate of gesture use than was PPVT (a measure of comprehension proficiency).

It is possible that no correlations between proficiency and rate of gesture use were found with these bilingual children (cf. Nicoladis et al., 1999) because they tended to be highly dominant in one language or the other. To see if that was the case, the following analyses compare gesture use by the French-dominant children and the English-dominant children as groups. If gesture use is related to proficiency, we would expect children to use more gestures in their dominant language. One-tailed t-tests were per-

TABLE 4

Correlation Coefficients Between Rate of Gesture Use and Proficiency Measures

	PPVT		MLU	
	French	English	French	English
Conventional gestures/ utterance	-.394	-.142	.484	-.099
Deictics/utterance	-.195	-.079	.342	.315
Iconics/utterance	-.170	.306	.412	.486

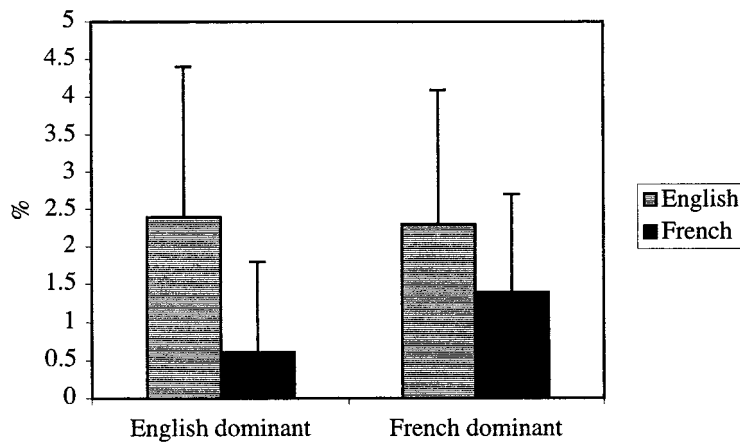


Figure 1. Average rate (standard deviation) of conventional gesture use by language and dominance group.

formed because it was predicted that the children would use more gestures in their dominant language.

Figure 1 shows the average rate of conventional gesture use (i.e., the number of conventional gestures divided by the number of utterances in that language used by each child) by the English- and French-dominant children. As can be seen in this Figure, both groups used more conventional gestures in English than in French. Because of this, there was no significant difference on the rate of conventional gesture use by dominant language on a one-tailed *t*-test, $t(7) = 0.52$.

Figure 2 shows the average rate of deictic gestures used per utterance in each language by each of the dominance groups. Here the children were likely to use more deictics in their dominant language, a difference that did not reach significance on a one-tailed *t*-test, $t(7) = 1.70$.

Figure 3 shows the average rate of iconic use by language and dominance group. Both groups used significantly more iconic gestures per utterance in their dominant language as compared to their non-dominant language on a one-tailed *t*-test, $t(7) = 2.08$, $p < .05$.

To sum up the relationship between proficiency and gesture use, MLU was more highly correlated with rate of gesture use than PPVT, but no correlation reached significance. It was thought that the lack of correlation might be due to the existence of two distinct dominance groups in this group of bilingual children. When we looked at rate of gesture use by dominant language, the children were more likely to use a higher rate of

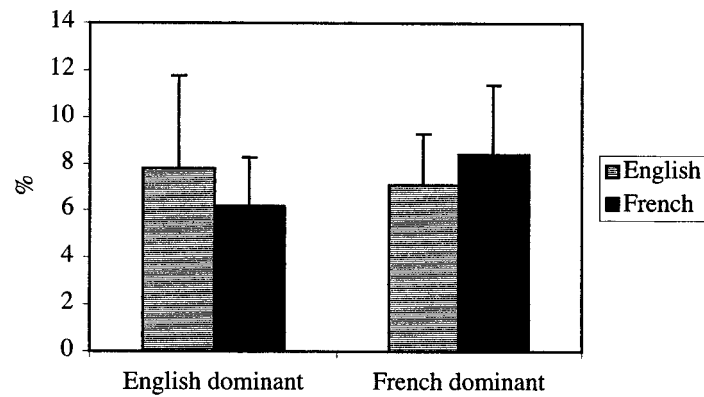


Figure 2. Average rate (standard deviation) of deictic use by language and dominance group.

gestures in their dominant language as compared to their non-dominant language for iconic gestures, but not for deictics or conventional gestures.

Kind of Gesture and Length of Utterance

We next turned to see if children made longer utterances when they used gestures as compared to no gestures, as well as when they used differ-

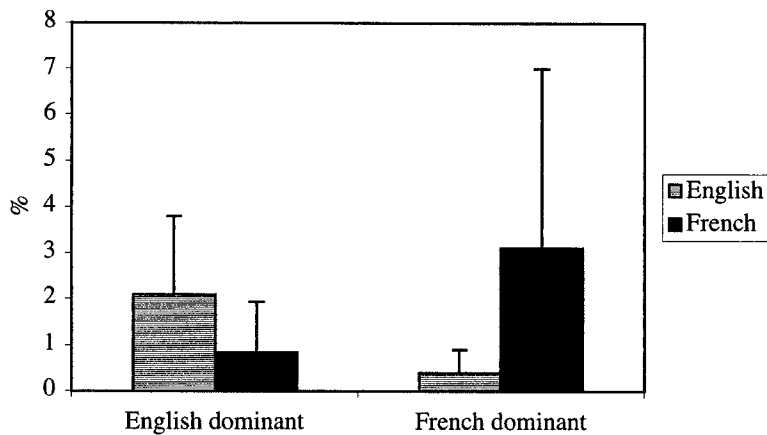


Figure 3. Average rate (standard deviation) of iconic use by language and dominance group.

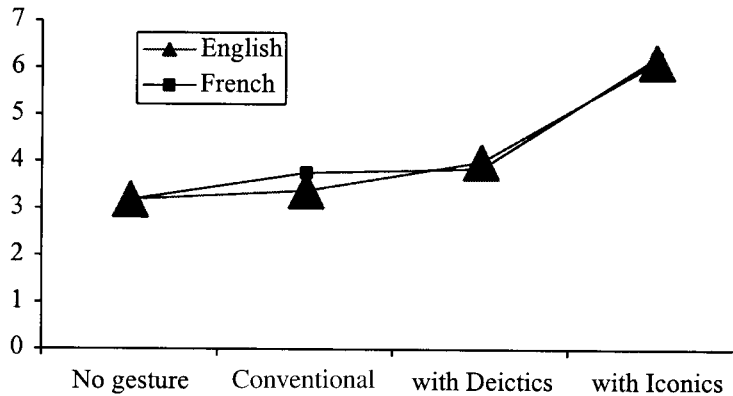


Figure 4. Average length of utterances produced with no gesture or with different gesture types.

ent kinds of gestures. Following Nicoladis et al. (1999), we expected to find that children would use longer utterances with iconic gestures than with deictic gestures and longer utterances with deictic gestures as compared to utterances produced without gestures. We had no predictions for conventional gestures. Figure 4 summarizes the average length of utterances used by the children with no gestures, conventional gestures, deictics and iconics. The same pattern holds for both the English-dominant and the French-dominant children, although their utterances are longer in their dominant language than in their non-dominant language. Because the same pattern was observed for both dominance groups, Figure 4 presents the average for all eight children.

As can be seen in Figure 4, utterances produced with iconic gestures were longer than utterances produced with no gestures, conventional gestures or deictics. There was not a big difference between the length of utterances produced with no gestures, conventional gestures and deictics. This result suggests that when the children used iconic gestures, they produced longer utterances than when they used no gestures, deictics or conventional gestures. Table 5 summarizes the children's MLU in English and French for utterances with iconic gestures and utterances without iconic gestures (so utterances without gestures, with deictic gestures and with conventional gestures). Four children did not produce iconic gestures in their non-dominant language. For the remaining 12 cases in which a comparison can be made between the MLU with and without iconic utterances, 11 out of these 12 show the same pattern as the average across children. The only exception to the general rule is Julie in French, whose

TABLE 5
**Mean Length of Utterance With Iconic Gestures
 and Without Iconic Gestures**

	English		French	
	With iconics	Without iconics	With iconics	Without iconics
Hélène	5.00	3.32	—	1.70
Jason	6.13	3.88	—	2.12
Julie	5.00	3.20	4.06	4.10
Nicole	—	2.16	6.00	3.97
Stéphane	—	1.38	7.17	3.25
Anthony	6.06	3.78	3.00	2.88
David	6.00	4.19	7.71	3.40
Aidan	8.75	3.98	9.50	4.55

MLU with iconic gestures was 4.06 and without was 4.10. The difference between 11 and 1 is significant on a sign test, $p < .01$.

Gestures Without Speech by Language Context

While the children did not use more gestures with their non-dominant language to compensate for weak proficiency, it is possible that they might use gestures without speech, particularly when trying to communicate with someone who speaks their weaker language. Table 6 summarizes the number of gestures produced with and without speech by each of the children. Note that only 13% (101 out of 771) of the children's gestures were produced without speech.

To see if gestures produced without speech were used to compensate for weak proficiency, we next look at the average number used in each session (i.e., either the English session or the French session) by the language dominance groups. Figure 5 shows these numbers. If the children were using gestures to compensate, we would expect to see them use more gestures without speech in the session of their non-dominant language. This is the pattern observed for both conventional gestures (particularly with the French dominant children in the English session), $\chi^2(1) = 9.83$, $p < .01$, and deictics (particularly with the English dominant children in the French session), $\chi^2(1) = 15.97$, $p < .01$. This pattern was not ob-

TABLE 6

Number of Gestures Produced With and Without Speech by Child

	Conventional gestures		Deictics		Iconics	
	Speech	No speech	Speech	No speech	Speech	No speech
Hélène	11	2	60	16	16	11
Jason	3	1	125	3	21	1
Julie	9	0	66	0	21	2
Nicole	17	13	71	7	5	0
Stéphane	3	0	35	4	8	14
Anthony	13	0	50	5	22	1
David	10	5	28	3	9	1
Aidan	1	10	56	2	9	0

served for iconic gestures: both dominance groups used more iconic gestures in the English session than in the French session and the difference did not reach significance, $\chi^2(1) = 0.02$.

Were Gestures Used in Instances of Word Finding Difficulty?

Recall that the children in the present were capable of producing longer utterances with iconic gestures than without gestures or with other kinds of gestures. It is possible then that the children produce longer utterances because the gestures help them remember words. We next look at how often iconic gestures were used as word finding difficulty. All the examples found are listed in the Appendix. The instances are presented in order of the age of the children. There were no instances of this kind for David or for Stéphane.

While only a minority of iconic gestures was produced in instances word finding difficulty (20% or 28 out of 142), there was a slight trend for the children to produce a greater proportion of iconic gestures while having word finding difficulties as they got older. Hélène, the youngest child in this group, only produced 7% (2 out of 27) of her iconic gestures in cases of word finding difficulties, while Aidan, the oldest child produced 67% (6 out of 9) in cases of word finding difficulty.

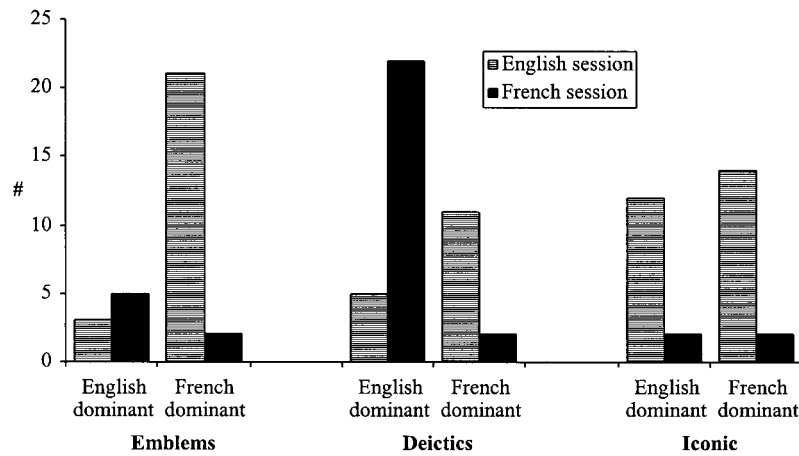


Figure 5. Average number of gestures used in each language context by language dominance groups.

Discussion

This study focused on how bilingual preschoolers between 3;6 and 4;11 used gestures in their two languages. As there were only eight children in the study, the following discussion should be interpreted with the caution that the present findings may not generalize to larger populations. The most striking results were in terms of how differently the children used different kinds of gestures. Table 7 summarizes the answers to the research questions by the different kinds of gestures.

The children in the present study used conventional and deictic gestures in similar ways relative to their stronger and weaker languages. They showed no systematic use of conventional or deictic gestures relative to proficiency (as was the case with the younger bilingual children in Nicoladis et al., 1999). Their utterances produced with conventional and deictic gestures were no longer than utterances produced with no gestures. And, they used more conventional and deictic gestures without speech when trying to communicate with someone who spoke their weaker language than with someone who spoke their dominant language. This last result suggests that children can use conventional gestures independently of speech to compensate for low proficiency. The fact that children can use conventional gestures independently of speech should come as no surprise, given that by their very definition they can usually be recognized

TABLE 7

Summary of Research Questions and Answers

	Conventional gestures	Deictics	Iconics
Did the children use more gestures with their stronger language?	No	No	Yes
Did the children create longer utterances with gestures than without gestures?	No	No	Yes
Did the children use more gestures with no speech when communicating with someone who speaks their weaker language?	Yes	Yes	No
Did the children use the gestures in instances of word retrieval difficulties?	—	—	Rarely, but more so with age

(and perhaps are often produced) by those familiar with the culture without support from a language context. Similarly, because the form of deictic gesture can vary from culture to culture (Wilkins, 2002), it is perhaps appropriate to think of deictic gestures as a kind of conventional gesture.

In contrast to conventional and deictic gestures, the children's iconic gestures showed a clear pattern relative to language dominance. The children used more iconic gestures with their dominant language than their non-dominant language. The utterances children made with iconic gestures were longer than with no gestures or with any other kind of gesture in both French and English. Iconic gestures without speech were not used in the pattern expected if children were compensating for weak proficiency. Finally, there was a trend for the older children to use iconic gestures more frequently when they were having word finding difficulties compared to the younger children. These results suggest that iconic gestures are not used to compensate for weak proficiency but are instead used in conjunction with the children's stronger language. Even when children used iconic gestures while searching for a word, they had a tendency to do so in their dominant language rather than their weaker language (see Appendix).

Can Gestures Compensate for Weak or Absent Speech?

The results from these studies suggest that development of iconics is related to development in spoken language. The development of conventional and deictic gestures is independent of spoken language. Conventional and deictic gestures can compensate for weak spoken proficiency. Iconic gestures cannot, at least for preschool children. One reason for the strong connection between iconic gestures and spoken proficiency may be that iconics help with the memory of individual words (as was the case for the adults in Frick-Horbury & Guttentag, 1998), as evidenced by the children's use of longer utterances with iconics.

If adults can occasionally use iconic gestures in a compensatory fashion, it stands to reason that children must learn to do so at some point in development. These preschool children used iconic gestures in word finding difficulties only rarely. Some evidence was seen in the present study, however, that these children may be on the cusp of a developmental switch in the use of iconic gestures, in that the older children were more likely to use iconics in cases of word finding difficulty than the younger children. Further research using the same methodology with children and adults would be necessary to establish whether there is a difference in the rate of iconic gesture use in word finding difficulty and if so, when in the course of development children start to use iconics separately from speech at the same rate and in the same circumstances as adults.

Gesture Development

These results, together with those of Nicoladis et al. (1999) with children aged 2;0 and 3;6, suggest that throughout the preschool years, children's use of iconic gestures is associated with their language proficiency while the use of conventional and deictic gestures may be more dependent on what the children are communicating (see Nicoladis et al., 1999, for a similar conclusion). These results suggest that children's production of iconic gestures is dependent on their ability to produce complex speech. Iconic gestures might be used as a compensatory strategy only when a language is known well. As such, it is not clear that iconic gestures are easy for children. Iconicity may be hard to learn. In contrast, conventional gestures and deictic gestures that rely on children's understanding of somewhat arbitrary connections between meaning and symbol may be easier to learn. This conclusion may come as a surprise for those used to thinking of children as attending primarily to the concrete, physical world. However, there is increasing evidence that children attend to speakers' intentions in

guiding their understanding of meaning (Bloom, 2000). If children focus on speakers' intentions, then transparent mappings between symbol and referent would simply be irrelevant in the early stages of language acquisition. Instead, transparent mappings between symbol and speakers' intentions should help children learn early symbols, including gestures. In fact, this may be what happens in adults' use of gestures with children (see, for example, Butterworth & Grover, 1999). To see if this were true, it is important to study more children's gestures in a variety of contexts. Of particular interest would be children's acquisition of conventional gestures (e.g., Caselli, 1990). If the conclusions here are correct, preverbal children should have no greater difficulty learning an arbitrary gesture for a referent as compared to a transparent gesture. In closing, I would like to remind readers that the present conclusions are based on eight children. It is essential to replicate the present results with more children before turning to possible ramifications of these results.

Appendix: Children's Iconic Gestures Produced in Instances of Word Finding Difficulty

Hélène (2/27 iconic gestures):

1. This is the top for climbing on . . . like this.
Gesture meaning: climbing up
2. No, no I'll do that.
Gesture meaning: attaching pretend seatbelt

Jason (1/22 iconic gestures):

3. It goes like this.
Gesture meaning: path of movement from a vehicle pictured in a book

Julie (10/23 iconic gestures):

4. Comme ça.
'Like this'
Gesture meaning: the motion of a flower sprinkler
5. Elle fait splishsplash.
'It goes splishsplash'
Gesture meaning: the motion of a flower sprinkler
6. Comme ça.
'Like this'
Gesture meaning: the motion of a flower sprinkler
7. Parce que le, le, le chose de bulles est rouge.
'Because the, the, the bubble thing is red'
Gesture meaning: bubble wand
8. Il fait [sound of sanding].
'He goes [sound of sanding]'
Gesture meaning: sanding

9. Parce que on a boingboingboing.
 'Because we have boingboingboing'
 Gesture meaning: rust spots
10. Parce que on a des . . .
 'Because we have some . . .'
 Gesture meaning: rust spots
11. [No speech].
 Gesture meaning: rust spots
12. On va faire sh.
 'We're going to go sh'
 Gesture meaning: pouring paint
13. Parce qu'il fait splishsplash splishsplash.
 'Because it goes splishsplash splishsplash'
 Gesture meaning: the motion of a flower sprinkler
- Nicole (3/5 iconic gestures):*
14. On va l'attraper comme ça boom boom boom boom!
 'We're going to catch it like this boom boom boom boom!
 Gesture meaning: throwing
15. P(u)is le faire comme ça?
 'Then do it like this?'
 Gesture meaning: demonstrating the motion she wants mother to do in playing ball
16. Fais-le rouler comme ça.
 'Make it roll like this'
 Gesture meaning: demonstrating the motion she wants mother to do in playing ball
- Anthony (6/23 iconic gestures):*
17. Raphael, comme ça.
 'Raphael, like this'
 Gesture meaning: long, curly hair
18. Comme . . . comme . . . comme . . . short.
 'Like . . . like . . . like . . . short'
 Gesture meaning: short hair
19. And then, and then you need a little straight thing like this.
 Gesture meaning: shoes for the Power Ranger he was building with his friend
20. But you need a little thing here that's around around thing . . . to shoot.
 Gesture meaning: the top of a truck he was building with his friend
21. You can fly like that.
 Gesture meaning: path of flight of lego construction, i.e., straight up
22. No, it's for the . . . this . . . for the straight.
 Gesture meaning: the straight part of handlebars
- Aidan (6/9 iconic gestures):*
23. On les lance . . . comme ça.
 'We throw them . . . like this'
 Gesture meaning: throwing back and forth

- 24–25. Non, toi tu fais à cette table et moi je fais à cette table.
 ‘No, you do at that table and I do at this table’
 Gesture meaning: draw circles (what he and his mother are to do at their respective tables)
- 26–27. So it can go like this and like this.
 Gesture meaning: looping paths that the train tracks they are building should do
28. Yeah, now we need to do this one.
 Gesture meaning: the next loop of the track they should build

Notes

1. Excluded from this literature review are studies on gesture comprehension, although there has been increasing interest in the lifespan development of gesture comprehension in recent years (see, for example, Kelly & Church, 1998; O’Reilly, Painter, & Bornstein, 1997; as well as the review in Thompson, 1995). By focusing on empty-handed gestures, this review also excludes symbolic play, or manipulation of objects in a culturally appropriate way, although this kind of play has been linked to children’s early speaking abilities (Bates, Bretherton, Snyder, Shore & Volterra, 1980; Bates, Thal, Whitesell, Fenson & Oakes, 1989; Blake, 2000). Finally the focus on preschool children’s gestures excludes studies demonstrating development of children’s gestures into the school years (e.g., Alibali, Kita, & Young, 2000; Bermejos Berro, 1993; Goldin-Meadow, 2000).
2. There are a number of different classification systems for gestures and the studies I review here do not always call these gestures “iconic.” To keep the discussion of these studies as simple as possible, I have used the word “iconic” where the author(s) seemed to be referring to the kinds of gestures that depicted a referent (or a part of a referent).
3. Some researchers have argued that a more valid measure of children’s morphosyntactic development is MLU calculated in morphemes rather than words. For the present study, the change in calculation makes no difference in the results. When French MLU is calculated in morphemes, the correlation between rate of iconic gestures and MLU is .440, rate of deictic gestures and MLU is .345 and rate of conventional gestures and MLU is .469.

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