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Young Bilingual Children's Heightened Sensitivity to Referential Cues

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Children growing up in a dual-language environment have to constantly monitor the dynamic communicative context to determine what the speaker is trying to say and how to respond appropriately. Such self-generated efforts to monitor speakers' communicative needs may heighten children's sensitivity to, and allow them to make better use of, referential gestures to figure out a speaker's referential intent. In a series of studies, we explored monolingual and bilingual preschoolers' use of nonverbal referential gestures such as pointing and gaze direction to figure out a speaker's intent to refer. In Study 1, we found that 3- and 4-year-old bilingual children were better able than monolingual children to use referential gestures (e.g., gaze direction) to locate a hidden toy in the face of conflicting body-distal information (the experimenter was seated behind an empty box while the cue was directed at the correct box). Study 2 found that by 5 years of age, monolingual children had mastered this task. Study 3 established that the bilingual advantage can be found in children as young as 2 years old. Thus, the experience of growing up in a bilingual environment fosters the development of the understanding of referential intent.

Children growing up bilingual face communicative challenges beyond those monolingual children have to cope with. They need to constantly monitor the dynamic communicative situation to determine what language a given

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speaker is using and how to respond appropriately (cf. Comeau & Genesee, 2001; Comeau, Genesee, & Lapaquette, 2003). This places a greater demand on bilingual over monolingual children both in terms of cognitive load and understanding of referential intentions. In a sense then, growing up bilingual provides a natural experiment to examine the role of experience in coping with challenging circumstances in fostering cognitive and linguistic development.

Successful communication requires speakers and listeners to attend to and integrate a wide range of information including the literal meaning of an utterance, information obtained from the linguistic and nonlinguistic context, nonlinguistic gestures such as eye gaze and pointing, the intonation in which a sentence is uttered, and the pragmatics of the situation. Monolingual and bilingual children alike must learn to monitor and integrate these sources of information to communicate successfully and avoid breakdowns in communication (e.g., Baldwin, 1995; Hollich, Hirsh-Pasek, & Golinkoff, 2000; Tomasello, 2003). But bilingual children additionally have to monitor and evaluate whether they and their communicative partners are speaking the same language. Bilingual children thus face a greater risk of communicative failure when, for example, an adult speaker switches to a language a bilingual child does not understand or when a bilingual child responds in a language that an adult speaker does not speak. We suggest that the increased risk of communicative failure may lead to greater vigilance on the part of bilinguals. The bilingual environment thereby motivates children to mobilize greater effort to maintain effective communication.

The increased need to monitor the communicative situation may lead to a heightened sensitivity in bilingual children to the social, pragmatic, and communicative contexts surrounding language use. Bilingual children have been shown to be better than monolingual children at taking the perspective of a listener into account and picking up on feedback and prompts from their communicative partner, and have a greater level of pragmatic awareness (Ben-Zeev, 1977; Comeau, Genesee, & Mendelson, 2007; Cummins & Mulcahy, 1978; Diesendruck, 2004; Genesee, Tucker, & Lambert, 1975; Hakuta, 1987; Siegal, Iozzi, & Surian, 2009). For example, Genesee et al. (1975) asked both monolingual and bilingual children from kindergarten, Grade 1, and Grade 2 to explain a game to two listeners—one blindfolded and the other not. Although children in general gave more information to the blindfolded listener than they did to the sighted listener, bilingual children gave more information to the blindfolded listener than the monolingual children did. Genesee et al. (1975) concluded that bilingual children were better able to take the role of others experiencing communication difficulties, perceive their needs, and respond to these needs appropriately.

Similarly, Ben-Zeev (1977) found that bilingual children (aged 5 to 9 years) were more sensitive to feedback cues. She presented a classification

and reclassification test to both monolingual and bilingual children. Whenever a child perseverated by giving the same classification twice instead of switching to another, the experimenter provided hints in the next trial that indicated the need to reclassify. For example, if a child was stuck on classifying into two shape categories—say, round and square—the hint set would also include triangles, which made it difficult to classify by shape again into two groups. She found that bilingual children picked up these hints more quickly, and once given feedback, corrected their mistakes faster than their monolingual counterparts did.

In a similar vein, Cummins and Mulcahy (1978) found that bilinguals were better able than monolinguals to use prompts to help them recognize ambiguity in sentences. In their study, first- and third-grade children were shown four line drawings while the experimenter read an ambiguous sentence. They had to choose two correct pictures representing the two interpretations of the sentence and provide an adequate explanation of their choices. If they chose only one of two correct answers, a verbal prompt was given to see if the other correct answer could be elicited. Bilinguals made better use of the prompts than monolinguals and subsequently found the second answer more often than monolinguals.

More recently, Siegal and colleagues (2009) found that bilingual children showed a greater level of conversational understanding than monolingual children. Four- to 6-year-old monolingual and bilingual children were asked to identify one of two dolls that uttered a response that violated a Gricean conversational maxim. Bilingual children showed an enhanced ability to detect violations of Gricean conversational maxims compared with monolingual children.

In sum, past research has shown that, compared with monolinguals, bilingual children between 4 and 9 years old can better take the perspectives of a listener, can benefit more from feedback and prompts from their communicative partners, and have a greater level of pragmatic awareness in conversational situations. Most of this past research has focused on how bilingual children are better at interpreting verbal feedback and using verbal input of some kind. However, bilingual children's heightened sensitivity to a communicative context may extend beyond the linguistic aspects of an interaction to the nonlinguistic aspects (e.g., referential gestures). Thus, growing up bilingual might also help children tune in to nonverbal signals, especially in complex, potentially confusing situations. There are no studies to date that compare young bilingual and monolingual children's sensitivity to nonverbal communicative cues per se. The goal of our research is to begin to explore whether young bilingual children become better able than monolinguals to pick up on and use nonverbal communicative cues, such as eye gaze and pointing.

We know that preschool children, monolingual and bilingual alike, readily interpret pointing and eye gaze when they are used in simple, straightforward contexts. A few recent studies, however, found that monolingual children have difficulty in using such nonverbal referential gestures in more challenging situations (Jaswal & Hansen, 2006; Povinelli, Reaux, Bierschwale, Allain, & Simon, 1997). Our question, then, is whether bilingual children may be better able than monolingual children to use nonverbal referential gestures under similar challenging contexts.

We use a procedure developed by Povinelli et al. (1997), which pitted nonverbal referential gestures (pointing and gaze) against conflicting body-distal information in the context of a hiding game. The original goal of their study was to examine whether chimpanzees possess a general understanding of reference as a mental state—for example, whether they are able to extract referential information from a pointing and/or gaze gesture. In the standard condition, the experimenter pointed to and/or looked at one of two boxes while positioned an equal distance from them. In the body-biased condition, the experimenter sat behind one box (the incorrect, empty box) but gestured toward the box that was farthest from him (the correct, baited box). Chimpanzees in the study appeared to rely on a distance-based rule and searched the box nearest to the experimenter rather than showing an appreciation of the attentional focus or referential intent of the experimenter as indicated by his point or gaze.

Povinelli et al. (1997) subsequently tested children between 2 and 2.5 years old on this same task for comparison purposes. When the experimenter was positioned equidistant from the two boxes, the children were able to understand the referential gesture and relied on it to successfully locate hidden rewards (their Study 2). However, when the experimenter sat behind the empty box but gestured toward the box farthest from him (the correct box with the reward), the results differed depending on whether pointing or gaze was used. Even under this more demanding body-biased condition, children successfully located hidden rewards based on the experimenter's pointing. However, they had difficulty in locating the hidden rewards when the referential gesture was gaze direction. We suggest that the use of gaze as a cue to the experimenter's referential intent was more challenging than pointing, because while pointing is used unambiguously to direct joint attention, gaze is not always used as a deliberate communicative act. For example, people do often look around or shift eye gaze and head direction without any intention to communicate anything to anybody. We hypothesized that bilingual children may be more attentive to a wider range of cues to identify someone's referential intent, even cues that are not unambiguously used to direct joint attention, such as eye gaze.

In Study 1, we adapted Povinelli et al.'s (1997) procedure to examine 3- and 4-year-old monolingual and bilingual children's use of pointing or eye gaze to find a toy hidden in one of two boxes when the experimenter was seated either equidistant from the two boxes or behind the empty box. We predicted that bilingual children would use referential gestures more effectively than monolingual children when the task was made challenging by providing conflicting body-distal information and/or using more subtle gestures (i.e., gaze vs. pointing).

STUDY 1

Method

Participants

Forty-eight 3- and 4-year-old English monolingual and bilingual children from a preschool in Palo Alto participated in this study. Twenty-four children were monolinguals (12 were 3-year-olds: M age $= 3;8$, range $= 3;2$ to 3;11, 5 males; 12 were 4-year-olds: M age $= 4;3$, range $= 4;0$ to 4;11, 6 males). The remaining 24 children were bilinguals (12 were 3-year-olds: mean age $= 3;5$, range $= 3;0$ to 3;10, 5 males; 12 were 4-year-olds: M age $= 4;5$, range $= 4;1$ to 4;11, 6 males). There were 3 other children (1 male and 2 female; 2 monolinguals and 1 bilingual) who either insisted on hiding the toy themselves or were distracted by outside noises, and so their data were dropped from the analyses.

A language questionnaire was sent to the parents via the school that asked for information about the language first acquired by the child, the language used by the parents and caregivers, and the amount of time (average percentage of exposure per week) the child was exposed to each language. Children were determined to be bilingual if they had at least 30% exposure to one of two languages weekly. The 24 bilingual children in the study were reported to have regular exposure to another language besides English since birth, such as Spanish ($n = 6$), Mandarin ($n = 7$), French ($n = 4$), Portuguese, Russian, Dutch, Hungarian, Korean, Greek, and Tagalog ($n = 1$ per language), mainly either from parents or a nanny.

All the children were recruited from the same university lab school and lived in Palo Alto and its neighboring areas. Most families were middle-to-upper class. To verify that the monolingual and bilingual children were drawn from the same socioeconomic status (SES) population, we followed the procedure reported by Westenberg, Siebelink, Warmenhoven, and Treffers (1999), Furth et al. (2000), Buck, Msall, Schisterman, Lyon, and Rogers (2000), Rathore et al. (2006), and Ward (2008) and used the participants' residential addresses to obtain an estimated value of each family's

dwelling from an Internet Web site that provides real estate information such as home prices and home values (www.zillow.com). Using this method, we then calculated the median, mean, and variance property valuation for the monolingual and bilingual children. The ratio of the median property valuation between monolingual and bilingual children was 1:1.09, and Mann-Whitney U-test confirmed that these two groups of children came from the same SES background, $Z = .023$, $p = .98$. Analyses done on the mean values and the variances of the two groups further confirmed that these monolingual and bilingual children were drawn from the same SES population. The ratio of the means was 1:1.02, and t-tests showed no significant differences between these two groups of children based on the estimated property valuations, $t(42) = 0.12$, $p = .91$. The ratio of the variances was 1:1.00, and the Levene test of equality in variances confirmed that the two group variances of estimated property valuations did not differ significantly from each other, $F(1,21) = 0.50$, $p = .48$.

Materials

The materials used in the study consisted of two identical opaque boxes (17.5 cm $\times$ 20 cm $\times$ 9 cm), a cardboard screen (50 cm $\times$ 116.5 cm), a bag of toys, and a chute-like structure (21 cm $\times$ 21 cm $\times$ 25 cm). The positions of the boxes, the experimenter, and the participants were similar to those described in Povinelli et al. (1997; see Figure 1). The boxes had lids that could be easily lifted off to hide or retrieve objects inside. In addition, to eliminate any sound that might be generated from the hiding process and thus give a clue to the participant where the toy could be hidden, a layer of nonskid cushion was taped to the entire inner bottom of each box. The chute-like structure was made from an opaque box with a sloping chute sticking out on the top and an opening on a side for conveying things out to the floor. The inside of the chute consisted of a xylophone that made sounds as the toy slid through the chute. The bag of toys consisted of nine items that were chosen to fit the chute's opening and to have sufficient variety to maintain the child's interest.

Procedure

There were four experimental conditions: body centered with point, body biased with point, body centered with gaze, and body biased with gaze (see Figure 2). In all trials, the boxes, the participant's location, and the experimenter's distance from the boxes remained in the same locations as described in Figure 1. In addition, a small dot was marked on the center of the table along the position of the screen to serve as a neutral location on which the experimenter fixed her gaze in both the point trials.
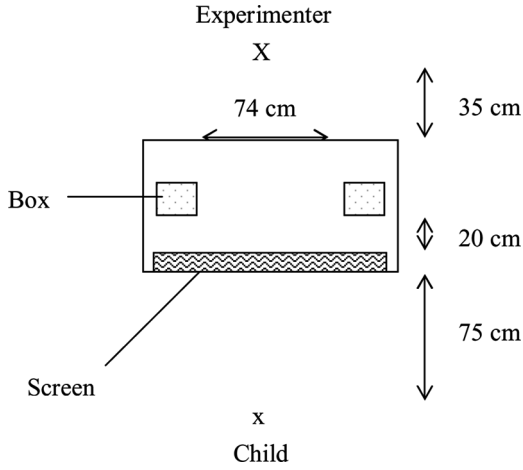
Experimenter

X

74 cm   35 cm

Box

20 cm

Screen

75 cm

x

Child

FIGURE 1   General set-up of the task.

Centered-Point   Biased-Point

X   X

Centered-Gaze   Biased-Gaze

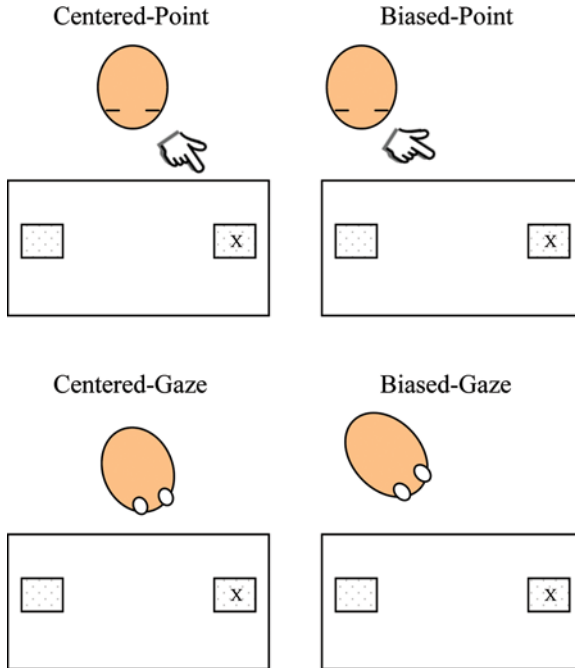X   X

FIGURE 2   A schematic illustration of the task for each condition.

Body-centered point condition.   In the body-centered point condition, the experimenter was positioned equidistant from the two boxes, extended part of her arm, and pointed to the baited box while fixing her gaze on the marked dot. The point was made so that the tip of her finger was approximately 25 cm from the correct box and 62 cm from the incorrect box.

Body-centered gaze condition.   In the body-centered gaze condition, the position of the experimenter was exactly the same as in the body-centered point condition, except that instead of pointing with her finger, the experimenter turned her head to look along the line of gaze toward the correct box and kept both of her hands either behind her back or in her lap.

Body-biased point condition.   In the body-biased point condition, the gesture was similar to the body-centered point condition, except that the experimenter sat directly behind the empty box and gestured to the farther but correct box. The point was made so that the tip of her finger was approximately equidistant from the two boxes.

Body-biased gaze condition.   In the body-biased gaze condition, the gesture was the same as the body-centered gaze condition, and the experimenter position was the same as the body-biased point condition.

Each session consisted of eight trials. There were two trials from each condition counterbalanced for side. There were four different orders. Each order began with a trial from a different condition in a predetermined randomized schedule. The orders were randomly assigned to each participant in a way that was balanced across gender, age, and language groups.

Warm-Up

During the warm-up period, the experimenter explained to the child that they were going to play a "hide-and-find-it" game. She asked the child to pick a toy from the bag, hid the toy in one of the boxes while the child watched, and then asked the child to locate the missing toy. When the child located the toy, the experimenter explained that the toy could be placed into the chute and would make sounds as it slid through the chute. After one trial of warm-up, the experimenter proceeded with the actual testing.

Testing

During the actual testing, each child received eight trials within a single session. The screen was always up before the start of every trial. The experimenter asked the child to pick a toy from the bag. While seated behind the screen equidistant from the two boxes, she hid the toy carefully to minimize

any sound or movement that might indicate the correct location of the toy. The experimenter glanced at a mirror located at one side of the room a few times to check that the child did not peek and could not see her hiding actions. She positioned her chair according to the trial type (e.g., stayed seated in the center if the trial was a body-centered trial, but moved her chair inconspicuously behind the incorrect box if the trial was a body-biased trial). She then checked to make sure that the child was looking in her direction before removing the screen and asked the child, "Can you find it now?" (or, "Can you find it for me now?") and pointed to or looked at the correct box while she spoke. If the child was not looking in the experimenter's direction before removing the screen, she would call out the child's name to get his or her attention before proceeding. She held her gestures while the child made a choice. The decision rule for the children having made a choice was when they moved a lid on either of the boxes. Pilot trials revealed that most children, upon having chosen the empty box, naturally approached the second (correct) box to retrieve the toy without prompting. So, to standardize the procedure, all children were encouraged to retrieve the toy from the second box if the initial box was an empty one (e.g., "Where is the toy?"). After the toy was retrieved, the child was praised and encouraged to slide the toy into the chute. This procedure was repeated for the remaining trials.

Results and Discussion

Based on Povinelli et al.'s (1997) findings, we expected that 3- and 4-year-old children would do well in conditions where pointing was used and less well in the condition where gaze was used and conflicted with body-distal information. We predicted that children's language status would interact with the experimental condition: Bilingual 3- and 4-year-olds would perform better than monolingual children only in the most challenging condition (when the subtler gesture gaze conflicted with body-distal information). In each condition, children were given a score of 0 to 2 that reflected the number of times they successfully selected the correct box. Table 1 presents the average total number of times (out of two) a child chose the correct box in the different conditions by language status and age.

Preliminary analyses revealed no effect of order or gender, so they were combined in subsequent analyses. There was no significant correlation between SES and performance in any of the experimental conditions, $r = -.02$ to $.10$; all p values were greater than .53, except the body-centered point condition, where there was a near significant negative relationship between SES and performance, $r = -.30$, $p < .10$ (which is hard to interpret).

A 2 (type of cue: point vs. gaze) $\times$ 2 (body position: centered vs. biased) $\times$ 2 (language status: monolingual vs. bilingual) $\times$ 2 (age: 3-year-old

TABLE 1

Mean Number of Correct Responses (Out of Two; With Standard Deviations in Parentheses) of 3- and 4-year-olds From Study 1, 5-year-olds From Study 2, and 2-year-olds From Study 3 by Condition and Language Status

		Point		Gaze	
		Body centered	*Body biased*	*Body centered*	*Body biased*
			Study 1		
Monolingual	3-year-old	1.75 (0.62)	1.58 (0.51)	1.58 (0.51)	0.83 (0.58)
	4-year-old	1.42 (0.67)	1.67 (0.49)	1.58 (0.51)	1.33 (0.78)
Bilingual	3-year-old	1.67 (0.49)	1.58 (0.51)	1.42 (0.79)	1.58 (0.51)
	4-year-old	1.75 (0.45)	1.67 (0.49)	1.42 (0.67)	1.58 (0.51)
			Study 2		
Monolingual	5-year-old	1.75 (0.45)	1.50 (0.67)	1.50 (0.79)	1.42 (0.79)
			Study 3		
Monolingual	2-year-old	1.31 (0.60)	1.50 (0.63)	1.13 (0.62)	0.88 (0.62)
Bilingual	2-year-old	1.31 (0.60)	1.75 (0.58)	1.38 (0.72)	1.38 (0.62)

vs. 4-year-old) repeated-measures analysis of variance (ANOVA) was conducted. There was a significant main effect of type of cue, $F(1,44) = 7.25$, $p = .01$. Children performed better when the cue provided was a point rather than gaze, suggesting that gaze is a more subtle communicative gesture than the point. There was a near significant interaction effect between body position and language status, $F(1,44) = 2.37$, $p = .076$. Monolingual and bilingual children were equally likely to find the correct box when the experimenter provided a cue while seated centered between the two boxes, but relatively more bilingual than monolingual children found the correct box when the experimenter sat in the biased position. However, as predicted, these effects were modulated by a significant three-way interaction effect between type of cue, body position, and language status, $F(1,44) = 6.84$, $p = .012$. Planned comparison t-tests between monolingual and bilingual children revealed that bilingual children performed better in the body-biased gaze condition than monolingual children, $t(46) = 2.80$, $p = .008$. There were no other significant differences between monolingual and bilingual children (all $ps > .36$).

We also compared performance against chance. Monolingual children significantly chose the correct box above chance in all conditions except the body-biased gaze condition (3-year-olds: $t(11) = 1.00$, $p = .17$; 4-year-olds: $t(11) = 1.48$, $p = .083$). In contrast, both 3- and 4-year-old bilinguals were significantly better than chance in choosing the correct box across all conditions, including the most challenging body-biased gaze condition (all $ps < .05$).

Although our study was not designed to measure fine-grained reaction time, we coded offline the time children took to respond to the request by

two independent coders using a stopwatch (interrater reliability $r = .93$, $p < .001$). This was done by calculating the time from when the experimenter had finished speaking to the time when the child touched either of the boxes. The reaction time coding was done only for the two trials in the body-biased gaze condition—the only condition where monolingual and bilingual children's performance differed. For the correct trials, the video coding of the children indicated no significant effect of language status on response time for either the first and second body-biased gaze trials, $F(1,21) = 0.062$, $p = .81$, $F(1,16) = 1.00$, $p = .33$, respectively. There was also no significant effect of language status on response time for the incorrect trials (all ps $> .72$). Monolingual children were not significantly faster or slower in responding than bilingual children, whether or not they successfully selected the correct box.

In addition, independent raters also coded offline whether the children were looking at the experimenter when the request was made before they made a response. Because of either equipment failure or recording errors, 23.9% of the trials were not codable. Of the remaining codable trials, monolingual children looked at the experimenter before making a decision 85% of the time, and bilingual children did so 84% of the time. Thus, differential attention to the experimenter could not account for the results.

In sum, preschoolers successfully used referential gestures such as pointing and gaze to locate hidden objects, but they found it generally more challenging when the gesture provided was gaze instead of a point. In particular, children found it most challenging when gaze was given together with contradictory body-distal information (the experimenter was seated behind one box but looked at the other box). As predicted, bilingual children fared better at reading the subtler pragmatic referential cue (i.e., eye gaze). While monolingual children were less able to use eye gaze to interpret a speaker's referential intent, bilingual children successfully used this subtler yet useful information. Study 2 extends this procedure to 5-year-old monolinguals to examine whether monolingual children master this task by 5 years of age.

STUDY 2

Method

Participants

Twelve 5-year-old English monolingual children from a preschool in Palo Alto participated in this study (M age $= 5;2$, range $= 5;0$ to $5;4$, 6 males). All the children were recruited from the same university lab school and lived in Palo Alto and its neighboring areas. Most families were middle-to-upper

class. Using the same method as in Study 1, we found no differences in the mean, median, or variance of property valuation between monolingual children from this study and bilingual children from Study 1.

Materials, Procedure, Warm-Up, and Testing

The same materials, procedure, warm-up, and testing were used as in Study 1.

Results and Discussion

In each condition, children were given a score of 0 to 2 that reflected the number of times they successfully selected the correct box (see Table 1 for the average total number of times children chose the correct box in different conditions). Preliminary analyses revealed no effect of order or gender, so they were combined in subsequent analyses. There was also no significant correlation between SES and performance in any of the experimental conditions, $r = -.23$ to .19, all $ps > .19$.

A 2 (type of cue: point vs. gaze) $\times$ 2 (body position: centered vs. biased) $\times$ 2 (language status: monolingual vs. bilingual) repeated-measures ANOVA was conducted comparing the performance of monolingual 5-year-olds in this study and bilingual 3- and 4-year-olds in Study 1. No significant effects were found (all p values were greater than .14). Monolingual 5-year-olds performed much like bilingual 3- and 4-year-olds across conditions. One-sample one-tailed t-tests confirmed that monolingual 5-year-olds were above chance in choosing the correct box across all conditions (all $ps < .05$). Thus, by 5 years of age, monolingual children had mastered this task.

Independent raters also coded offline whether children were looking at the experimenter when the request was made before they made a response. Of all the trials across all children, monolingual children looked at the experimenter before making a decision 89% of the time, comparable to the bilingual children from Study 1 who looked at the experimenter before making a decision 84% of the time.

In conclusion, 5-year-old monolinguals were just as able as 3- and 4-year-old bilinguals to use referential gestures such as pointing and gaze to locate hidden objects, even in the face of conflicting body-distal information. The other side of the coin here is that 3- and 4-year-old bilingual children were performing as well as 5-year-old monolingual children in all conditions. It remains a question, however, whether bilinguals' advantage in using referential cues is present even in children as young as 2 years old. Two-year-old bilingual children have been found to successfully match their language choice with both parents and unfamiliar speakers (Comeau

et al., 2003; Genesee, Boivin, & Nicoladis, 1996; Nicoladis & Genesee, 1996; Tare & Gelman, in press). In addition, 2-year-old bilinguals are able to identify their language choice as a cause of communication breakdown (i.e., when they used a language that their interlocutor did not understand) by switching languages to match that of the interlocutor and avoiding this strategy when the breakdown was caused by other factors (e.g., inaudible utterances; Comeau et al., 2007). Therefore, it is possible that bilingual children's advantage in using nonverbal cues to locate a target of interest may emerge in 2-year-old children. We address this question in Study 3.

STUDY 3

Method

Participants

Thirty-two 2-year-old English monolingual and bilingual children were brought in by their caregivers to participate in this study. Sixteen children were monolinguals (M age = 2;9, range = 2;6 to 2;11, 7 males) and 16 were bilinguals (M age = 2;9, range = 2;7 to 2;11, 9 males). There were 7 other children who either showed a side bias (consistently chose the same box for all trials; 2 males and 2 females; 3 monolinguals, 1 bilingual), or did not know where to look (1 male and 2 females; 1 monolingual, 2 bilinguals), and their data were dropped from the analyses. The language questionnaire sent to parents and the questionnaire coding were the same as used in Study 1. The 16 bilingual children in the study were reported to have regular exposure to another language besides English from birth, such as Spanish ($n = 7$), Farsi ($n = 2$), Mandarin, Korean, Tibetan, Japanese, Russian, Hungarian, Swiss-German ($n = 1$ per language), mainly either from parents or a nanny.

All the children recruited lived in Palo Alto and its neighboring areas. Most families were middle-to-upper class. Using the same method as in Study 1, we again found no differences in the mean, median, or variance of property valuation between monolingual children and bilingual children in this study.

Materials and Procedure

The same materials and procedure were used as in Study 1, except that the cardboard screen was shorter (38 cm × 116.5 cm). Pilot data revealed that some younger children were anxious if the screen covered the experimenter totally and they could not see at least the head of the experimenter (they seemed to want the reassurance that the experimenter was still there behind the screen).

Warm-Up and Testing

The warm-up procedure was the same as in Study 1, except that two warm-up trials (with a toy hidden in one of each box) were used instead. After two trials of warm-up, the experimenter proceeded with the actual testing as in Study 1.

Results and Discussion

We asked whether bilingual 2-year-olds are better able to use referential gestures than monolinguals in this hiding game. In each condition, children were given a score of 0 to 2 that reflected the number of times they successfully selected the correct box (see Table 1). Preliminary analyses revealed no effect of order or gender, so they were combined in subsequent analyses. There was also no significant correlation between SES and performance in any of the experimental conditions, $r = -.078$ to .24, all $ps > .20$.

A 2 (type of cue: point vs. gaze) $\times$ 2 (body position: centered vs. biased) $\times$ 2 (language status: monolingual vs. bilingual) repeated-measures ANOVA was conducted. There was a significant main effect of cue, $F(1,30) = 4.48$, $p = .043$. Children performed better when the cue provided was a point rather than gaze, suggesting again that gaze is a more subtle communicative gesture than the point. There was also a two-way significant interaction effect between type of cue and body position, $F(1,30) = 5.42$, $p = .027$.

Post-hoc paired-sample t-tests between the trials revealed two significant effects. There was a significant difference between the body-biased point versus body-biased gaze conditions, $t(31) = 2.98$, $p = .006$; Bonferroni correction, $p = .013$. When the experimenter sat behind the incorrect box and referenced the farther box, children performed worse when the referential gesture was a gaze rather than a point. There was also a significant difference between body-biased point versus body-centered point conditions, $t(31) = 2.99$, $p = .005$; Bonferroni correction, $p = .013$. Children performed worse when the experimenter pointed to the correct box while sitting behind the incorrect box compared with sitting equidistant from the two boxes. Thus, children found it more challenging when referential cues conflicted with body-distal information, especially if the cue provided was a gaze compared with a point.

There was a significant main effect of language status, with bilingual children outperforming monolingual children, $F(1,30) = 4.91$, $p = .034$. There was no significant interaction between language status and condition. We conducted post-hoc paired-sample t-tests between monolingual and bilingual children for each condition. There was a near significant difference in performance in the body-biased gaze condition only, $t(31) = 2.14$, $p = .03$; Bonferroni correction, $p = .013$ (all other p values were greater than .25).

Two-year-old bilinguals performed better than monolinguals only in the most challenging task—the body-biased gaze condition.

As in Study 1, we coded offline the time children took to respond to the request by two independent coders using a stopwatch (interrater reliability, $r = .99$, $p < .001$). The reaction time coding was done only for the two trials in the body-biased gaze condition—the only condition where monolingual and bilingual children's performance differed. For the correct trials, the video coding of the children indicated no significant effect of language status on response time for either the first and second body-biased gaze trials, $F(1,14) = 1.65$, $p = .22$, $F(1,20) = .019$, $p = .89$, respectively. There was also no significant effect of language status on response time for the incorrect trials (all $ps > .47$). Monolingual children were not significantly faster or slower in responding than bilingual children, whether or not they successfully selected the correct box.

We also compared performance against chance. One-sample one-tailed t-tests revealed that 2-year-old monolingual children performed above chance in the point trials but at chance in the gaze trials (centered–point: $t(15) = 2.08$, $p = .028$; biased–point: $t(15) = 3.16$, $p = .003$; both centered–gaze and biased–gaze: $t(15) = 0.81$, $p = .22$). This suggests that 2-year-old monolingual children had difficulty in using the experimenter's gaze but not her point to locate the correct box, regardless of where the experimenter was seated relative to the boxes. In contrast, bilinguals were significantly better than chance in choosing the correct box across all conditions, $t(15)$ ranges from 2.08 to 5.20, $ps < .03$.

Children were coded offline whether they were looking at the experimenter when the request was made before they made a response. Twelve percent of the trials were not codable, either due to equipment failure or recording errors. Of the codable trials, monolingual children looked at the experimenter before making a decision 86% of the time, and bilingual children did so 91% of the time. This difference is not significant, $t(25) = -0.86$, $p = .40$.

In sum, 2-year-old children found it generally more challenging when the gesture provided was gaze instead of a point and most challenging when gaze was provided with contradictory body-distal information, such as the experimenter seated behind one box but looked at the other box. This is consistent with previous findings that pointing is a stronger cue to a speaker's referential intent than eye gaze. Most importantly, we found that bilingual 2-year-olds were better than monolingual 2-year-olds at using referential gestures to understand a speaker's intent, especially the subtler and less direct gesture (i.e., eye gaze in a body-biased position). Thus, these results suggest that bilingualism facilitates the development of the understanding and use of referential gestures in children as young as 2 years old.

GENERAL DISCUSSION

The results of these studies provide evidence that bilingualism improves young children's ability to infer a speaker's referential intent from nonverbal referential gestures. We explored preschoolers' use of pointing and gaze in the context of a hiding game where children had to find a toy hidden in one of two boxes. The experimenter either pointed to or gazed at the correct box while either seated centered between the two boxes or behind the incorrect box. This latter "biased" position was more challenging, especially when gaze was the referential cue. Under this challenging context, monolingual children were able to use the more reliable communicative cue, pointing, to interpret a speaker's referential intent but less able to do so when the cue was the subtler one (gaze). On the other hand, bilingual children were able to use the subtler cue (gaze) to understand a speaker's referential intent even when it was provided under the more challenging "biased" context. This more effective use of nonverbal referential gestures in bilingual children was striking in that advantages were found in bilingual children as young as 2 years old and bilingual 3- and 4-year-olds performed as well as monolingual 5-year-olds.

We have argued that the experience of growing up bilingual improved children's use of pragmatic and communicative cues. But another possibility is that the bilingual advantage we found results from bilingual children's relatively advanced inhibitory control. Bilingual children may have been better at inhibiting their response toward the incorrect box in the hiding task. In fact, there is substantial evidence that bilingual children have an advantage in tasks that require high levels of control (e.g., Bialystok, 1999; Bialystok & Codd, 1997; Bialystok & Majumder, 1998; Martin-Rhee & Bialystok, 2008). Bilingual children are also better at disambiguating and resolving conflicting information (Bialystok & Martin, 2004; Bialystok & Shapero, 2005). Even bilingual infants, as young as 7 months old, show an early gain in cognitive flexibility and control (Kovács & Mehler, 2009).

Thus, one possible explanation of our results is that inhibitory control is recruited to solve the tasks in our study, such that children have to restrain themselves from responding to the possibly more salient body cue (experimenter sitting directly behind an empty box) and instead use the experimenter's eye-gaze cue to correctly locate the hidden object in the other box. So children who have better inhibitory control would be more successful in retrieving the hidden object than those who do not. One prediction from this analysis is that bilingual children should be faster when deciding which is the correct box to reach for; that is, they should have shorter response times than monolingual children especially in the body-biased gaze trials (see Martin-Rhee & Bialystok, 2008, where they found that bilingual

children have shorter reaction times on correct trials). Our studies were not designed to test this hypothesis. However, offline video coding of the 2- to 4-year-old children in our studies did not reveal any significant effect of language status on response time.

Whether or not inhibitory control is recruited to solve the tasks in our study, it remains plausible that the experience of growing up bilingual improves children's sensitivity to referential gestures. In particular, we suggest that such improvement stems from bilingual children's *self-generated* efforts to communicate effectively. This emphasis on the role that self-generated efforts play in promoting development differs from the more usual emphasis on the role of experience and input. The influence of experience on children's linguistic and cognitive development is well documented. For example, there is a substantial relationship between the quantity, lexical richness, and sentence complexity of mothers' speech to their children and the vocabulary and syntactic growth and linguistic processing in young children (e.g., Hart & Risley, 1995; Hoff, 2003; Hurtado, Marchman, & Fernald, 2008; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002; Pan, Rowe, Singer, & Snow, 2005). In addition, children whose parents more frequently use and explain mental-state terms in conversations with them develop an understanding of theory of mind at an earlier age (e.g., Garner, Jones, Gaddy, & Rennie, 1997; Ruffman, Slade, & Crowe, 2002; Wellman, 1990; Wellman, Cross, & Watson, 2001). Thus, there is little doubt that input can be a critical factor in understanding others and developing language skills.

We would like to emphasize that experience also fosters development in another critical way: skills gained via *self-generated* attempts to cope with challenges that children regularly face. Take, for example, the bilingual advantage in inhibitory control that we mentioned earlier. The proposed mechanism is that to use the appropriate language in the right context, bilingual children often have to, of their own accord, suppress one language to use the other. The regular practice of suppressing interference from one language while communicating in another yields considerable prowess in executive functioning. These advances in inhibitory control skills are gained largely due to bilingual children's own efforts to communicate in the appropriate language.

Similarly, we argue that the advantages we found in bilingual children's use of referential gesture are a result not of differences in input per se but of their self-generated attempts to communicate successfully. We are suggesting that the amount of parental input—for example, parents' use of pointing, eye gaze, or other gestures—may not substantially differ between monolinguals and bilinguals, but rather, bilingual children become more vigilant in trying to avoid communicative breakdown and thereby have more practice in monitoring and assessing a wider range of communicative cues.

We take bilingualism as a way of examining the importance of experience and practice in the development of social and cognitive skills. In particular, we suggest that regular experience with communicative challenges could heighten children's sensitivity to a speaker's communicative intent and foster the understanding and use of communicative cues. We further postulate that rather than input per se, it is children's self-generated efforts to cope with the communicative challenge that has a significant influence on their sociocognitive development. It remains possible that both heightened sensitivity to communicative intent and better inhibitory control contribute to the bilingual children's superior performance in our study. Either way, this self-generated accommodation to the challenges they face facilitates bilingual children's cognitive development.

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