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Who can communicate with whom? Language experience affects infants' evaluation of others as monolingual or multilingual

Casey E. Pitts [a], Kristine H. Onishi [b], Athena Vouloumanos [a,*]

[a] New York University, New York, NY, USA
[b] McGill University, Montreal, QC, Canada

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ABSTRACT

Adults recognize that people can understand more than one language. However, it is unclear whether infants assume other people understand one or multiple languages. We examined whether monolingual and bilingual 20-month-olds expect an unfamiliar person to understand one or more than one language. Two speakers told a listener the location of a hidden object using either the same or two different languages. When different languages were spoken, monolinguals looked longer when the listener searched correctly, bilinguals did not; when the same language was spoken, both groups looked longer for incorrect searches. Infants rely on their prior language experience when evaluating the language abilities of a novel individual. Monolingual infants assume others can understand only one language, although not necessarily the infants' own; bilinguals do not. Infants' assumptions about which community of conventions people belong to may allow them to recognize effective communicative partners and thus opportunities to acquire language, knowledge, and culture.

1. Introduction

As adults, we recognize not only that language is communicative, but also that people have the capacity to understand more than one language. Globally, more people are multilingual than monolingual (Tucker, 1999). How does the understanding that unfamiliar individuals might understand more than one language develop?

Like adults, infants are aware of the communicative function of speech: by 12 months, infants recognize that speech can transfer information from one person to another (Martin, Onishi, & Vouloumanos, 2012; Vouloumanos, Martin, & Onishi, 2014; Vouloumanos, Onishi, & Pogue, 2012). But each language has its own conventions; speakers of the same language generally use the same word to convey the same meaning (Clark, 1996). For example, an English speaker would expect a chair to be labeled "chair," but a French speaker would not. Adults recognize that monolinguals understand only one conventional system, whereas multilinguals understand more than one, and also recognize that individuals who understand the same conventional system are more likely to be able to communicate with each other successfully. Monolingual infants show an understanding of the conventional nature of language, for example, that object labels are shared between individuals, while preferences for particular objects are not (Buresh & Woodward, 2007; Graham, Stock, & Henderson, 2006; Henderson & Graham, 2005; Henderson & Woodward, 2012). However, it is unclear whether infants understand

* Corresponding author at: Department of Psychology, New York University, 6 Washington Place, New York, NY 10003, USA. Tel.: +1 212 998 7937.
E-mail address: athena.vouloumanos@nyu.edu (A. Vouloumanos).

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that people may be multilingual and therefore understand more than one system of conventions.

For infants to understand that different languages follow different conventions, they must be able to distinguish between different languages. Rhythm is one salient linguistic cue that differentiates between languages. From birth, infants can distinguish between languages based on their rhythmic properties. For example, French newborns discriminated between Japanese and English, but did not respond differently to languages within the same rhythmic class (Nazzi, Bertoncini, & Mehler, 1998). Infants' sensitivity to differences between languages increases with age. By 4 months, infants distinguish between languages within their native rhythmic class: Catalan and Spanish monolinguals discriminated between the two rhythmically similar languages (Bosch & Sebastián-Gallés, 1997). Very young infants use various linguistic cues including rhythm to distinguish between different languages.

Children treat people differently based on the language the person speaks. For example, language is used to identify members of social groups; monolingual infants as young as 6 months looked longer at speakers of their native language than at speakers of a foreign language, while 10-month-olds preferentially accepted toys from native-language speakers (Kinzler, Dupoux, & Spelke, 2007). Young children also use language as a cue to other people's information states. For example, 3-year-olds expected a bilingual observer to have access to different information than a monolingual observer (i.e., to understand a label used for a novel object; Diesendruck, 2005). Children can also update their own understanding of–and modify their response to–a particular social partner based on the partner's language use. With no initial information about an unfamiliar interlocutor's language, 2-year-old bilingual children made rapid adjustments to the stranger's language proficiency, increasing their use of the language spoken by the stranger (Genesee, Boivin, & Nicoladis, 1996). While young children can use an unfamiliar person's language to gather information and make inferences about them, previous research has not investigated whether infants have assumptions about whether people can understand only one, or more than one, language.

To examine whether 20-month-old infants expect an unfamiliar person to understand one or more than one language, we tested infants in a third-party scenario. Infants saw an actor (the Listener), alone, playing with a ball. Next, a second actor (Speaker 1) was introduced, alone, and hid the ball in one of two locations. Then, with the two actors present, Speaker 1 told the Listener the location of the ball in one of two languages. The Listener then reached for the correct location, establishing that she understood this first language. In the next scene, the Listener, again alone, played with the ball. Next, a third actor (Speaker 2) was introduced, alone, and hid the ball in one of two new locations. Then, with Speaker 2 and the Listener present, Speaker 2 told the Listener the location of the ball, using the same language as or a different language from Speaker 1. The different language was rhythmically distinct from the first language. The Listener then reached correctly or incorrectly. We examined infants' looking time to the Listener's reach. If infants recognize that Speakers 1 and 2 used the same language, they should look longer when the Listener responds incorrectly to Speaker 2. In contrast, if infants recognize that two different languages have been used, and assume an unfamiliar person can understand only one language, they would not look longer when the Listener responds incorrectly to Speaker 2. If infants assume the Listener understands the specific language used by Speaker 2, they would look longer when the Listener responds incorrectly. However, if infants assume the Listener understands more than one language, but are unsure of which ones, they would have no prediction about the Listener's ability to understand Speaker 2, and thus look equally whether the Listener responds correctly or incorrectly.

Infants' assumptions about others' language comprehension abilities may be influenced by their own language experience. In order to examine this possibility, we tested two groups of infants: monolinguals and bilinguals, two groups with different linguistic experiences who may have different expectations about how other people use language (Diesendruck, 2005; Genesee et al., 1996; Petitto et al., 2001). We predicted that monolingual and bilingual infants would differ in whether they expect an unfamiliar person to understand more than one language.

2. Method

2.1. Participants

Data from 64 infants were included. Thirty-two full term monolingual infants (M_{age} = 19 months, 22 days; range 18,28 to 20,22; 20 females) and 32 full term bilingual infants (M_{age} = 19 months, 18 days; range 18,20 to 20,24; 13 females) participated. Half the infants from each Language Background group (Monolingual, Bilingual) were assigned to the Same and half to the Different Language conditions.

Monolingual infants were exposed to at least 90% English. Monolinguals were randomly assigned to the Same or Different Language conditions, and within language condition were randomly assigned to hear English or Spanish (Same Language condition) or English first or English second (Different Language condition). Thus half the monolinguals heard a familiar and half heard an unfamiliar language during the Language Evaluation test trial. Bilingual infants were exposed to at least 30% of two languages from two different rhythmic classes. Of these, 11 had dominant exposure to a stress-timed language with a syllable-timed nondominant language (8 English–French, 2 English–Spanish, 1 Arabic–French); 14 had dominant exposure to a syllable-timed language with a stress-timed nondominant language (13 French–English, 1 French–Arabic); and 7 had equal exposure to a stress-timed and a syllable-timed language (4 English–French, 2 English–Spanish, and 1 Arabic–French). English-French bilinguals were randomly assigned to the Same or Different language conditions, and within language condition were assigned randomly to hear English or French (Same Language condition) or English first or English second (Different Language condition). The remaining bilinguals heard either

English or French plus another language and were assigned to the Same language condition and heard English or French (whichever was familiar). Thus all bilinguals heard familiar language(s) during the experiment.

Data from an additional 29 infants were excluded from analysis due to fussiness or crying (9), not looking when relevant actions were presented (3), parental interference (3), and experimenter or computer error (14).

2.2. Stimuli

Stimuli included a silver ball, 8.5 cm in diameter, and four novel cups designed to be equally visually complex. One cup was black with a red circle, one was blue with white vertical stripes, one was green with a yellow diagonal stripe and a yellow stripe along the bottom, and one was pink with white diagonal stripes and orange squares. Two cups and the ball were in view of the infants and in view and within reach of the actor(s) in each scene (except in Test scenes, when the ball was hidden from view).

2.3. Apparatus

Infants sat on a caregiver's lap facing a display box. The back wall contained an opening with two flaps permitting the Listener to be visible or not. The right wall had a large opening covered by a curtain, permitting Speaker 1 to be visible or not, and the left wall had a large opening covered by a curtain, permitting Speaker 2 to be visible or not. A separate curtain hid the display box between trials. Two panels isolated the participant from the rest of the room and a peephole in each panel allowed an observer to code the infant online without seeing the events in the display. Infants' looking time behavior was coded by pressing a button on a video game controller attached to a computer running the Windows-based program Baby (Baillargeon & Barrett, 2005). Both the infant and the events were recorded on video.

2.4. Design and procedure

The experiment was divided into 2 blocks. In the Language Demonstration block, the Listener always responded correctly to Speaker 1's language, which gave infants evidence that the Listener understood Speaker 1's language. In the Language Evaluation block, the Listener either responded correctly or incorrectly to Speaker 2's language allowing us to evaluate whether infants inferred that the Listener understood Speaker 2's language. Speakers were native speakers of the language they produced during the experiment: English, Spanish, or French. Each block had 3 trials: familiarization, pretest, and test (see Fig. 1). Each of the 6 trials consisted of a computer-controlled initial section, in which the actors performed informative actions choreographed to a once-per-second metronome beat, as well as an infant-controlled main section, in which the actors remained still. The end of the trial was signaled by a beep and the curtain was lowered in front of the scene. The trial ended when the infant looked away for 2 consecutive seconds after having looked for at least 2 s in the main section of the trial or when the infant looked for the trial maximum (40 s). The infants' looking times during the main section of the test trial of the Language Evaluation block are reported.

2.4.1. Language Demonstration block

2.4.1.1. Familiarization. When the curtain rose, the Listener was visible through the opening in the back wall. From the infant's perspective, the pink cup was on the right, the green cup on the left, and the ball between them. The listener looked neutrally in the center (2 s), looked at the ball (2 s), looked at the pink cup (2 s), looked at the green cup (2 s), looked at the ball (1 s), grasped the ball with her right hand (1 s), raised it (2 s), grasped it with both hands (1 s), tilted it in her left hand (1 s), grasped the ball with both hands (1 s), tilted it in her right hand (1 s), repeated left and right (4 s), then placed the ball down (1 s) and paused, ending the initial section of the trial. She remained still with her hands resting on the opening in the back wall for the remainder of the trial (main section) until it was ended (see trial-end criteria above).

2.4.1.2. Pretest. When the curtain rose, Speaker 1 was visible on the right side of the display. The Listener was no longer present. Speaker 1 looked at the ball (2 s), grasped (1 s) and raised it (2 s), vocalized "I like the ball" (or Spanish "Me gusta la bola" or French "J'aime la balle"; 3 s), and vocalized "The ball is great" (or Spanish "La bola es genial" or French "La balle est super"; 3 s). She looked at the pink cup (2 s), looked at the green cup (2 s), reached towards the green cup (the one farther from her; 1 s), placed the ball in the green cup (2 s), brought her arm back (1 s), and looked down (1 s), ending the initial section of the trial, then remained still for the remainder of the trial (main section) until it was ended.

2.4.1.3. Test. When the curtain rose, both the Listener and Speaker 1 were present. Speaker 1 told the Listener the location of the ball, using a nonsense word in order to examine infants' abstract understanding of the communication between the Listener and the Speaker, and ensuring the infants were not responding based on their prior understanding of the meaning of a particular word. Specifically, after infants looked at the scene for 2 s, the Listener looked at the central location where the ball had been (2 s), looked at Speaker 1 (2 s), then Speaker 1 vocalized twice "The ball is in the *blicket*" (or Spanish "La bola está en la *ñepa*" or French "La balle est dans le *razeau*"; 8 s). The Listener then looked at (1 s) and reached into the green cup (1 s) while Speaker 1 looked at the Listener's hand. The Listener's hand remained inside the cup and the ball was never shown. Both actors remained still for the remainder of the trial (main section) until it was ended.

2.4.2. Language Evaluation block

2.4.2.1. Familiarization. The Listener, alone, repeated the same actions she had performed in the Familiarization trial of the Language Demonstration block. However, in this block, the cup on the right (which later held the ball) was black for half and blue for half the infants in each of the 4 subgroups created by crossing Language condition by Language Background.

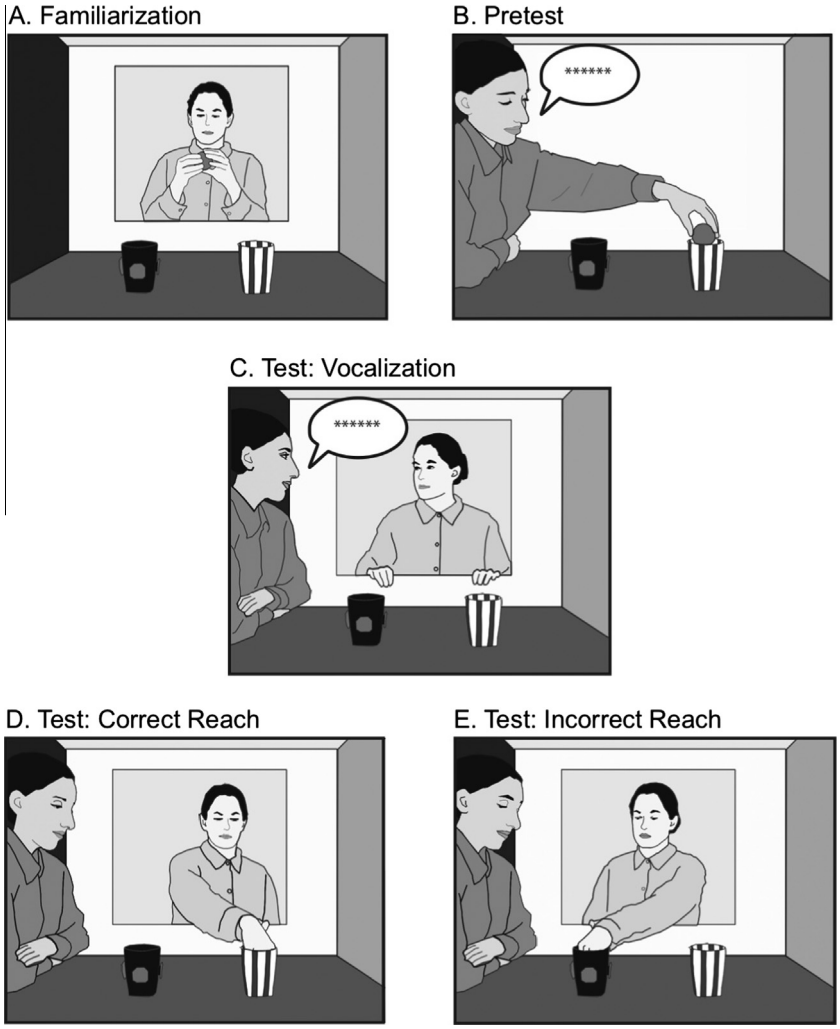

Fig. 1. Procedure. Language Evaluation block. (A) During Familiarization, the Listener played with the ball. (B) During Pretest, Speaker 2 spoke either the same language as Speaker 1 or a different language (if Speaker 1 spoke English, Speaker 2 spoke either Spanish or French, and vice versa) and hid the ball in one of two locations. (C) During Test, Speaker 2 told the Listener the location of the ball using the same language she used in Pretest. The Listener then reached (D) correctly or (E) incorrectly. The cup locations were counterbalanced across infants.

2.4.2.2. Pretest. Speaker 2 was visible on the left side of the display, and performed actions that were the mirror image of Speaker 1's in the first Pretest, hiding the ball in the cup farther from her. In the Same Language condition, Speaker 2 spoke the same language as Speaker 1 (English, Spanish or French). In the Different Language condition, Speaker 2 spoke a different language (from a different rhythmic class) than Speaker 1: when Speaker 1 spoke English, Speaker 2 spoke Spanish or French, and vice versa.

2.4.2.3. Test. Speaker 2 performed the actions from the first Test, but from the left side. In the Different Language condition, Speaker 2 vocalized twice using the same language she had used in Pretest (different from the language of Speaker 1), either in English "The ball is in the *blicket*" or Spanish "La bola está en la *ñepa*" or French "La balle est dans le *razeau*". In the Same Language condition, because the hiding locations were different than in the Language Demonstration block, Speaker 2 had to use a different nonsense word than Speaker 1: "daxel" (instead of "blicket"), "llerra" (instead of "ñepa") or "mapi" (instead of "razeau"). Every infant saw one test trial in the Language Evaluation block. The Listener performed the same actions as in the first Test, except that for half the infants in each Language condition (Same or Different) and Language Background group (Monolingual, Bilingual), the Listener reached correctly, and for the other half, she reached incorrectly.

3. Results

We examined whether 20-month-old infants expect an unfamiliar person to understand one or more than one language, and whether their expectations are modulated by their own language experience. Infants behaved differently depending on their own language background (see Fig. 2). When the speakers used the same language, both

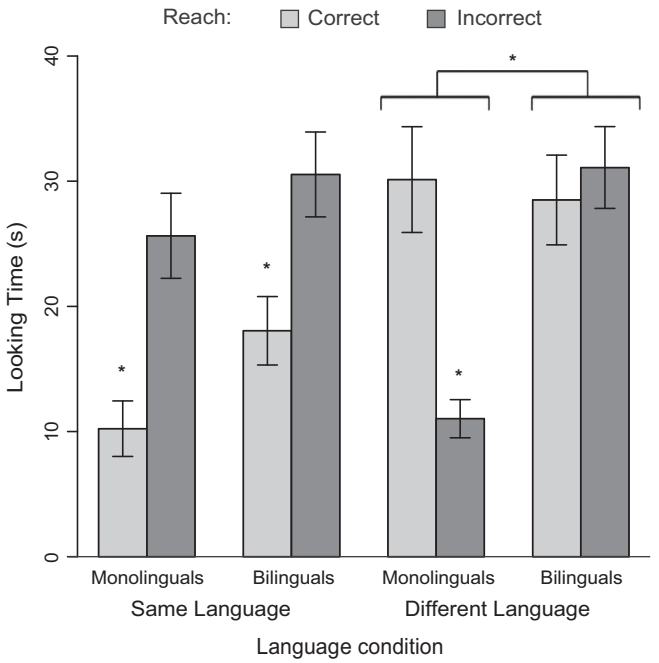

Fig. 2. Mean looking time (in seconds) and standard error of the mean for Correct and Incorrect reaches for Same (left) and Different (right) Language conditions for Monolingual and Bilingual infants. Asterisk (∗) represents $p < .02$.

monolinguals and bilinguals had similar expectations: they inferred that if an unfamiliar person responded correctly to information in one language, that even when the speaker changed, the listener would continue to respond correctly to that same language. When the two speakers used different languages, the monolinguals and bilinguals had different expectations. Monolinguals seemed to expect the unfamiliar person to respond incorrectly to the second language after she had responded correctly to the first language, while bilinguals demonstrated no such expectation.

A 2 (Language condition: Same, Different) by 2 (Language Background group: Monolingual, Bilingual) by 2 (Reach: Correct, Incorrect) factorial analysis of variance (ANOVA) showed a reliable 3-way interaction, $F_{interaction}$ (1, 56) = 7.66, $p = .008$, $\eta^2 = .07$. Additional effects which were qualified by the 3-way interaction included: a main effect of Language Background, $F_{language\ background}$ (1, 56) = 12.28, $p < .001$, $\eta^2 = .11$, as bilinguals looked longer than monolinguals overall, as well as interactions of Reach (Correct, Incorrect) with Language condition, $F_{interaction}$ (1,56) = 24.94, $p < .001$, $\eta^2 = .23$ (due to shorter looking to Correct than Incorrect reaches in the Same Language condition), and with Language Background, $F_{interaction}$ (1,56) = 4.45, $p = .039$, $\eta^2 = .04$ (due to relatively longer looking by bilinguals to Incorrect reaches).

To better understand the 3-way interaction, we examined the Same and Different Language conditions separately. When the two speakers used the same language (Same Language condition), infants looked longer when the Listener reached incorrectly, $M_{incorrect} = 28.1$ s, $SE = 2.4$, than correctly, $M_{correct} = 14.1$ s, $SE = 2.0$, supported by a main effect of Reach, F_{reach} (1,28) = 21.98, $p < .001$, $\eta^2 = .40$, but no interaction with Language Background group, $F_{interaction}$ (1,28) < 1, in a 2 (Language Background: Monolingual, Bilingual) by 2 (Reach: Correct, Incorrect) ANOVA. Both monolinguals, $M_{incorrect} = 25.6$ s, $SE = 3.4$, $M_{correct} = 10.2$ s, $SE = 2.2$, F_{reach} (1, 14) = 14.43, $p = .002$, $r = .71$, and bilinguals, $M_{incorrect} = 30.5$ s, $SE = 3.4$, $M_{correct} = 18.1$ s, $SE = 2.7$, F_{reach} (1, 14) = 8.23, $p = .012$, $r = .61$, looked longer when the Listener reached incorrectly, consistent with monolinguals and bilinguals having similar expectations. Again, there was a main effect of Language Background, $F_{language\ background}$ (1, 28) = 4.57, $p = .041$, $\eta^2 = .08$, as bilinguals looked longer than monolinguals overall.

When the two speakers used different languages (Different language condition), infants' expectations varied with their language background, $F_{interaction}$ (1, 28) = 10.77, $p = .003$, $\eta^2 = .20$. Monolinguals looked longer when the Listener reached correctly, $M_{correct} = 30.1$ s, $SE = 4.2$, than incorrectly, $M_{incorrect} = 11.0$ s, $SE = 1.5$, F_{reach} (1, 14) = 18.08, $p < .001$; they seemed to expect the Listener not to understand the second language and looked longer when she reached correctly. Bilinguals, in contrast, looked about equally whether the Listener reached correctly, $M_{correct} = 28.5$ s, $SE = 3.6$, or not, $M_{incorrect} = 31.1$ s, $SE = 3.3$, F_{reach} (1, 14) < 1, consistent with having no expectation about whether the Listener would understand the second language or not[1]. Additional effects which were qualified

[1] We further examined whether testing bilingual infants in their dominant (more familiar) language influenced their looking time when Speakers 1 and 2 used different languages. In the original sample, 6 bilingual infants met that criterion. We collected data from an additional 10 infants for a total sample of 16 infants, 8 who saw the Correct reach and 8 the Incorrect reach. Infants looked equally at the Correct, $M = 24.8$ s, $SE = 3.6$, and Incorrect, $M = 22.6$ s, $SE = 3.8$, reaches even when Speaker 2 spoke the infants' dominant language, $F(1,14) < 1$.

Table 1
Looking time means (in seconds) and standard errors for correct and incorrect reaches for same and different languages for monolinguals and bilinguals based on the specific test language used in the language evaluation block.

Language Evaluation block	M	SE	M	SE	M	SE	M	SE
	Same Language				Different Language			
Monolinguals								
Stress-timed test	11.7	4.2	23.0	5.2	28.6	7.4	11.8	2.3
Syllable-timed test	8.8	1.9	28.3	4.7	31.6	5.3	10.2	2.2
Bilinguals								
Stress-timed test	18.4	3.4	25.8	4.8	31.5	4.9	26.7	4.1
Syllable-timed test	17.7	4.8	35.3	4.0	25.6	5.5	35.5	4.5

by the 2-way interaction were main effects of Reach, F_{reach} $(1,28) = 6.24$, $p = .019$, $\eta^2 = .12$, and Language Background, $F_{language\ background}$ $(1,28) = 7.78$, $p = .009$, $\eta^2 = .15$, both driven by the shorter looking for Incorrect reaches by the Monolinguals only.

Half the infants from each language background heard Speaker 2 speak a stress-timed language (English), half the rhythmically distinct syllable-timed language (French or Spanish) during the Language Evaluation Test. To examine whether infants' looking times for correct and incorrect reaches varied based on the specific test language, we conducted follow-up analyses. Sample sizes were too small (n = 4) for inferential statistics within stress- and syllable-timed language groups, however, in every condition, responses to Correct and Incorrect reaches were similar for stress-timed and syllable-timed languages (see Table 1) and other inferential statistics are consistent with no effect of specific test language. Specifically, in the Same Language condition there were no main effects of or interactions with test language in 2 (Test Language: Stress-timed, Syllable-timed) by 2 (Reach: Correct, Incorrect) ANOVAs, for either monolinguals Fs < 1, ps > .35, or bilinguals Fs < 1.4, ps > .25. Only Reach was significant for both groups $F_{monolinguals}$ $(1,12) = 13.42$, $p = .003$, $\eta^2 = .51$, $F_{\text{bilinguals}}$ $(1,12) = 8.50$, $p = .013$, $\eta^2 = .37$. Critically, for the monolinguals, the familiarity of the language did not matter. Whether the test language was stress-timed (and thus familiar) or syllable-timed (and thus unfamiliar), infants looked longer when the Listener reached incorrectly than correctly. Similarly, bilinguals also looked longer when the Listener reached incorrectly than correctly, for both stress- and syllable-timed languages. In the Different Language condition, there were no main effects of or interactions with test language in 2 (Test Language: Stress-timed, Syllable-timed) by 2 (Reach: Correct, Incorrect) ANOVAs, for either monolinguals Fs < 1, ps > .64, or bilinguals Fs < 2.4, ps > .14. Reach was only significant for monolinguals, $F_{monolinguals}$ $(1,12) = 15.82$, $p = .002$, $\eta^2 = .56$. Monolinguals looked longer when the Listener reached correctly than incorrectly, for both stress- and syllable-timed languages. Bilinguals looked similarly for Incorrect and Correct reaches for both stress- and syllable-timed languages.

To ensure infants were generally equally attentive during the experiment we analyzed the sum of looking times for the 5 trials prior to the Language Evaluation Test. A 2 (Language condition) by 2 (Language Background) by 2 (Reach) factorial ANOVA showed only a 2-way interaction between Language condition and Reach, $F_{interaction}$ $(1,56) = 4.00$, $p = .05$, $\eta^2 = .06$, and no reliable 3-way interaction, $F_{interaction}$ $(1,56) = 1.85$, $p = .18$, suggesting that the main pattern of results cannot be explained by differences in infants' general looking behavior.

4. Discussion

Infants expected speech to convey information from the Speaker to the Listener (about the location of a ball). Furthermore, infants responded differently to correct and incorrect reaches when Speakers used the same language or different languages. The pattern of results was consistent with understanding that when both Speakers used the same language they shared an information system with the Listener; however when Speakers used different languages expectations depended on infants' language background (monolingual or bilingual). Crucially for our question, whether infants expected an unfamiliar person to be monolingual or multilingual varied with the infants' own language background. After the Listener gave evidence of understanding one language (by searching for the ball in the correct location during the Language Demonstration block), both monolingual and bilingual infants looked longer when the Listener reached incorrectly after receiving information from a second Speaker using this same language. However, only monolingual infants looked longer when the Listener reached correctly after being provided with information in two different languages, while bilingual infants looked equally at both outcomes. Twenty-month-old monolingual infants assumed that an unfamiliar person would understand only one language, but bilingual infants did not. Previous studies had shown that infants understand that speech transmits information from one person to another (Martin et al., 2012; Vouloumanos et al., 2012). This study demonstrates that infants do not expect all speech to convey information to all people.

Remarkably, monolingual infants did not expect an unfamiliar person to understand a second language, even when this second language *was the infants' own language*. That is, English-speaking monolingual infants did not always assume that an unfamiliar person would understand English; when the Listener was shown to understand Spanish, infants looked longer when she later responded correctly to English, the infants' own language. Looking longer at the *correct* outcome (even when adults may

evaluate the probability of selecting one of two choices as 50–50) is consistent with previous studies in which infants saw failed communicative attempts (Koenig & Echols, 2003; Krehm, Onishi, & Vouloumanos, 2014; Martin et al., 2012). A possible explanation for this looking pattern is that infants recognize that the second language is a communicative attempt, but one that is inconsistent with the Listener's language. The Listener should thus not be able to act on the information from the second language and when she responds appropriately, infants find it incongruent and look longer. Prior experiments have also found that when a person's behavior is likely to be interpreted as communicative (speech, pointing) infants expect it to convey information to another person, but when the behavior is unlikely to be communicative (coughing, waving a fist) infants find it unexpected when the recipient acts as if she has received the critical information (i.e., infants look longer when she behaves correctly; Krehm et al., 2014; Martin et al., 2012).

At the same time, even when the infants themselves did not understand the test language, they still assumed that the language could transfer information from the Speaker to the Listener; infants treated both familiar and unfamiliar languages as equally able to communicate about the location of the ball in the Same language condition. While previous work showed that infants understand that novel speech that followed the word-form structure of their native language could communicate information (Martin et al., 2012; Vouloumanos et al., 2012, 2014), the current study demonstrates that infants understand that a non-native language can also transfer information from one person to another. At 20 months, infants seem to have a generalized understanding that languages can serve a communicative function, even languages that they discriminate from their native language, but do not themselves understand.

Unlike monolinguals who applied a monolingual expectation to the listener, bilingual infants did not systematically extend their own specific bilingual understanding to the listener even though they seem to appreciate that there are people who have access to multiple communication systems (e.g., Diesendruck, 2005). Bilinguals may think a person could understand two languages, but perhaps through their experience with people of differing language backgrounds, require more information about a listener before inferring an unfamiliar person's competency with a particular language. We suggest that bilinguals and monolinguals respond differently when the Listener responds to a second language because, while both groups of infants realize that the second language is a communicative attempt, the monolinguals expect the Listener not to understand this attempt, while the bilinguals are agnostic. That bilinguals looked similarly to correct and incorrect reaches is consistent with bilinguals having no expectation about whether the Listener would understand the particular second language spoken.

At 20 months, infants seem to understand that the success of communication depends on people having a shared communication system. The understanding that communicative success is more likely between interlocutors who share a language suggests that infants may be treating each language as a different conventional system. Infants as young as 9 months recognize that there are conventional ways to refer to objects (Henderson & Woodward, 2012), and children assume that two individuals share knowledge about a novel object's label without explicit evidence (Diesendruck & Markson, 2011; Graham et al., 2006; Henderson & Graham, 2005; Henderson & Woodward, 2012). However, different language communities use different conventions, and communication across these different conventional systems is more difficult. Monolingual speakers participate in only one community of conventions and can communicate most easily with others in the same community using their shared conventions. Multilingual speakers are also limited to communicating with those who speak the same language, but they participate in more than one community of conventions and, therefore, have access to different information than monolingual speakers. Prior studies suggest that 4-year-olds understand that a bilingual but not a monolingual speaker would know the newly-learned novel names of objects in the bilingual's second language (not spoken by the monolingual; Diesendruck, 2005) and 13-month-old monolinguals understand that object labels are not generalized across individuals who have been shown to speak different languages (Scott & Henderson, 2013). These findings suggest that children understand that object labels are conventional within a language and furthermore, that the language(s) a person knows determine whether that person can understand a novel object label. The current study suggests infants as young as 20 months understand that members of different conventional communities have access to different information that can guide their behavior.

Knowing which language a person speaks, and therefore which conventional community she or he belong to, potentially allows infants to recognize effective communicative partners. Infants prefer native-language speakers to foreign-language speakers, and young children prefer learning object names and functions from speakers who have demonstrated conventional knowledge (Diesendruck, Carmel, & Markson, 2010; Diesendruck & Markson, 2011; Jaswal & Neely, 2006; Kinzler et al., 2007). Therefore, infants' assumptions about another person's linguistic abilities may limit who infants believe is an appropriate conversational partner and teacher. However, understanding that multiple conventional systems exist enhanced foreign language label learning in 3- and 4-year-olds (Akhtar, Menjivar, Hoicka, & Sabbagh, 2012) and infants living in more linguistically diverse neighborhoods (and thus likely to have more exposure to speakers of foreign languages) imitated actions by a foreign-language speaker more often than their counterparts from less diverse neighborhoods (Howard, Carrazza, & Woodward, 2014). Infants' understanding that different conventional systems exist may facilitate later foreign language learning.

One open question concerns the precise role of infants' familiarity with the language(s) used in the experiment. When the two speakers used different languages, monolingual infants always understood only one of the two languages spoken (English) while bilingual infants understood both of the languages (English and French),

language familiarity rather than infant language background might have led to the differences between the language background groups. However, when the two speakers used the same language, monolingual infants made the same inferences about the unfamiliar language as the familiar language, inferring that the Listener would understand the second Speaker even when the infants did not themselves understand what was said. Furthermore, the fact that bilinguals understood both languages and still did not expect the Listener to respond correctly to both languages provides stronger evidence that they do not assume an unfamiliar person understands the same two languages as the infant herself. Thus, while it is possible that infants were affected by the familiarity of the language(s) they heard in the experiment, we believe infant language background rather than knowledge of the specific languages is driving our effects. Future studies with bilingual infants who are tested with one or two unfamiliar languages would allow us to more directly assess this.

Another potential alternative explanation for the current results is that infants are treating language as a social group marker and, therefore, are expecting only in-group members to understand and help each other since infants themselves prefer those who speak their native language (Kinzler, Dupoux, & Spelke, 2012; Shutts, Kinzler, McKee, & Spelke, 2009). However, in previous work, infants were forced to choose between a native-language speaker and a foreign-language speaker. In the current experiment, the two speakers were never in competition with each other; that is, the Listener was never forced to choose between information presented from one speaker over the other, it was simply a matter of acting on the information presented by each speaker in turn. We believe it unlikely (though possible) that infants assume speakers of two different languages would not cooperate.

The current findings provide evidence that monolingually exposed infants assume others are monolingual, whereas bilingually exposed infants do not. By 20 months, infants have an abstract understanding that languages–even non-native languages–communicate information to others and are distinct conventional systems, revealing an advanced understanding of the communicative function of language in infancy.

References

Akhtar, N., Menjivar, J., Hoicka, E., & Sabbagh, M. (2012). Learning labels from a foreign speaker: The role of (limited) exposure to a second language. *Journal of Child Language, 39*(5), 1135–1149.

Baillargeon, R., & Barrett, J. (2005). Baby. An experimental software program for infant looking time experiments.

Bosch, L., & Sebastián-Gallés, N. (1997). Native-language recognition abilities in 4-month-old infants from monolingual and bilingual environments. *Cognition, 65*, 33–69.

Buresh, J. S., & Woodward, A. L. (2007). Infants track action goals within and across agents. *Cognition, 104*, 287–314.

Clark, H. H. (1996). *Using language*. Cambridge, MA: Cambridge University Press.

Diesendruck, G. (2005). The principles of conventionality and contrast in word learning: An empirical examination. *Developmental Psychology, 41*(3), 451–463.

Diesendruck, G., & Markson, L. (2011). Children's assumption of the conventionality of culture. *Child Development Perspectives, 5*, 189–195.

Diesendruck, G., Carmel, N., & Markson, L. (2010). Children's sensitivity to the conventionality of sources. *Child Development, 81*(2), 652–668.

Genesee, F., Boivin, I., & Nicoladis, E. (1996). Talking with strangers: A study of bilingual children's communicative competence. *Applied Psycholinguistics, 17*(4), 427–442.

Graham, S. A., Stock, H., & Henderson, A. M. E. (2006). Nineteen-month-olds' understanding of the conventionality of object labels versus desires. *Infancy, 9*, 341–350.

Henderson, A. M. E., & Graham, S. A. (2005). Two-year-olds' appreciation of the shared nature of novel object labels. *Journal of Cognition and Development, 6*(3), 381–402.

Henderson, A. M. E., & Woodward, A. L. (2012). Nine-month-old infants generalize object labels, but not object preferences across individuals. *Developmental Science, 15*(5), 641–652.

Howard, L. H., Carrazza, C., & Woodward, A. L. (2014). Neighborhood linguistic diversity predicts infants' social learning. *Cognition, 133*(2), 474–479.

Jaswal, V. K., & Neely, L. A. (2006). Adults don't always know best: Preschoolers use past reliability over age when learning new words. *Psychological Science, 17*(9), 757–758.

Kinzler, D., Dupoux, E., & Spelke, E. (2007). The native language of social cognition. *Proceedings of the National Academy of Sciences USA, 104*(30), 12577–12580.

Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2012). 'Native' objects and collaborators: Infants' object choices and acts of giving reflect favor for native over foreign speakers. *Journal of Cognition and Development, 13*(1), 67–81.

Koenig, M. A., & Echols, C. H. (2003). Infants' understanding of false labeling events: The referential roles of words and the speakers who use them. *Cognition, 87*(3), 179–208.

Krehm, M., Onishi, K. H., & Vouloumanos, A. (2014). I see your point: Infants under 12 months understand that pointing is communicative. *Journal of Cognition and Development, 15*(4), 527–538.

Martin, A., Onishi, K. H., & Vouloumanos, A. (2012). Understanding the abstract role of speech in communication at 12 months. *Cognition, 123*(1), 50–60.

Nazzi, T., Bertoncini, J., & Mehler, J. (1998). Language discrimination by newborns: Toward an understanding of the role of rhythm. *Journal of Experimental Psychology: Human Perception and Performance, 24*(3), 756–766.

Petitto, L. A., Katerelos, M., Levy, B. G., Gauna, K., Tétreault, K., & Ferraro, V. (2001). Bilingual signed and spoken language acquisition from birth: Implications for the mechanisms underlying early bilingual language acquisition. *Journal of Child Language, 28*(2), 453–496.

Scott, J. C., & Henderson, A. M. E. (2013). Language matters: Thirteen-month-olds understand that the language a speaker uses constrains conventionality. *Developmental Psychology, 49*(11), 2102–2111.

Shutts, K., Kinzler, K. D., McKee, C. B., & Spelke, E. S. (2009). Social information guides infants' selection of foods. *Journal of Cognition and Development, 10*(1–2), 1–17.

Tucker, G. R. (1999). A global perspective on bilingualism and bilingual education. In J. Alatis & A. Tan (Eds.), *Georgetown University Round table on Languages and Linguistics 1999* (pp. 332–340). Washington, DC: Georgetown University Press.

Vouloumanos, A., Onishi, K. H., & Pogue, A. (2012). Twelve-month-old infants recognize that speech can communicate unobservable intentions. *Proceedings of the National Academy of Sciences USA, 109*, 12933–12937.

Vouloumanos, A., Martin, A., & Onishi, K. H. (2014). Do 6-month-olds understand that speech can communicate? *Developmental Science, 17*(6), 872–879. http://dx.doi.org/10.1111/desc.12170.