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Voulez-vous jouer avec moi? Twelve-month-olds understand that foreign languages can communicate

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ABSTRACT

Infants understand that speech in their native language allows speakers to communicate. Is this understanding limited to their native language or does it extend to non-native languages with which infants have no experience? Twelve-month-old infants saw an actor, the Communicator, repeatedly select one of two objects. When the Communicator could no longer reach the target but a Recipient could, the Communicator vocalized a nonsense phrase either in English (infants' native language), Spanish (rhythmically different), or Russian (phonotactically different), or hummed (a non-speech vocalization). Across all three languages, native and non-native, but not humming, infants looked longer when the Recipient gave the Communicator the non-target object. Although, by 12 months, infants do not readily map non-native words to objects or discriminate most non-native speech contrasts, they understand that non-native languages can transfer information to others. Understanding language as a tool for communication extends beyond infants' native language: By 12 months, infants view language as a universal mechanism for transferring and acquiring new information.

1. Introduction

Early perceptual biases draw infants to speech from birth (Butterfield & Siperstein, 1970; Vouloumanos, Hauser, Werker, & Martin, 2010; Vouloumanos & Werker, 2007), and by 6–12 months infants understand an important function of speech: that speech, and not non-speech sounds, can communicate information between people (Martin, Onishi, & Vouloumanos, 2012; Thorgrimsson, Fawcett, & Liszkowski, 2015; Vouloumanos, Martin, & Onishi, 2014; Vouloumanos, Onishi, & Pogue, 2012). Previous studies however only tested communicative understanding using speech sounds consistent with the infants' native language and not non-native languages. But infants' processing of non-native languages changes rapidly: by 12 months, infants no longer map non-native words to objects (e.g., MacKenzie, Curtin, & Graham, 2012), and they no longer discriminate most non-native speech sounds (e.g., Werker & Tees, 1984). Infants' linguistic processing has narrowed to privilege their native language. Even as word learning and speech perception processes favor their native language, infants' understanding of communication might be broader: at 12 months, infants may recognize that non-native languages can transfer information to others. Extending infants' understanding of the communicative function of speech to non-native languages would suggest that infants view language as a universal mechanism for acquiring and transmitting information.

Infants can differentiate between native and non-native languages from birth based on a range of linguistic properties that vary between languages including phonetics, phonotactics, and rhythm (e.g., Bosch & Sebastián-Gallés, 2003; Jusczyk, Friederici, Wessels, Svenkerud, & Jusczyk, 1993; Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Nazzi, Jusczyk, & Johnson, 2000; Werker & Tees, 1984). Rhythm allows even newborn infants to discriminate between stress-timed language, such as English and Russian, which have equal timing between stressed syllables and variable duration between unstressed syllables, and syllable-timed languages, such as Spanish and French, which have roughly equal timing between all syllables (Mehler et al., 1988; Nazzi, Bertoncini, & Mehler, 1998; Nazzi & Ramus, 2003). By 9 months, infants can discriminate between languages within a rhythmic class, such as English and Russian, using phonotactic constraints that specify permissible consonant clusters and vowel sequences within a language (Jusczyk et al., 1993).

As their sensitivity to native speech properties develops, infants' processing of non-native speech properties declines: by 12 months, infants discriminate many non-native phonemes poorly (Bosch & Sebastián-Gallés, 2003; Kuhl et al., 1992; Werker & Tees, 1984), reject word forms with non-native phonotactics as possible labels for objects (MacKenzie et al., 2012), and even disfavor speakers of non-native languages (Kinzler, Dupoux, & Spelke, 2007). Without referential cues, 14–20 month old infants fail to learn words composed of non-native phonemes (May & Werker, 2014) or non-native tonal contrasts (Graf Estes & Hay, 2015; Hay, Graf Estes, Wang, & Saffran, 2015). By

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12 months, infants thus process native and non-native speech and speakers differently. However, infants do not just process speech in terms of its formal linguistic properties, they are also sensitive to its communicative properties. Is infants' understanding of the communicative function of speech limited to their native language, like much of their processing of formal linguistic properties of speech, or does it generalize beyond their specific linguistic experience to a non-native language? We examined whether infants understand that a language that differs rhythmically (Spanish) or phonotactically (Russian) from their native language can communicate information between people.

In the current study, 12-month-old infants watched two actors perform a series of actions (Martin et al., 2012; Vouloumanos et al., 2014). Infants first saw an actor (the Communicator) alone playing with one of two objects, establishing it as the target. Next, a new actor (the Recipient) alone spent equal time playing with both objects. In the test scene, the Communicator and Recipient were present together, but, owing to a change in the setting, the Communicator could no longer reach either object. Instead, she turned to the Recipient and vocalized a nonsense phrase in English, Spanish, Russian, or humming – a non-speech vocalization that may plausibly be communicative but lacks referential specificity and that infants should not infer as transferring information in this situation (see also Martin et al., 2012; Vouloumanos et al., 2012). The Recipient then handed the Communicator either the target object or the non-target object.

If infants understand that non-native languages can communicate, they should look longer at the non-target outcome than at the target outcome in both the Spanish and Russian conditions, as well as in the English condition. The English nonsense phrase, which followed English rhythm and phonotactics, allowed us to examine whether infants recognize that the form of their native language communicates, rather than responding to specific words whose meanings they already knew (e.g., had we used the English phrase equivalents, "give me X" or "I'd like X"). Alternatively, infants might not treat non-native speech as communicative, looking equally at the target and non-target outcomes as they did for non-speech vocalizations in previous studies (Martin et al., 2012; Vouloumanos et al., 2014). A third possibility is that infants may only treat one of the non-native languages as communicative, reflecting a sensitivity to either rhythmic (Spanish) or phonotactic (Russian) properties of language. Finally, we predicted that infants would treat humming as not communicative, similarly to non-speech vocalizations in previous studies, and look equally at target and non-target outcomes.

2. Method

2.1. Participants

Sixty-two healthy, full-term infants (M = 12 months, 11 days (SD = 9 days), range = 11, 23 to 12, 23) participated. This sample size was justified by an a priori power analysis (GPOWER; Faul, Erdfelder, Lang, & Buchner, 2007) indicating that we would need n = 60 infants to detect a significant interaction between Vocalization (Speech, Non-speech) and Outcome (Target, Non-target) in infants' looking times with 80% power at an alpha level of $p < .05$ based on an effect size of d = 0.37 (from the interaction between Outcome and Vocalization in Experiment 1 in Martin et al., 2012). Forty-two infants were tested in one of the three Speech conditions. Fourteen infants (6 females) tested in the English condition had a minimum of 50% exposure to English (average exposure to English was 85% (SD = 15%), range: 50–100%). Fourteen infants (5 females) tested in the Spanish condition had 0% exposure to Spanish (average exposure to English was 78% (SD = 30%), range: 15–100%). Fourteen infants (6 females) tested in the Russian condition had 0% exposure to Russian (average exposure to English was 85% (SD = 18%), range: 50–100%). Twenty infants (10 females) were tested in the Nonspeech humming condition.

Data from 35 additional infants were excluded from analysis because of experimenter error (8), parent interference (1), not meeting minimum language criteria (1), pre-existing health conditions (3), never looking away during the entire session (13), fussiness or inattentiveness (8), or looking times greater than 2 standard deviations from the mean (1). The infants who never looked away during the session were evenly distributed across conditions: 8 in the Speech condition: 4 Target, 4 Non-target, and 5 in the Nonspeech humming condition: 3 Target, 2 Non-target. Parents gave informed written consent on behalf of their infants. All procedures were approved by New York University's University Committee on Activities Involving Human Subjects (FY2016-81).

2.2. Apparatus

Infants sat on a parent's lap facing a display at the infant's eye level. Parents closed their eyes after the first familiarization trial. From the infant's viewpoint, the back of the display contained a window, which allowed the Communicator to be visible or not. The right side of the display contained a large opening covered by a yellow curtain, which allowed the Recipient to be visible or not. The left and right sides of the display were covered by two cloth dividers that prevented the infant and parent from seeing beyond the display, while allowing a hidden online coder to see the infant, but not the events on the stage. This online coder recorded whether the infant was looking at the display during each scene by pressing a button on a hand-held controller, which was connected to an iMac computer running Baby (Baillargeon & Barrett, 2005). The infant and the two actors were recorded by video camera.

2.3. Stimuli

Two novel objects were used: a red funnel (10.8 cm tall and 10.2 cm wide at the base), and a rectangular blue plank (13.3 cm tall, 5.1 cm wide, and 1.0 cm thick) that was topped with a blue pipe cleaner loop.

2.4. Procedure

Infants were not familiarized with the non-native languages prior to testing. Each infant saw 5 trials: three familiarization trials, one pretest trial, and one test trial. A beige curtain hid the display between each of the trials. Each trial contained a computer-controlled initial section, during which the actors performed the informative actions, and an infant-controlled main section, during which the actors either remained still or repeated a non-informative action. Reported looking times were recorded during the main section of the test trial after all informative actions had been completed. Trials ended when the infant looked away from the scene for a total of 2 consecutive s after having looked during the main section for 2 s, or if the infant looked for the maximum time. To keep actions and timing consistent across participants, all actors performed their actions in time with a metronome set to one beat per second. The stimuli were positioned so that the infants could see both objects and the two actors could see and reach each object (except as noted). The type and location of the target object were counterbalanced across participants within each vocalization condition. The funnel was the target object for half of the participants, and the plank was the target for the other half. The target object was on the right for half of the participants, and on the left for the other half. During the test trial, half of the participants saw the Recipient present the Communicator with the target object, and the other half saw the Recipient present the Communicator with the non-target object.

2.4.1. Familiarization

When the curtain rose, the Communicator was visible in the window at the back of the display. Only the top of her face and her arms were visible to the infants. The Communicator first looked at a neutral center point of the display (2 s). She then looked at one object (2 s) then the