

Research Report

INFANTS' RECOGNITION OF THE SOUND PATTERNS OF THEIR OWN NAMES

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Abstract—Among the earliest and most frequent words that infants hear are their names. Yet little is known about when infants begin to recognize their own names. Using a modified version of the head-turn preference procedure, we tested whether 4 5-month-olds preferred to listen to their own names over foils that were either matched or mismatched for stress pattern. Our findings provide the first evidence that even these young infants recognize the sound patterns of their own names. Infants demonstrated significant preferences for their own names compared with foils that shared the same stress patterns, as well as foils with opposite patterns. The results indicate when infants begin to recognize sound patterns of items frequently uttered in the infants' environments.

Research on early cognitive and perceptual capacities indicates that infants enter the world equipped with a surprisingly broad set of abilities. For example, infants seem to have a notion of physical identity that matches adult conceptions of object properties. Not only do young infants demonstrate sensitivity to the relative permanence of objects (Baillargeon, Graber, DeVos, & Black, 1990), they also appear to have at least a rudimentary understanding of causal relations (Leslie & Keeble, 1987) and of number (Starkey, Spelke, & Gelman, 1990, Wynn, 1992).

The precocious capacities of infants are perhaps best documented for the domain of language. It is well established that within the first 2 months of life, infants are able to discriminate a wide range of speech contrasts (Eimas, Siqueland, Juszczyk, & Vigorito, 1971, Trehub, 1976). Moreover, they appear to be able to compensate for stimulus variability introduced into speech by changes in speaking rate (Eimas & Miller, 1980) and talkers' voices (Juszczyk, Pisoni, & Mullennix, 1992, Kuhl, 1979). These early abilities allow infants to begin the process of categorizing the information available in speech and ultimately lead to acquisition of a native language.

Infants' basic speech perception capacities provide a starting point for discovering how sound patterns are organized in their native language. Because languages differ in their organization of sounds into meaningful units, infants must learn about the characteristics that hold for utterances in their language. There is now evidence that infants begin learning about particular properties of native-language utterances from an early age. For example, it has been demonstrated that even newborns show some capacity to discriminate utterances in their mothers' native language from those in another language (Mehler et al., 1988). There are also indications that within the 1st year, infants

learn about various aspects of sound organization in their native language: phonetic categories and their internal structure (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992, Werker & Tees, 1984), the characteristic sequences of sounds permitted in words (Juszczyk, Friederici, Wessels, Svenkerud, & Juszczyk, 1993), and the prosody typical of words (Juszczyk, Cutler, & Redanz, 1993). However, communication in language requires not only learning about the distinctive sound properties of one's language, but also learning to recognize certain sound patterns and to relate these to particular meanings.

Whereas many investigations have focused on infants' sensitivities to various sound properties of language, relatively few studies have explored the antecedents of relating sounds to meanings. What information is available on the latter issue comes largely from studies with approximately 9-month-old infants on the verge of producing their first words (e.g., Benedict, 1979, Huttenlocher, 1974). Such studies indicate that infants at this age show some limited comprehension of a few words. However, these studies do not indicate just when or how the process of lexical development actually begins.

One potential antecedent of relating sounds to meanings is beginning to recognize sound patterns that are uttered frequently in communicative settings that actively engage an infant's attention. For example, while playing with an infant, parents frequently use the child's name. To what extent does the infant begin to recognize the sound patterns corresponding to his or her own name? Considering the potential implications that learning one's own name might have not only for beginning to learn relations between sounds and meanings, but also for eventually establishing a sense of identity, it is surprising that so little attention has been given to this issue in previous research. The present study was designed to explore whether infants as young as 4 5 months demonstrate even the first signs of recognizing their own names.

One aspect of recognizing one's name is to treat utterances of that name as being different from utterances of other names. For example, are repetitions of an infant's own name more likely to capture the infant's attention than repetitions of other names? Certainly, adults' attention is more apt to be drawn to utterances of their own names (Howarth & Ellis, 1961, Moray, 1959). Furthermore, carefully selecting which other names to present along with an infant's own name should make it possible to gain information about just how precise the infant's representation of the sound pattern of his or her name is. For instance, it is certainly possible that at an early stage of development, an infant encodes only some rather global features of the sound pattern (e.g., the stress pattern, the number of syllables) of his or her name. Consequently, in the present study, we examined whether infants who heard their own names along with stress-matched or stress-mismatched foils would show any significant tendency to listen to their own names.

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Previous research indicates that infants between the ages of 7 and 10 months exhibit some recognition of words. For example, infants between the ages of 8 and 10 months show some comprehension of certain native-language words (Benedict, 1979; Huttenlocher, 1974). In addition, 7 5-month-olds display some rudimentary capacity for recognizing words in fluent speech and retaining them (Juszyk & Aslin, in press). Because their own names are presumably among the first and most frequent words that infants hear, we decided to test even younger infants to see if they show some evidence for recognizing these special lexical items.

METHODS

Subjects

Twenty-four infants from homes in which only English is spoken were recruited to participate in the present study (mean age = 149 days, range = 133 days–167 days). Half of the infants were males, the other half were females. An additional 13 infants were eliminated because of excessive fussiness or crying ($n = 9$), failure to orient properly to the test apparatus ($n = 2$), and experimenter error or testing interference ($n = 2$).

Stimuli and Apparatus

Each infant was presented with repetitions of four different names: his or her own name and three foils. The foils were designed to assess whether the infant would commit false alarms to names with prosodic patterns similar to those of the infant's own name. Specifically, one foil matched the stress pattern of the infant's name, the other two followed the opposite stress pattern. For example, an infant whose name was Aaron might be presented with three foils such as "Corey" (same stress), "Christine" (opposite stress), and "Michelle" (opposite stress). Table 1 provides a full listing of all infants' names and foils used in the present study.¹ Although all infants heard foils that either matched or mismatched the stress patterns of their own names, they did not all hear exactly the same set of foils. Rather, a different set of foils was used for each infant to control for the possibility that some names might be inherently more interesting to listen to. Each name was repeated 15 times to create a stimulus file for testing. The names were digitally recorded by a naive female talker who was not informed about which names were foils and which belonged to infants participating in the experiment. In fact, some foils were

Table 1 List of children's names and corresponding foil sets

Child's name	Same-stress foil	Different-stress foils	
		Group 1	Group 2
Joshua	Agatha	Maria	Eliza
Johnny	Abby	Elaine	Lamont
Sarah	Michael	Kathleen	Nicole
Becca	Aaron	Rumiz	Michele
Abby	Carol	Michele	Rumiz
Emmie	Connor	Denise	Marie
Christopher	Jessica	Eliza	Marissa
Henry	Corey	Rumiz	Christine
Katie	Kevin	Denise	Lavern
Cameron	Jenna	Elaine	Nicole
Brandon	Kevin	Lorraine	Nicole
Emily	Christopher	Marissa	Samantha
Rachel	Meghan	Darlene	Justine
Dana	Brandon	Elaine	Justine
Nick	Ben	Lucy	Travis
Erin	Connor	Rumiz	Christine
Corey	Lucy	Christine	Nicole
Ky	Meg	Audrey	Connor
Sam	Bob	Carol	Henry
Jojo	Mimi	Denise	Lavern
Philip	Kathy	Michele	Rumiz
Steven	Kyle	Rumiz	Michele
Emily	Joshua	Marissa	Maria
Travis	Lucy	Darlene	Michele

actually the names of other infants in the study. These precautions ensured that each infant's own name would not be unduly emphasized relative to any of the foil names. The talker was encouraged to record the names with lively affect, as if calling to an infant, and to vary her productions across the different repetitions of the names.

All names were digitized on a VAXStation Model 3176 computer at a sampling rate of 10 kHz via a 12-bit analog-to-digital converter. The digitized stimuli were then transferred to a PDP 11/73 computer, which controlled the presentation of the names and recorded the observer's coding of the infant's responses throughout the testing session.

Procedure

A modified version of the head-turn preference procedure was employed (see Juszyk & Aslin, in press, and Kemler Nelson et al., 1995, for an extensive review of the procedure). Each infant sat on a caregiver's lap in the middle of a three-sided enclosure constructed out of pegboard panels (4 ft by 6 ft) on three sides and open at the back. On the center panel of the enclosure, directly facing the infant, was a green light, mounted at eye level, that could be flashed to attract the infant's attention to midline. A red light was mounted on each side panel, and a loudspeaker was mounted at the infant's ear level behind each side panel. In addition, a video camera mounted behind the center panel recorded each test session. An experimenter,

¹ Because studies of this type have not been done previously, it was hard to know a priori which variable would prove most important in infants' representations of names at this early stage. Given the wealth of research suggesting that prosodic factors play a substantial role in early language acquisition, we decided to begin our investigation by manipulating stress pattern alone. Certainly, other variables (e.g., phonetic and featural information) might play an important role as well, and remain a topic for future investigation.

Infant Name Recognition

seated behind the center panel, observed the infant through a small hole. She began and terminated trials, recording the infant's looking times by operating a response box linked to a PDP 11/73 computer.

A test trial began with the flashing of the green light on the center panel. When the infant was facing center, the green light was extinguished, and a red light on one of the side panels began to flash. When the infant made a head turn of at least 30° in the direction of the flashing light, the experimenter initiated a speech sample from the loudspeaker on the same side as the light and began recording the infant's looking time by pressing a button on the response box. If the infant turned away from the loudspeaker by 30° for less than 2 consecutive seconds, and then reoriented in the appropriate direction, the trial continued, but the time spent looking away from the loudspeaker was eliminated from the total orientation time on that particular trial (the experimenter pressed another button on the response box that stopped the timer). If the infant looked away for more than 2 consecutive seconds, the trial was terminated.

Both the experimenter and the caregiver wore SONY MDR-V600 sound-insulated headphones and listened to loud masking music to prevent them from hearing the stimulus materials throughout the duration of the experiment. The music was highly effective in masking the test stimuli (see Kemler Nelson et al., in press).

Each session began with a preparatory phase in which the infant was presented with musical stimuli to familiarize the infant with the lights on the sides of the testing booth and to ensure that he or she was capable of making the required orienting response.² This phase continued until the infant accumulated 40 s of listening time to the musical stimuli. The loudspeaker from which the stimuli were emitted varied randomly from trial to trial. After the infant completed this preparatory phase, the test phase began. Stimuli for the test phase consisted of the stimulus file of the 15 repetitions of the infant's name and the files for the three foils. Test trials were blocked in groups of four. The stimulus set for each of the four names (the infant's own, along with the three foils) appeared once in a given block in random order. Each infant was tested on three blocks, completing 12 test trials in all.

RESULTS AND DISCUSSION

Mean listening time to each name was calculated for each infant across the three blocks of trials. These means were then averaged for the infants' own names and for each group of foils (one group of same-stress names and two groups of different-stress names). Across all 24 subjects, the average listening times were 16.14 s ($SD = 5.49$ s) for the infants' own names,

13.03 s for names with the same stress pattern ($SD = 6.26$ s), and 12.17 s and 12.39 s for the two groups of different-stress names ($SD = 5.46$ s and 5.10 s). An analysis of variance revealed that these means were significantly different, with a main effect of name category, $F(3, 69) = 5.60, p = .0017$. Moreover, a series of planned comparisons indicated that infants demonstrated significant listening preferences for their own names compared with names that had identical stress patterns ($t(23) = 2.64, p = .014$), as well as compared with names that followed opposite patterns ($t(23) = 3.98, p = .000$, and $t(23) = 3.54, p = .002$, for the two groups of oppositely patterned names). No other comparisons reached significance.

The present results indicate that by 4.5 months of age, infants listen longer to their own names than to other infants' names. In addition, the pattern of longer listening times to one's own name occurred even in the presence of prosodically similar foils. This finding suggests that 4.5-month-olds have a rather detailed representation of the sound patterns of their names. Each infant responds differentially to a particular sound pattern that will eventually have special social and perceptual significance for him or her (Howarth & Ellis, 1961; Moray, 1959; Van Lancker, 1991; Wood & Cowan, in press).

Although the present results do not demonstrate that infants actually comprehend their own names, the ability to recognize and respond to sound patterns of frequently occurring items is clearly a prerequisite for relating sounds to meanings. Ultimately, learning a word involves recognizing that a particular sound pattern consistently refers to a given object or meaning. This process requires that the learner not only has stored the appropriate meaning, but also recognizes and remembers the sound pattern that is associated with it. Thus, word learning may sometimes involve storing away an interesting sound pattern that will be subsequently attached to a meaning, as well as learning the names that correspond to meanings one wants to express—the more traditional view (MacWhinney, 1987; Pinker, 1984). Sound patterns of words frequently uttered when parents interact with their infants, such as the infants' names, are apt to be salient. Consequently, they are good candidates to be encoded into memory. Of course, the major breakthrough in word learning comes when infants learn that these sound patterns can stand for specific meanings.

It is possible that, in addition to their own names, 4.5-month-olds recognize other words that occur frequently in their language-learning environments (e.g., terms that relate to other socially salient persons, objects, or events). Regardless of whether there are other items that are learned even earlier than infants' own names, infants as young as 4.5 months of age are learning to recognize sound patterns that will have a special personal significance for them. This achievement, in turn, may set the stage for relating sounds to meanings.

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2. Prior research using this procedure has demonstrated that infants at this age often fail to orient to their sides without some degree of prompting. This beginning phase was added to our study to deal with the possibility that infants would not spontaneously make the required orienting response. We chose musical rather than linguistic stimuli for this phase so as not to influence responding during the test phase.

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