Do Six-Month-Olds Link Sound Patterns of Common Nouns To New Exemplars?

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Abstract

Previous work (Tincoff & Jusczyk, 1999) demonstrated that 6-month-olds can link the sound patterns "Mommy" and "Daddy" to video images of the appropriate parents, but do not attach these words to unfamiliar men and women. Using a preferential looking procedure, the current study extends these findings by showing that 6-month-olds can attach sound patterns of the familiar spoken words (“Hands” and “Feet”) to instances of these referents that they had never seen.

Introduction

Word comprehension is a complex ability that requires: forming representations of objects and events, responding to attentional cues, remembering the sound patterns of potential words, and linking auditory and visual events. These component skills are evidenced at a very early age. For example, by 4 months, infants can represent objects and reason about their motion, respond to the prosody of infant-directed speech, recognize the sound pattern of their name & "baby", link faces and voices, link sounds to their sources (see Cooper & Aslin, 1990; Fernald, 1985; Mandel, Jusczyk, & Pisoni, 1995; Mandel-Emer & Jusczyk, 1997; Spelke, 1976; Spelke, Breinlinger, Macomber, & Jacobson, 1992; Walker-Andrews, 1991).

Furthermore, 6-month-olds link stored sound patterns to specific referents in the world. Specifically, Tincoff & Jusczyk (1999) showed that 6-month-olds look longer at a video of their mother when they hear the word "Mommy" and look longer at a video of their father when they hear "Daddy". However, when they see videos of *unfamiliar* men and women, they do *not* adjust their looking patterns. These findings suggest that infants' earliest word-world associations might all be highly specific, as is the case with proper nouns. However, in contrast to proper names, common nouns refer to categories of objects as well as particular instances. Research shows that 3-4 month old infants do form perceptual categories such as "cat", "mammal", or "animate" (Madole & Oakes, 1999; Quinn & Eimas, 1996). The present study asks, do very young infants link the sound patterns of common nouns only to specific instances or can they link these words to unfamiliar referents? If infants' earliest word-world associations are highly specific then they should initially attach sound patterns of common nouns to specific and familiar referents. Therefore, they should not show comprehension if an unfamiliar exemplar is presented as the referent. Alternatively, given that even very young infants evidence some categorization ability, 6-month-olds might be able to link sound patterns of spoken words to new instances of perceptually similar objects.

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Method

Subjects

Twenty-five infants were tested (13 males, 12 females) with a mean age of 5 months, 28 days (5, 14 – 6, 15). Data from an additional 16 infants were not included due to crying/fussing (n = 7), extreme side bias (≥95%) (n = 2), parents reported that they did not use "hand", "hands", "feet", or "foot" (e.g, used "arm", "toes", "piggies") (n = 7).

Stimuli

The auditory stimuli were lists of 8 tokens of "hand" & "feet" produced by a female monolingual American English speaker. The visual stimuli were videos of the same female adult's hand & feet. *Hand* and *feet* were selected because these words are frequently used by parents when interacting with 6-month-olds (parental report, $N = 29$). In addition, there is evidence that 3-6-month-olds recognize their own body's features and characteristics (Bahrick & Watson, 1985; Morgan & Rochat, 1997; Rochat & Morgan, 1995, 1998). Finally, hands and feet have a high degree of perceptual similarity across individuals, relatively to other body parts such as eyes or noses. We selected adult exemplars because they would be less similar to the shape and character of the infants' own hands and feet, and thus represent more novel exemplars of the perceptually-based *hand* and *feet* categories.

Procedure

Infants were tested in a version of the Intermodal Preferential Looking Procedure (see *Figure 1*). During the experiment, the caregiver wore a visor with an attached piece of thick black felt to shield the caregiver's view of the monitors. The experimenter stood behind the center wall to control the stimuli presentation and viewed the infant through a videocamera. A trial was initiated by the experimenter via a button press when she judged the infant to be visually fixating a blinking orange light located between the TV monitors. Once the infant looked to the center light, the experimenter raised the opaque screen covering the monitors to display the video stimuli. On test trials, the audio began playing on the experimenter's button press. The timing of the 10s trials was monitored by the computer. The test sessions were recorded on videotape for later offline coding (reliability coefficients between 2 observers for each side on each trial > .90).

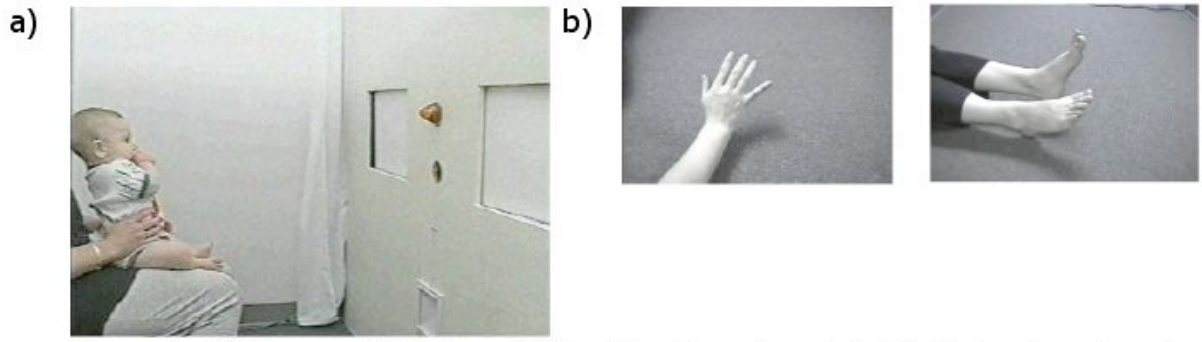

Figure 1. a) Intermodal Preferential Looking Procedure, b) still photos from *hand* and *feet* videos.

Design

Infants first saw Silent Pretest Trials (n = 4, 10s duration). These trials acquainted the infant with the location of each video. The infant viewed the silent *hand* video and the silent *feet* video, one at a time, in alternation. During offline coding, the observers checked each trial to ensure that the infant oriented to each side. Then the Silent Baseline Trials were presented (n = 4, 10s duration). The infant viewed the two silent videos simultaneously. During offline coding the observers measured the amount of time the infant looked at each video as a measure of overall preference. Finally, the Test Trials were presented (n = 8, 10s duration). The infant viewed the two videos simultaneously, while listening to "hand" and "feet" on different trials.

During offline coding, the observers measured the amount of time the infant looked at the video that matched the audio (Match) and the video that did not match the audio (Mismatch). For analysis, three measures were used: looking time in milliseconds, proportional looking time, and a looking time score that adjusted for individual prefernces. This looking time score was calculated for each infant on each audio-video test trial. It represents the change in looking time to the video when the audio is present, adjusted for the infants' baseline looking to the silent video.

Looking Time Score:
Mean proportional change in looking time from baseline, adjusted for baseline preference

$$\frac{LT_{\text{Hand Audio-Video Match, Trial 1}} - LT_{\text{Hand Video, Baseline}}}{LT_{\text{Hand Video, Baseline}}}$$

Results

Infants looked more at the hand video when they heard "hand" and more at the feet video when they heard "feet" [looking times in ms: $M_{Audio/Video\ Match}$ = 3980 ms, SD = 809, $M_{Audio/Video\ Mismatch}$ = 3400 ms, SD = 615, paired $t(24) = 2.654$, $p = .014$, 2-tailed sign test $N = 25$, $x = 6$, $p = .015$; Proportional looking time vs. chance (.50): $M_{Audio/Video\ Match}$ = .538, SD = .066, one sample $t(24) = 2.849$, $p = .009$, 2-tailed, sign test $N = 25$, $x = 6$, $p = .015$]. See *Figure 2* for graph of mean looking times.

The looking time scores were analyzed to compare performance on "hand" and "feet", adjusting for individual preferences. A repeated measures 2X2 ANOVA, *Match* (video matches audio vs. video mismatched with audio) X *Item* (hand video vs. feet video) showed a main effect of Match $F(1, 24) = 5.482$, $p = .023$ and an interaction of Match X Item $F(1, 24) = 5.023$, $p = .035$. The Item main effect was nonsignificant, $p > .05$. Planned comparisons showed that infants successfully matched both *hand* and *feet*, [Hand $F(1,24) = 4.977$, $p = .034$, $M_{Hand\ Match} = .227 >> M_{Hand\ Mismatch} = .137$; Feet $F(1, 24) = 29.014$, $p < .001$, $M_{Feet\ Match} = .500 >> M_{Feet\ Mismatch} = .283$]. See *Figure 3* for plot of individual responses.

Conclusions and Future Directions

These results show that 6-month-olds have some ability to attach sound patterns of spoken words to unfamiliar referents that are perceptually similar to familiar referents. This finding supports the conclusion that early word comprehension does *not* appear to be limited to linking specific sound patterns to specific referents. In addition, these findings provide further evidence that infants as young as 6 months are relating spoken language to the world in order to form meaningful representations. This conclusion raises several important issues for future investigations, such as, how do changes in infants' strategies for segmenting sound patterns from fluent speech or changes in their strategies for forming categories influence their recognition of a word-world association? In what ways are the associations between spoken words and the world differ from other cross-modal associations? Given that the component skills of word comprehension are emergent themselves, how does word comprehension at 6 months differ from word comprehension at 12-14 months? This range of questions highlights that researchers are still at the beginnings of understanding how infants' early perceptual abilities interact with their other cognitive systems to form their mature language systems.

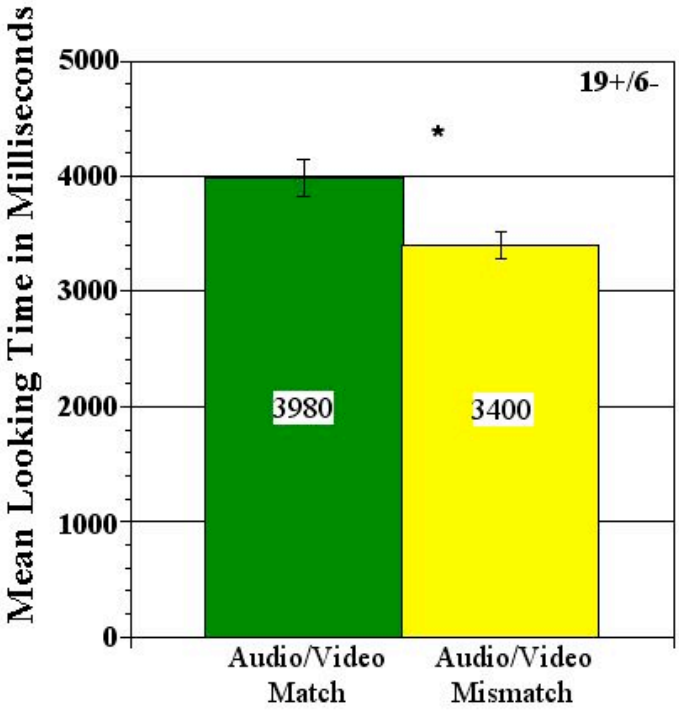

Figure 2. Mean looking time (in ms) to video that matches the audio and to the video that is mismatched with the audio. *$p < .05$. Bars indicate standard error.

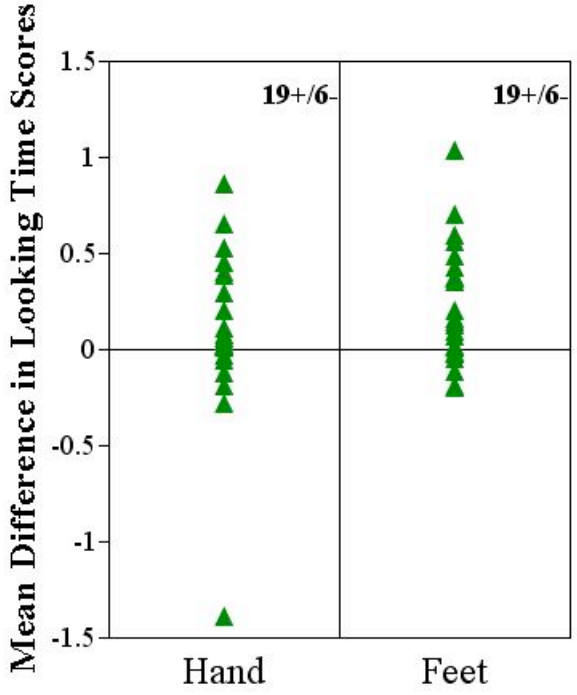

Figure 3. Mean difference in looking time scores, for each infant ($N = 25$), to *hand* and *feet* videos. Positive scores indicate longer looking towards video that matches audio. $M_{Diff.Hand} = +0.09$, $M_{Diff.Feet} = +0.22$

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