

BRIEF REPORT

Two-Day-Olds Prefer Their Native Language

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Newborn infants whose mothers were monolingual speakers of Spanish or English were tested with audio recordings of female strangers speaking either Spanish or English. Infant sucking controlled the presentation of auditory stimuli. Infants activated recordings of their native language for longer periods than the foreign language.

language newborn nonnutritive sucking perception preference

Because newborns can recognize the sound of a familiar voice (DeCasper & Fifer, 1980; Fifer & Moon, 1989), story (DeCasper & Spence, 1986), or melody (Cooper & Aslin, 1989), it is also possible that they can respond to a familiar language. Experiments have demonstrated older infants' ability to discriminate two languages. Five-month-olds, in a study of Spanish and English, were able to categorize languages, even in the presence of linguistic variation (Bahrick & Pickens, 1988). Two-month-olds from English-speaking families discriminated English from Italian (Mehler et al., 1988). Two-month-olds did not demonstrate discrimination when the contrast was between French and Russian, suggesting that familiarity with one of the languages is necessary for discrimination.

Mehler et al. (1988) also tested 4-day-olds from French-speaking families using a noncontingent dishabituation of high-amplitude sucking procedure.

Dolly Soto, Daisy Edmonson, Dharma Cortes, Maribel Vargas, and Karin Blumofe assisted with this study, which was conducted at Babies Hospital, Columbia-Presbyterian Medical Center, and Jacobi Hospital of the Albert Einstein Medical College, both in New York City. Support was provided by NICHD grants RO1 HD22817 and F32 HD06781 to C.M. and R.P.C., respectively. Support also came from NICHD Contract NO1-HD-5-2910 to Haskins Laboratory.

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They found evidence for discrimination based upon response asymmetries. Infants who were presented with French during the preshift habituation phase had higher sucking rates compared to those who heard Russian during this phase. Postshift dishabituation of sucking occurred only when the transition was from Russian to French, not French to Russian. Mehler et al. suggested that the asymmetrical response patterns not only evidence language discrimination, but may also indicate that the native language was preferred. It is difficult to evaluate this interpretation because the traditional purpose of the procedure used by Mehler et al. is to assess discrimination, not preference. Thus, although it is possible that such asymmetrical response recovery reflects both discrimination and preference, it may also reflect a methodological failure to demonstrate discrimination without respect to order effects. Therefore, a more direct test of native language preference in newborns was conducted using a preference procedure that has previously been successful with newborns (DeCasper & Fifer, 1980; Fifer & Moon, 1989; Moon & Fifer, 1990).

In the following experiment, 2-day-old infants of monolingual speakers of English and Spanish were presented with recordings of women speaking English or Spanish. Presentation of language was infant controlled, contingent upon sucking bursts. It was predicted that infants would learn the contingent relationship between sucking and auditory presentation and would, after an acquisition period, demonstrate a preference for the native language by activating it more than the foreign language.

Sixteen apparently healthy infants between the ages of 25 and 56 hours were the subjects ($M = 43$ hours, $SD = 10.0$). Mothers of 8 of the subjects were monolingual Spanish speakers, and the remaining 8 subjects had mothers who were monolingual English speakers. Maternal language was determined through interview and a 5-item questionnaire. A total of 44 infants participated in experimental sessions. Infant data were rejected due to the following: drowsiness ($n = 12$); crying ($n = 4$); unmeasurable bursts ($n = 3$); experimenter error ($n = 6$); and other (bowel movement, spitting up; $n = 3$).

All subjects heard the speech stimuli through headphones. Infants sucked on a nipple that was connected to a pressure transducer. The pressure signal was transmitted to a microcomputer that recorded the subjects' sucking patterns and controlled auditory stimulus presentation.

There were two types of auditory stimuli: reinforcers and signals. For the reinforcing stimuli, one recording each of voices of eight Spanish-speaking and eight English-speaking women (a total of 16 recordings) was used. For each voice, a 25-s recorded sample of spontaneous narrative speech was re-recorded onto a continuous loop tape, which was presented through the headphones at conversational sound level (varying around 70 dB; Bruel & Kjaer Sound Level Meter Type 2235, Artificial Ear 4152.) The stimuli were equated for loudness by two experimenters prior to each session. The 16

voices were selected from a large collection of recordings on the basis of tape quality, fluency, and typicality of phonation and articulation. Each Spanish voice was paired randomly with an English voice, and the pair were roughly matched on overall pitch.¹ Thus, the 16 voices formed eight pairs. Each pair was presented to 2 infants: 1 whose maternal language was Spanish and 1 whose maternal language was English. Two types of stimuli served as signals for the availability of reinforcing voices; these were synthesized 500-ms vowels [a] and [i] (see Moon & Fifer, 1990, for a full description).

Sessions were conducted in the hospital with the infant in a quiet alert state. Headphones were placed over both ears, and a nipple was placed in the infant's mouth. A 2-min baseline sucking period followed, after which the auditory stimuli were presented for 18 min. One experimenter monitored the recording equipment, and the other experimenter held the nipple in the infant's mouth. The second experimenter was blind to the experimental condition and was unable to hear the stimuli because they were inaudible beyond the earphones. Sessions lasted 18 min unless terminated prematurely due to cessation of measurable sucks by the infant for more than two periods of 45 s, in which case data were excluded from analysis. The sounds were presented contingent upon negative pressure generated by sucking bursts. A burst was defined as a minimum of three consecutive sucks, and a reinforcing sound (either the Spanish or English voice) began during the initiation of the third suck. The reinforcing voice continued for the duration of the burst and was terminated when 1 s elapsed with no suck detected. Immediately upon cessation of the reinforcing voice, vowel signals commenced. Signals were thus presented only during interburst intervals. The initiation of the vowel sequence was random, and the two vowels were in 4-s strings that alternated with each other. If the infant initiated a sucking burst during either string, the vowel signals terminated, and either Spanish or English was presented for as long as the sucking burst continued. For 4 of the infants in each of the two language conditions, [a] signaled the Spanish voice and [i] signaled the English voice, whereas for the other 4 infants, the signal-voice pairing was the converse.

The native and foreign language recordings acted as reinforcers both for sucking while the recordings were being presented and for sucking during the appropriate signals. Therefore, there were two possible response measures: burst duration and frequency of responding to a given signal. It was anticipated that, as in previous studies, differences in response to the two languages would not be apparent until the final 6 min of the 18-min session (DeCasper & Fifer, 1980; Moon, Bever, & Fifer, 1992; Moon & Fifer, 1990).

¹ This pitch matching was accomplished by having two adults listen to the voice pairs and indicate whether one voice differed substantially from the other.

A mixed analysis of variance (ANOVA) was performed on the burst duration data. The subjects' native language (Spanish vs. English) was the between-subjects variable; reinforcer (native vs. foreign language) and period (first, middle, and final 6 min) were the within-subject variables. The ANOVA results showed no main effects of language, reinforcer, or period. The interaction of language \times reinforcer \times period also did not reach significance. However, there was a significant interaction between reinforcer and period, $F(2, 28) = 7.40, p < .01$. Planned t tests revealed no difference in responding to the native versus foreign language during the first, $t(15) = 0.57$, or the middle 6-min periods, $t(15) = 1.7$. During the final period, 12 of the 16 infants responded to the native language recording with longer sucking bursts ($p < .06$, two-tailed binomial). The mean length of sucking bursts to the native language ($M = 7.3, SD = 2.8$) was significantly longer than to the foreign language ($M = 6.2, SD = 2.1$), $t(15) = 3.1, p < .01$ (see Figure 1).

It is possible that in a pair of Spanish-English tape recordings, one of the voices could have been preferred on the basis of characteristics other than language, for example, pitch or phonation (even though attempts were made to match on these variables). Therefore, for the final period, an additional analysis was conducted comparing the mean sucking burst durations of Spanish and English subject pairs who heard the same two voices. Difference scores were calculated by taking the average burst duration during the native language minus foreign language. The results showed that 4 of the 16 subjects had longer burst durations during the foreign voice, and therefore, a negative difference score. However, for each of these 4 infants the absolute difference was smaller than that of the matched infant for whom the preferred voice was speaking the native language. Thus, in all eight pairs of infants, relative responding was greater for the native language ($p < .01$, two-tailed binomial test).

The second possible measure of preference was frequency of activation by sucking during the appropriate signal. On this measure, an ANOVA revealed no significant main effects and no interaction effects.

After an initial acquisition period of about 12 min, infants emitted longer average sucking bursts during a native language recording than during a recording of a voice speaking in a foreign language. For half of the subjects, the native language was Spanish; for the other half it was English. Four of the 16 infants emitted longer average bursts during a voice that was speaking a foreign language as compared to the native voice, but other infants who heard the same voice and for whom it was speaking the native language had even longer average burst durations during the voice relative to the foreign voice. Thus, a voice that was attractive to both infants who heard it was more attractive to the infant for whom it was speaking the native language.

This differential response is interpreted as a preference by newborns for their native language. Over time, subjects altered sucking patterns that resulted in hearing the native language for longer periods than the foreign

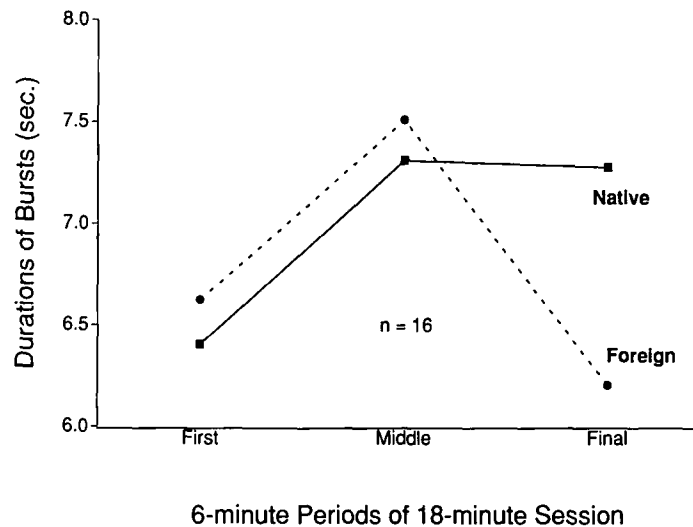


Figure 1. Mean duration of sucking bursts during presentation of languages.

language. The contingent relationship between sucking and sound plus the development of the response over time are evidence for the voluntary nature of subjects' reaction to the native language.

We do not know why infants responded with longer average burst durations to the native language and not also with responses to the appropriate signal for the native language. Similar newborn procedures with two response contingencies have produced mixed results (Moon & Fifer, 1990). Further experiments using discriminative stimuli and synchronous reinforcement may reveal factors that influence neonatal patterns of response.

This experiment contributes to our growing understanding of the initial capacities and selective attention of newborns. It appears that not only do newborns respond preferentially to specific voices, but also to more speaker-general properties of speech (e.g., intonation patterns characteristic of their native language). Although it is possible that postnatal experience with the infant's language environment is sufficient to account for this native language preference, it seems more likely that the necessary experience occurred prenatally. Future studies on prenatal exposure to speech patterns will be needed to assess these various contributions.

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