Approval and Disapproval: Infant Responsiveness to Vocal Affect in Familiar and Unfamiliar Languages

Anne Fernald
Stanford University

FERNALD, ANNE. Approval and Disapproval: Infant Responsiveness to Vocal Affect in Familiar and Unfamiliar Languages. CHILD DEVELOPMENT, 1993, 64, 657–674. In a series of 5 auditory preference experiments, 120 5-month-old infants were presented with Approval and Prohibition vocalizations in infant-directed (ID) and adult-directed (AD) English, and in ID speech in nonsense English and unfamiliar languages, German, Italian, and Japanese. Dependent measures were looking-time to the side of stimulus presentation, and positive and negative facial affect. No consistent differences in looking-time were found. However, infants showed small but significant differences in facial affect in response to ID vocalizations in every language except Japanese. Infants smiled more to Approvals, and when they showed negative affect, it was more likely to occur in response to Prohibitions. Infants did not show differential affect in response to Approvals and Prohibitions in AD speech. The results indicate that young infants can discriminate affective vocal expressions in ID speech in several languages and that ID speech is more effective than AD speech in eliciting infant affect.

Research on the development of infants’ responsiveness to emotional expressions has taught us much less about how infants listen to voices than about how they look at faces. Although early investigators suggested that young infants smile earlier to voices than to faces (Wolff, 1963) and respond differentially to positive and negative affect in the voice (Bühler & Hetzer, 1928; Lewis, 1936/1951), recent research on infants’ perception of emotion has focused primarily on the face. The majority of microanalytic studies of mother-infant communication have coded maternal facial expression and gaze while neglecting vocal expression (e.g., Fogel, 1982; Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986), or limiting vocal measures to amount of speech, verbal content, or timing of vocalizations (e.g., Field, 1977; Lamb, 1978; Mayer & Tronick, 1985). With a few notable exceptions (e.g., Papousek, Papousek, & Bornstein, 1985; Stern, 1985; Stern, Spieker, & MacKain, 1982), research on early emotional development has largely ignored the role of vocalizations in affective communication with the infant. The implicit assumption that young infants are more responsive to the face than to the voice is also reflected in research on the early discrimination and recognition of emotional signals. This literature, too, is dominated by studies of infants’ perception of facial expressions (e.g., Barrera & Maurer, 1981; Nelson & Dolgin, 1985; Schwartz, Izard, & Ansu, 1985). While a few studies have investigated infants’ discrimination of facial-plus-vocal expressions (e.g., Haviland & Lelwica, 1987; Walker, 1982; Walker-Andrews, 1986), only recently have researchers begun to explore how infants respond to vocal expressions alone, without simultaneous facial affect (Papousek, Bornstein, Nuzzo, Papousek, & Symmes, 1990; Walker-Andrews & Lennon, 1991).

Studies showing that infants younger than 7 months cannot consistently categorize facial expressions (e.g., Ludemann & Nelson, 1988) have led several investigators to conclude that infants are unable to recognize emotional expressions until late in the first year (Klinnert, Campos, Sorce, Emde, & Svejda, 1983; Nelson, 1987). However, recent research by Caron, Caron, and MacLean (1988) suggests that studies relying solely on facial stimuli may underestimate...
infants' ability to discriminate naturalistic emotional expressions. Caron et al. found that 7-month-old infants could discriminate happy from angry expressions when dynamic facial displays were accompanied by appropriate vocal affect. When the voice was removed, however, infants no longer showed evidence of being able to make the discrimination, leading Caron et al. to conclude that infants rely more on the voice than the face when discriminating between highly animated emotional expressions. Research on the response of 6-month-old infants to auditory-visual compounds provides further evidence that young infants are influenced more strongly by auditory than visual input (Lewkowicz, 1988). These findings motivate one question addressed by the present research: Are young infants able to discriminate positive and negative vocal expressions at an age when they are not yet consistently able to discriminate positive and negative facial expressions?

A second question addressed by this research is whether infants respond with differential emotion to vocal expressions differing in affective tone. The numerous studies of infants' perception of facial displays have focused on discrimination and categorization abilities, without asking whether infants respond meaningfully to facial expressions (see Nelson, 1987). Similarly, the few studies of infants' perception of facial-plus-vocal displays provide limited evidence for discrimination of some vocal expressions (Walker-Andrews & Grolnick, 1983), and cross-modal matching of vocal and facial cues (Walker, 1982; Walker-Andrews, 1986; Walker-Andrews & Lennon, 1991), with no evidence that affective vocal expressions are meaningful to infants. Research on social referencing, however, does suggest that infants around the age of 8 months are able to interpret some facial expressions meaningfully (Klinnert et al., 1983). The only evidence that infants at a younger age are sensitive to the emotional meaning in facial expressions comes from a study by Haviland and Lelwica (1987). In this research, 10-week-old infants, presented with their mothers' facial and vocal expressions of happiness, sadness, and anger, responded with matching facial expressions in the happiness and anger conditions. However, since the mothers' emotional displays were simultaneously facial and vocal, it is unclear to what extent infants were responding to the face or to the voice. The present study investigates whether young infants respond with differential affect to emotional vocalizations presented without simultaneous facial affect.

While previous studies of infants' response to affect have presented infants with expressions of discrete emotions such as fear and happiness (e.g., Caron et al., 1988; Nelson & Dolgin, 1985), the present research focuses on more naturalistic affective vocalizations, typical of those used by adult interacting with infants. Adults in many cultures use a special speech register characterized by exaggerated intonation when speaking to infants (Fernald et al., 1989; Grieser & Kuhl, 1988). Although most studies of "motherese" have focused on its language-teaching functions (e.g., Fernald & Mazzie, 1991; Snow, 1972), several investigators have argued that exaggerated prosody in speech to infants may function more immediately to influence infant affect and attention in the early months of life (Fernald, 1984, 1991; Faoustek et al., 1985; Stern et al., 1982).

Empirical support for the role of exaggerated intonation in modulating infant affect and attention comes from three different sources in the recent literature on speech to infants. First, experimental studies have found a listening preference for infant-directed (ID) speech over adult-directed (AD) speech in preverbal infants (Cooper & Aslin, 1990; Fernald, 1985; Fernald & Kuhl, 1987; Werker & McLeod, 1989). Second, several investigators report consistencies in the relation of prosodic forms to communicative functions in speech to infants (Ferrier, 1985; Ryan, 1978; Stern et al., 1982). For example, Fernald (1992a) describes cross-language similarities in the prosodic contours used to express approval or praise to infants, in contrast to those used to express disapproval or prohibition. Approval vocalizations, such as Good! are typically spoken with exaggerated rise-fall F0 contours, while prohibition vocalizations, such as No! are spoken with lower pitch in short, sharp F0 contours. These studies suggest that specific types of prosodic contour are differentially effective in eliciting attention and communicating affect to the infant. Third, adult listeners are able to identify the communicative intent of the speaker much more accurately in ID than in AD speech using only prosodic cues (Fernald, 1989). The present research extends these findings by asking whether infants respond differentially to prosodic patterns in ID speech and whether ID speech is more effective than AD speech in eliciting infant affect.
In the five experiments reported here, infants were presented with affective vocalizations typical of those used by mothers when either praising or scolding an infant. The rationale for using ID approvals and prohibitions, rather than vocal expressions specified in terms of discrete emotions, was that such ID vocalizations are more common in infants' experience and are well suited for affective communication with infants. To test the hypothesis that infants respond differentially to positive and negative vocalizations, two dependent measures were used. The first dependent measure was the amount of time infants looked to the side on which each type of vocalization was presented. Using a modification of the auditory preference procedure developed by Fernald (1985), approvals and prohibitions were presented on opposite sides of a testing booth. However, unlike the original procedure, equal numbers of each type of vocalization were played in random order; on each trial, speech continued to play for 20 sec, or until the infant terminated the trial by looking away from the side of presentation. Thus while the type of vocalization presented on each trial was under the experimenter's control, the duration of the trial was under the infant's control. This looking-time measure was intended to index subjects' differential attention to approvals and prohibitions.

The second dependent measure was infant facial affect in response to approvals and prohibitions. When a mother says Good girl! to her infant with positive vocal affect, her intention is to reward the child's behavior; when she says No, stop that! with negative vocal affect, her intention is to inhibit the child's behavior, that is, to punish rather than to reward. The different communicative intentions motivating approval and prohibition vocalizations in ID speech lead to clear predictions about infants' affective responses to these two categories of vocal expression. If infants are indeed responding differentially and appropriately, they should show more positive affect in response to approvals and more negative affect in response to prohibitions.

Approval and prohibition vocalizations in four languages were used as stimuli in these experiments, a cross-language design motivated by two considerations. First, to eliminate the possibility that infants were responding to semantic content, affective vocalizations were presented in unfamiliar languages as well as in English. Second, several languages were included to investigate the generality of the prosodic patterns used to express approval and disapproval in ID speech in different cultures. While there is some cross-language evidence for acoustic similarity among ID vocalizations similar in communicative intent (Fernald, 1992a), this tells us nothing about the perceptual similarity of these prosodic patterns. The finding that infants reared in English-speaking families respond differentially and appropriately to ID approval and disapproval vocalizations in unfamiliar languages, as well as in English, would provide evidence for the functional equivalence of these affective vocalizations across languages.

Two other features of the experimental design were intended to provide evidence for response convergence and stimulus convergence in this auditory preference procedure. First, one objective in using both looking-time and facial affect as response measures, following Werker and McLeod (1989), was to determine to what extent these behaviors constitute convergent measures of infant listening preference. While smiling would seem to be a clear index of pleasure in response to a vocal stimulus, looking-time is a less straightforward measure of auditory preference. The use of both measures in a series of studies which include a range of vocal stimuli should be helpful in comparing and evaluating looking-time and facial affect as indices of infant listening preference. Second, of the six sets of approval and prohibition vocalizations used as stimuli, four were prepared in the laboratory from scripts (Experiments 1, 3, and 5), and two were composed of excerpts from field recordings of spontaneous mother-infant interaction (Experiments 2 and 4). While "posed" affective vocalizations can be controlled for semantic content and other relevant linguistic and acoustic characteristics, they may lack critical features of more natural ID speech. Recordings of spontaneous speech, on the other hand, while more representative of natural mother-infant interaction, inevitably introduce uncontrolled variation in linguistic and acoustic structure which may or may not be relevant to the perception of affective quality. Since both approaches have advantages, and neither is entirely satisfactory, both are used here in order to explore the extent of stimulus convergence in this procedure.

Experiment 1

In Experiment 1, 5-month-old infants were presented with Approval and Prohibi-
tional vocalizations typical of ID speech in German. The speech of German parents to infants has been described in several studies (Fernald & Simon, 1984; Fernald et al., 1989; Papousek, Papousek, & Haekel, 1987), and is similar to English in its global prosodic characteristics. Two hypotheses were tested: First, that infants would look longer to the side on which Approvals were presented than to the side on which Prohibitions were presented, reflecting a listening preference for positive vocalizations; and second, that infants would show more positive affect to Approvals and more negative affect to Prohibitions.

Method

Because Experiments 1–5 used the same subject population, apparatus, procedure, and methods for signal calibration and data coding, these will be described in detail for Experiment 1 only. The vocal stimuli differed across experiments and will be specified separately for each experiment.

Subjects.—The subjects in Experiment 1 were 20 full-term, healthy infants (10 males, 10 females), recruited from a predominantly white, middle-class population through a university hospital. All infants came from homes in which English was the only language spoken and were not exposed regularly to any other language. Infants were 5 months old (M: 148 days; range: 132–168 days). Thirteen additional subjects were eliminated from the study due to fussiness (6), failure to orient (4), or experimenter error (3).

Stimuli.—The ID Approval and Prohibition vocalizations used as stimuli in Experiment 1 were spoken in German by a bilingual English/German adult female. Audio-recordings were made on a Revox B77 MKII reel-to-reel tape recorder, using a Sony ECM-23F microphone. The Approval stimuli consisted of 14 vocalizations with appropriate ID semantic content (e.g., So brav bist du [You’re so good]). These positive vocalizations were spoken with the exaggerated rise-fall F0-contours typically used by German mothers when praising preverbal infants (Fernald, 1991). The Prohibition stimuli consisted of 14 negative vocalizations (e.g., So böse bist du [You’re so naughty]), spoken with intonation patterns typical of those used by German mothers when scolding preverbal infants.

In order to equate the two sets of speech stimuli for verbal density, each Approval vocalization was matched with a Prohibition vocalization equivalent in number of syllables. The intervals between vocalizations varied from 450 ms to 1,200 ms for both Approvals and Prohibitions. However, because individual Approval vocalizations tended to have longer vowel durations than matched Prohibitions, the total duration of the sequence of 14 Approvals was 24 sec, while the duration of the Prohibition sequence was 20 sec. Multiple repetitions of the sequence of Approval vocalizations were dubbed continuously onto one stimulus tape; Prohibition vocalizations were dubbed onto a second stimulus tape.

The vocal stimuli were acoustically analyzed using the Micro Speech Lab (MSL) speech analysis routines on a Macintosh IIfx computer. For each stimulus tape, the mean F0 was calculated across the entire sequence of vocalizations. F0-range was calculated by subtracting the F0-minimum from the F0-maximum for each vocalization, and computing the mean F0-range for Approvals and Prohibitions. Both the standard deviation of the mean F0 and the mean F0-range were converted into semitones, in order to facilitate meaningful comparison of pitch variability and range across stimuli differing in mean-F0 (see Fernald et al., 1989). As indicated in Table 1, the mean F0 was higher, the F0-variability was greater, and the mean F0-range was wider for Approvals than for Prohibitions. Examples of F0-contours from the German stimuli are shown in Figure 1. As a manipulation check, six monolingual English-speaking adults were presented with 10 positive and 10 negative vocalizations in random order from the German stimuli and were asked to categorize these as either Approvals or Prohibitions. Listeners categorized 95% of the stimulus vocalizations correctly in this task.

Apparatus.—Testing was conducted in a sound-treated laboratory room, acoustically isolated from an adjacent control room. The testing booth consisted of 1 m × 2 m cloth-covered panels on three sides and was open on the fourth side. A chair for parent and infant was centered in the booth, facing the front panel. At the level of the infant’s eyes, a green blinker light was mounted on the front panel, operated from the control room. The lens of a Panasonic WV 3200 video camera projected through an opening in the front panel below the green light. Two JVC loudspeakers were mounted behind the left and right panels, at 45° angles to each side relative to the infant, at the level of the infant’s head. Two identical 10 cm × 12.5-
<table>
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<th>LANGUAGE</th>
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<td>English AD</td>
<td>212</td>
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</tr>
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* Mean $F_0$ calculated in hertz for each sequence of stimulus vocalizations.

$^b$ Standard deviation of mean $F_0$ converted into semitones to adjust for differences in absolute $F_0$.

$^c$ $F_0$-range calculated by subtracting $F_0$-minimum from $F_0$-maximum for each stimulus vocalization in the sequence, converted into semitones.

$^d$ In Experiment 3, Approvals and Prohibitions were approximately matched for $F_0$-characteristics.

**TABLE 1**

**MEAN FUNDAMENTAL FREQUENCY ($F_0$), STANDARD DEVIATION OF MEAN $F_0$ AND MEAN $F_0$ RANGE OF APPROVAL AND PROHIBITION VOCALIZATIONS USED AS STIMULI IN EXPERIMENTS 1-5**

![Diagram of F0 contours for German infant-directed Approval and Prohibition vocalizations used as stimuli in Experiment 1.](image-url)
Procedure.—The infant sat on the parent’s lap, facing the front of the testing booth. The parent listened to vocal music over AKG headphones, to divert attention from the stimuli presented to the infant. In the control room, the infant’s head position was observed on the monitor by a judge, blind to which set of speech stimuli was presented on which side of the testing booth. The responsibilities of the judge were to turn on the blinker light in order to draw the infant’s attention to midline at the start of a new trial; to signal the experimenter when to start a new trial, as soon as the infant’s eyes were centered; to judge when the infant made a criterion head-turn (>45°) toward the side on which the speech stimulus was presented; to judge when the infant looked away for more than 2 sec from the side on which the speech stimulus was presented, signaling the experimenter to stop the trial; to time the presentation of speech signals, stopping the trial after 20 sec if the infant had not yet looked away. Three individuals served as judge during this series of experiments, all trained extensively in judging criterion head-turns and look-aways.

The responsibilities of the experimenter were to calibrate the loudness levels of the speech stimuli before each test session; to assign each subject randomly to an experimental condition; to operate the tape recorders, following the judge’s signals to start and stop trials; to present each speech signal on the appropriate side, following a predetermined random trial order; to monitor the audio signals over headphones, making sure that sound production was terminated only during the silent intervals between vocalizations.

Each test session consisted of 16 trials, in which eight Approval and eight Prohibitions vocalizations were presented. On the first four trials, Approvals and Prohibitions were presented in alternating order; during the remaining trials, stimuli were presented in a different random order for each subject. Approval vocalizations were presented on the right side of the test booth for half the subjects, and on the left side for the other half. The initial order of presentation of Approvals and Prohibitions was also counterbalanced across subjects. If an infant failed to orient to the sound presentation within 10 sec on four or more of the 16 trials, or on two or more of the first four trials, the subject was excluded from the final sample.

Coding duration of looking-time.—Duration of infant head-turns was measured off-line from the video record. In preparation for coding, a laboratory assistant recorded the time code marking the onset and offset of the audio signal on each trial. This protocol was used by a coder who was blind to the hypothesis of the study and blind to the side of presentation of Approvals and Prohibitions. Watching the video display without the soundtrack, the coder used the slow-motion function of a Panasonic AG-1950 video editing deck to determine when the infant made a 45° head-turn, relative to the onset of each trial, and how long the head-turn was maintained. The time between the onset of the audio signal and the infant’s head-turn toward the side of sound presentation was coded as the response latency. The time from the infant’s head-turn toward the side of presentation and the infant’s return to midline, terminating the trial, was coded as duration of looking. If, however, the infant returned to midline for less than 2 sec during a trial, the trial was not discontinued. Since this judgment had been made on-line by the judge during the test session, the coder performed a post hoc manipulation check to correct for errors that affected the duration of sound presentation. In the few cases where the judge had either terminated a trial after a look-away <2 sec, or continued a trial after a look-away ≥2 sec, that trial was dropped from the analysis. If such errors occurred on more than one trial
for a given subject, the data from that subject were not included in the analysis and were recorded as experimenter error.

Coding infant affect. — Infant facial affect was coded off-line from the video record by a second coder blind to the hypothesis of the study and blind to the side of presentation of Approvals and Prohibitions. Positive and negative affect were coded separately, following procedures described by Hirshberg and Svejda (1990). Positive affect was rated on a three-point scale: 0 = neutral; 1 = positive attention; 2 = smile. The three-point scale for negative affect was: 0 = neutral; 1 = tense brow, wary; 2 = frown. Each trial was divided into 5-sec intervals, with one positive and one negative affect rating given for each interval. Mean positive and negative affect scores were computed for each trial.

Reliability. — Reliability was assessed by having two coders independently code the head-turn and affect data for 40% of the subjects. For the looking-time data, correlation coefficients ranged from .88 to 1.0 (M = .92). Cohen’s kappa values ranged from .75 to .87 (M = .82) for positive affect, and from .77 to .84 (M = .80) for negative affect. Given that infant affect could potentially provide a cue to the side of presentation of Approvals and Prohibitions, an additional reliability check was performed. A single trial from the videotape for each subject was randomly selected and dubbed onto a second videotape, so that no information about the previous responses of a given infant could influence coders’ judgments on any trial. Two coders independently coded duration of head-turn and facial affect for each of these 20 trials. The correlation coefficient for agreement between coders on this composite tape was .96 for duration of looking-time; kappa values were .81 for positive affect, and .79 for negative affect.

Data analysis. — Infant looking-time and affect data in Experiment 1 were analyzed using 2 x 2 x 2 mixed ANOVAs in which sex and side-of-approval were between-subject variables, and vocal expression (Approval, Prohibition) was the repeated measure. Comparable analyses were also used in Experiments 2–5.

Results and Discussion

Table 2 shows the mean durations of infant looking-time toward Approvals and Prohibitions in German ID speech. A 2 x 2 x 2 ANOVA yielded a significant main effect of vocal expression, \( F(1, 16) = 10.66, p < .005 \). No other main effects or interactions were significant. While the finding that infants looked longer to Approvals than to Prohibitions could reflect a preference for Approvals, it could also reflect a difference in the localizability of the two types of vocal expression. If infants oriented to Prohibitions more slowly than to Approvals because

<table>
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<tbody>
<tr>
<td>MEAN INFANT LOOKING-TIME (in Sec) IN RESPONSE TO APPROVAL AND PROHIBITION VOCALIZATIONS IN EXPERIMENTS 1–5</td>
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<table>
<thead>
<tr>
<th>Groupa</th>
<th>Approvals</th>
<th>Prohibitions</th>
<th>Approval/Prohibition Difference</th>
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<tbody>
<tr>
<td>Experiment 1: German ID</td>
<td>9.28</td>
<td>6.32</td>
<td>( p &lt; .005 )</td>
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<tr>
<td>Experiment 2: Italian ID</td>
<td>5.50</td>
<td>4.15</td>
<td>( p &lt; .02^b )</td>
</tr>
<tr>
<td>Experiment 3: English nonsense ID</td>
<td>5.97</td>
<td>5.49</td>
<td>N.S.</td>
</tr>
<tr>
<td>Experiment 4: Japanese ID</td>
<td>7.15</td>
<td>6.43</td>
<td>N.S.</td>
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<tr>
<td>Experiment 5: English ID</td>
<td>5.05</td>
<td>5.56</td>
<td>N.S.</td>
</tr>
<tr>
<td>English AD</td>
<td>5.61</td>
<td>5.06</td>
<td>N.S.</td>
</tr>
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</table>

\(^{a}n = 20\) for each group.

\(^{b}\) Effect of vocal expression significant only for infants presented with Approvals on the right side.

\(^{c}\) In Experiment 3, Approvals and Prohibitions were approximately matched for \( F_0 \)-characteristics.
they were more difficult to localize, this pattern could reduce the mean trial duration for Prohibitions. To investigate this possibility, the mean response latencies to the first two Approval trials and the first two Prohibition trials were computed for each infant. A paired t test revealed no differences in infants' initial response latencies to the two types of vocal expression.

Infants responded with more positive affect to Approvals than to Prohibitions spoken in German, as shown in Table 3. Infants also responded with more negative affect to Prohibitions than to Approvals, as shown in Table 4. Positive affect scores were analyzed in a $2 \times 2 \times 2$ ANOVA, revealing a significant main effect of vocal expression, $F(1, 16) = 7.10, p < .02$. The same analysis performed on the negative affect scores also yielded a significant main effect of vocal expression, $F(1, 16) = 4.52, p < .05$. No other main effects or interactions were significant.

In Experiment 1, 5-month-old English-learning infants responded with a differential looking-time and affect to Approvals and Prohibitions spoken in German, a language with which they were completely unfamiliar. When presented with vocal expressions typical of those used by German mothers when praising or scolding a preverbal infant, infants looked significantly longer to Approvals than to Prohibitions. Infants also showed significantly more positive affect when listening to Approvals and significantly more negative affect when listening to Prohibitions. It should be noted, however, that infants responded with both positive and negative affect to both kinds of stimulus vocalization and that the amount of negative affect shown overall was small in magnitude, an issue to be considered in the “General Discussion.” In the next experiment, this investigation of infants’ responsiveness to vocal affect in ID speech was extended to include a second language unfamiliar to American English infants, using more naturalistic vocal stimuli.

**Experiment 2**

The goal of Experiment 2 was to explore the generality of the findings of the first experiment, by presenting 5-month-old infants with Approval and Prohibition vocalizations in Italian and by using as stimuli spontaneous tokens of ID speech recorded from several different mothers. In Experiment 1, the German stimuli were spoken by a single speaker and were posed rather than natural, in order to equate the number of syllables across vocal expressions. The stimuli in Experiment 2, in contrast, consisted of spontaneous Approvals and Prohibitions recorded during home observations of Italian families.

**Method**

**Subjects.**—Subjects were 20 full-term, healthy infants (10 males, 10 females). Infants were 5 months old ($M$: 141 days; range:

<table>
<thead>
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<tr>
<td>INFANTS' POSITIVE AFFECT SCORES IN RESPONSE TO APPROVAL AND PROHIBITION VOCALIZATIONS IN EXPERIMENTS 1–5</td>
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<table>
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<tr>
<th>Group*</th>
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<tr>
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<td>.27</td>
<td>.34</td>
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* $n = 20$ for each group.

**Note.**—The values represent mean scores for infants’ positive facial affect, rated on a three-point scale: 0 = neutral, 1 = positive attention, 2 = smile.

* In Experiment 3, Approvals and Prohibitions were approximately matched for Fo*—characteristics.
TABLE 4
INFANTS’ NEGATIVE AFFECT SCORES IN RESPONSE TO APPROVAL AND PROHIBITION VOCALIZATIONS IN EXPERIMENTS 1–5

<table>
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<td>.19</td>
<td>( p &lt; .01 )</td>
</tr>
<tr>
<td>Experiment 3:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English nonsense ID</td>
<td>.06</td>
<td>.13</td>
<td>( p &lt; .05 )</td>
</tr>
<tr>
<td>Experiment 4:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese ID</td>
<td>.13</td>
<td>.09</td>
<td>N.S.</td>
</tr>
<tr>
<td>Experiment 5:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>English ID</td>
<td>.04</td>
<td>.09</td>
<td>( p &lt; .05 )</td>
</tr>
<tr>
<td>English AD</td>
<td>.10</td>
<td>.09</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

NOTE.—The values represent mean scores for infants’ negative facial affect, rated on a three-point scale: 0 = neutral, 1 = tense brow, 2 = frown.
\* \( n = 20 \) for each group.
\* In Experiment 3, Approvals and Prohibitions were approximately matched for \( F_q \) characteristics.

132–151 days). Twenty-five additional subjects were eliminated due to fussiness (13), failure to orient (8), or experimenter error (4).

Stimuli.—The positive and negative vocalizations used as stimuli in Experiment 2 were recorded during home visits to four monolingual Italian-speaking families in Rome, Italy, following procedures described by Fernald et al. (1989). From the recording of each Italian mother, a 6–9-sec segment was chosen in which she praised her infant for retrieving an object. An equivalent segment was chosen in which each mother scolded her infant for touching a forbidden object or tried to stop the infant from approaching the object. For each type of vocal expression, the four individual segments were combined on one audio tape, with 1,200-ms pauses between segments. The positive sequence consisted of 30 sec of ID Approval expressions from four Italian mothers, while the negative sequence consisted of 32 sec of ID Prohibition expressions by the same four speakers. Multiple repetitions of the Approval and Prohibition sequences were dubbed continuously onto two separate stimulus tapes.

As shown in Table 1, the mean \( F_q \) was higher, \( F_q \)-variability was greater, and the mean \( F_q \)-range was wider for Approvals than for Prohibitions, as in the German stimuli in Experiment 1. Six monolingual English-speaking adults, presented with 10 positive and 10 negative vocalizations from the Italian stimuli, categorized 98% of the vocalizations correctly as either Approvals or Prohibitions.

Results and Discussion
As shown in Table 2, infants listening to Italian mothers’ speech looked longer to Approvals than to Prohibitions, although effects of side were also found in this experiment. A 2 × 2 ANOVA yielded significant main effects of vocal expression, \( F(1, 16) = 8.21, p < .02 \), and side-of-Approval, \( F(1, 16) = 9.50, p < .01 \), as well as a significant vocal expression × side-of-Approval interaction, \( F(1, 16) = 11.94, p < .01 \). Infants who heard Approval vocalizations on the left side of the testing booth listened longer to both types of vocal expression than did infants presented with the opposite configuration. Follow-up tests indicated that only those infants who heard Approvals on the right side looked significantly longer to Approvals than to Prohibitions, \( F(1, 18) = 22.31, p < .0001 \). Subjects presented with positive vocalizations on the right looked 6.4 sec to Approvals and 3.9 sec to Prohibitions, while subjects presented with positive vocalizations on the left looked 4.6 sec to Approvals and 4.4 sec to Prohibitions. Of the 20 subjects in Experiment 2, 14 looked longer to Approvals than to Prohibitions; of the six subjects who showed the opposite pattern, four were in the condition in which Approvals were presented on the left. A
paired t test revealed no differences in infants' initial response latencies to Approvals and Prohibitions, indicating that infants could localize both types of vocal expression.

As shown in Tables 3 and 4, infants responded with more positive affect to Approvals than to Prohibitions in Italian ID speech and with more negative affect in response to Prohibitions than to Approvals. Positive affect scores were analyzed in a 2 × 2 × 2 ANOVA, revealing a significant main effect of vocal expression, F(1, 16) = 6.16, p < .05. The analysis of negative affect scores also yielded a significant main effect of vocal expression, F(1, 16) = 12.17, p < .01. No other main effects or interactions were significant in these analyses.

In Experiment 2, 5-month-old infants responded with differential looking-time to positive and negative vocalizations from the spontaneous ID speech of four Italian mothers, although this preference was significant only when Approvals were presented on one side of the booth. Thus the looking-time findings of Experiment 1 were only partially replicated in Experiment 2. American infants listening to Italian mothers' speech also responded with more positive affect to Approvals and with more negative affect to Prohibitions. Infants' greater positive affect in response to Italian and German Approvals is consistent with the hypothesis that infants prefer to listen to these positive vocal stimuli. However, it is not clear from these data that it was the affective quality of the Approval vocalizations that elicited the listening preference. Since the Approvals in Experiments 1 and 2 were characterized by high mean F0 and wide F0-range, while the Prohibitions had a narrower F0-range, as shown in Table 1, it could be that it was the difference in the extent of overall F0-modulation that recruited longer looking-time and more positive affect to Approvals in most infants, rather than other acoustic features uniquely associated with affective quality. Infants might simply smile more to wide-range pitch contours than to narrow-range pitch contours, regardless of the affective tone of the vocalization. This alternative hypothesis is quite plausible, in light of Fernald and Kuhl's (1987) finding that 4-month-old infants listened more to wide-range F0-contours, typical of ID speech, than to narrow-range F0-contours, typical of AD speech, even when other acoustic features were held constant. To investigate this possibility, the next experiment focused on Approval and Prohibition vocalizations equivalent in F0-modulation.

**Experiment 3**

The goal of Experiment 3 was to eliminate the confound between F0-characteristics and affective quality which characterized the ID Approval and Prohibition vocalizations used as stimuli in Experiments 1 and 2. In order to determine whether infants' responses to Approvals and Prohibitions were simply related to differences in frequency range and modulation, the positive and negative vocal stimuli in Experiment 3 were approximately matched in F0-range and F0-variability. It was predicted that infants would look longer and show more positive affect to Approvals than to Prohibitions, even when these vocal expressions were matched in F0-characteristics. The positive and negative vocal stimuli consisted of American English prosodic patterns using identical nonsense syllables, in order to eliminate differences in segmental content between Approvals and Prohibitions.

**Method**

Subjects.—The subjects in Experiment 3 were 20 full-term, healthy infants (10 males, 10 females). Infants were 5 months old (M: 141 days; range: 138–150 days). Twelve additional subjects were eliminated from the study due to fussiness (5), failure to orient (5), or experimenter error (2).

Stimuli.—The stimuli in Experiment 3 consisted of a sequence of 14 vocalizations each consisting of one to four English nonsense “words,” including only syllables which are phonologically acceptable in English, (e.g., Bem nol kren and Zot). A native speaker of American English, experienced with infants, was instructed to produce the same sequence of nonsense utterances in two different ways, once as if praising a preverbal infant, and once as if scolding the infant. Prior to recording the stimuli, the speaker practiced extensively, using visual feedback from a Visipitch F0-analyzer (Kay Elemetrics) to ensure that the positive and negative vocalizations were matched in overall F0-range. As shown in Table 1, English nonsense Approvals and Prohibitions were similar in F0-range and F0-variability. The stimuli were recorded and dubbed onto two stimulus types. The total durations of the Approval and Prohibition sequences were 23 sec and 21 sec, respectively. Six English-speaking adults categorized 85% of the English nonsense stimulus vocalizations correctly as Approvals or Prohibitions.
Results and Discussion

Table 2 shows the mean durations of infant looking-time toward English nonsense Approvals and Prohibitions. A $2 \times 2 \times 2$ ANOVA yielded no significant main effects or interactions. Paired $t$ tests revealed no differences in initial response latencies to the two types of vocalization. Infants' mean affect scores to positive and negative vocal expressions in ID English nonsense speech are shown in Tables 3 and 4. Positive and negative affect scores in response to Approvals and Prohibitions were analyzed in $2 \times 2 \times 2$ ANOVAs. Infants listening to English nonsense stimuli showed significantly more positive affect to Approvals than to Prohibitions, $F(1, 16) = 5.97, p < .03$, and more negative affect to Prohibitions than to Approvals, $F(1, 16) = 5.63, p < .03$, with no other significant main effects or interactions.

In the first two experiments, positive vocalizations were higher in mean-F$_g$ and wider in F$_g$-range than negative vocalizations, as is typical of Approvals and Prohibitions in mothers' speech in a number of languages (Fernald, 1992a). In Experiment 3 the two types of vocal expression were more similar in F$_g$-range and F$_g$-variability (see Table 1), thus eliminating the previous confound between F$_g$-modulation and affective quality. Even when positive and negative vocalizations were matched in pitch range and variability, infants listening to English nonsense speech responded with small but significant differences in affect. This finding suggests that subjects in Experiments 1 and 2 were not simply responding to differences in pitch range and variability but were sensitive to other acoustic features differentiating Approvals and Prohibitions, such as spectrum, intensity, and rise time. Which of these acoustic features are critical in eliciting affect in infants is a question for future research.

While infants looked reliably longer to positive vocalizations in Experiments 1 and 2, there was no difference in mean looking-time to Approvals and Prohibitions in Experiment 3. Thus when negative and positive vocalizations were similar in F$_g$-variability and F$_g$-range, infants looked equally long to both. Should the absence of differential looking to Approvals in Experiment 3 be interpreted as the absence of a listening preference for positive over negative vocalizations in English nonsense speech? One possible explanation for these results is that infants were unable to discriminate Approval and Prohibition vocalizations which were similar in pitch characteristics. However, the finding that infants listening to English nonsense speech responded with differential affect is not consistent with this interpretation. Subjects' affective responsiveness to English nonsense speech suggests that the positive and negative vocalizations were indeed discriminable. Moreover, infants' positive affective response to Approvals in English nonsense speech would seem to indicate a listening preference for these positive vocal expressions even in the absence of a difference in looking-time. The discrepancy between looking-time and affect in Experiment 3 suggests that these two measures may assess different aspects of infants' response to auditory signals. Although English nonsense Approvals and Prohibitions were equally effective in maintaining infant attention, they were not equivalent in their influence on infant emotion. Infants showed evidence of greater pleasure in response to Approvals and greater displeasure in response to Prohibitions. One implication of these findings is that infants' looking-time to German and Italian Approval vocalizations in Experiments 1 and 2 may have been determined primarily by the wide F$_g$-range of these signals, rather than by other acoustic features uniquely associated with positive vocal affect.

Experiment 4

The purpose of Experiment 4 was to test the generality of the findings of Experiments 1–3 by presenting infants with Japanese ID speech, a choice motivated by two considerations: First, Japanese differs in prosodic structure from the languages used in the three previous experiments, although ID speech in Japanese is similar in its global prosodic characteristics to ID speech in European languages (Fernald et al., 1989). Second, cross-cultural research on the perception of emotional signals by adults has shown that Japanese facial expressions (Shimoda, Argyle, & Riccibitti, 1978) and vocal expressions (Magno-Calvognetto & Kori, 1983) are more difficult to identify than analogous English or Italian emotional expressions.

Method

Subjects.—The subjects in Experiment 4 were 20 full-term, healthy infants (10 males, 10 females). Infants were 5 months old ($M$: 140 days; range: 133–152 days). Fourteen additional subjects were eliminated from the study due to fussiness (4),
failure to orient (8), or experimenter error (2).

Stimuli.—The stimuli consisted of excerpts from recordings made during home visits to three native Japanese families who were visiting the San Francisco area for a short period. The mothers in these families were all monolingual speakers of Japanese. A Japanese research assistant recorded mothers interacting with their 10–14-month-old infants, following procedures described by Fernald et al. (1989). From each recording, segments were chosen in which the mother spontaneously praised and scolded her infant. For each type of vocal expression, 6–9-sec segments from each speaker were combined on one audio tape, with 1,200-ms pauses between segments. The Approval sequence consisted of 22 sec of praise expressions, while the Prohibition sequence consisted of 24 sec of disapproval expressions from the same three speakers. In these spontaneous Japanese vocalizations, the mean-F_r was higher and F_r-variability was greater in Approvals than in Prohibitions, although the mean F_r-range was similar (see Table 1). Six monolingual English-speaking adults categorized 82% of the Japanese stimulus vocalizations correctly as Approvals or Prohibitions.

Results and Discussion

Table 2 shows the mean looking-times to Japanese Approvals and Prohibitions. A 2 x 2 x 2 ANOVA yielded no significant main effects or interactions. Paired t tests revealed no differences in initial response latencies to the two types of vocalization. Mean affect scores in response to positive and negative vocal expressions in Japanese ID speech are shown in Tables 3 and 4. ANOVAs performed on positive and negative affect scores revealed no significant main effects or interactions.

In Experiment 4, English-learning infants failed to respond differentially to positive and negative vocalizations in Japanese ID speech. Although differing in mean-F_r, Japanese Approvals and Prohibitions were more similar in F_r-range and F_r-variability than were the positive and negative vocal stimuli used in Experiments 1 and 2. Moreover, Japanese Approvals were relatively narrow in F_r-range, compared to the German and Italian Approvals. The attenuation of F_r-range in Japanese mothers’ speech relative to ID-speech in European languages was also noted by Fernald et al. (1989) and is consistent with other research showing that facial and vocal expressions of emotion tend to be much less extreme among Japanese than American adults (Ekman, 1972). The limited prosodic contrast between positive and negative vocalizations may have made Japanese Approvals and Prohibitions more difficult for infants to discriminate. It is interesting to note that the English-speaking adults who were asked to categorize the vocal stimuli in this series of experiments were less accurate when judging vocal expressions in Japanese than in German, Italian, or nonsense English, consistent with the finding of Magno-Caldognetto and Kori (1983) that European listeners were often unable to identify the intended affect in Japanese vocal expressions.

Experiment 5

In Experiment 5, infants were presented with positive and negative vocalizations in both ID and AD speech in American English. One goal of this experiment was to provide a native-language control, since the stimuli used in Experiments 1–4 were all in languages unfamiliar to the infant subjects. The second goal was to test the hypothesis that infants would respond differentially to affective vocalizations in ID speech but not in AD speech.

Method

Subjects.—The subjects in Experiment 5 were 40 full-term, healthy infants (20 males, 20 females). Infants were 5 months old (M: 138 days; range: 131–147 days). Sixteen additional subjects were eliminated from the study due to fussiness (5), failure to orient (8), or experimenter error (3). Twenty infants were randomly assigned to the ID speech condition, and 20 to the AD speech condition, with equal numbers of males and females in each group.

Stimuli.—The stimuli in Experiment 5 were spoken by three female native speakers of American English, all experienced with infants. Approvals and Prohibitions in both ID and AD speech were recorded in role-played scenarios. While the text was improvised, speakers were instructed to use the word Good frequently in Approvals directed to both infants and adults and to use the words No and Don’t frequently in Prohibitions directed to both infants and adults, in order to match the semantic content within and across the ID and AD speech conditions. For the AD Prohibitions, each speaker role-played the following scene with an adult colleague: The adult col-
league, while hanging a picture on the wall, started to step backward into an electrical cord, knocking over a lamp. The speaker tried to prevent this accident with such warnings as No! Don't step back! Don't put your foot there. The AD Approvals were role-played in a scene in which the speaker congratulated her colleague for completing a difficult task, using such praise expressions as Good job! That's great, you're finally finished. Good work. For ID Prohibitions, speakers spoke as if attempting to stop an infant from touching an electrical cord, while for ID Approvals, they spoke as if praising an infant for putting a ring toy together. From the recordings of each speaker, 6-9-sec segments of Approvals and Prohibitions to each addressee were chosen, matched for the number of positive and negative words. Two ID and two AD speech stimulus tapes were constructed, following procedures described in Experiments 2 and 4. The durations of the ID Approval and Prohibition sequences were 26 sec and 24 sec, respectively; the durations of the AD Approval and Prohibition sequences were 22 sec and 23 sec, respectively.

Results and Discussion

Table 2 shows the mean duration of infant looking-time toward Approvals and Prohibitions in ID and AD speech in English. Looking-times were analyzed separately for ID and AD speech in 2 x 2 x 2 ANOVAs, which yielded no significant main effects or interactions. Paired t tests revealed no differences in initial response latencies to the two types of vocalization for infants in either condition. Infants' mean affect scores to positive and negative vocal expressions in ID and AD speech are shown in Table 3. Positive and negative affect scores in response to ID and AD stimuli were analyzed separately in 2 x 2 x 2 ANOVAs. Infants listening to ID speech showed significantly more positive affect to Approvals than to Prohibitions, F(1, 16) = 9.69, p < .01, and significantly more negative affect to Prohibitions than to Approvals, F(1, 16) = 5.45, p < .05. In contrast, infants listening to AD speech showed no reliable differences in their affective responses to Approvals and Prohibitions. The only significant finding to emerge in the analyses of infants' emotional responses to AD speech was that females showed more negative affect than males, F(1, 16) = 5.18, p < .05. No other main effects or interactions were significant.

The finding that infants did not look longer to Approvals in either ID or AD speech in Experiment 5 was surprising, given that positive and negative vocalizations were spoken in a language familiar to the subjects, and Approvals were wider in F0-range than Prohibitions. In Experiments 1 and 2, which also used positive and negative vocalizations differing in F0-range, infants tended to look longer to Approvals. The interpretation proposed earlier, that the wide F0-range of Approvals might recruit greater attention, would predict a similar difference in looking-time to the English stimuli in Experiment 5. The major finding of Experiment 5 was that infants responded with differential affect to positive and negative vocalizations in ID speech but not in AD speech in natural English, consistent with the view that affective communication is an important function of the special prosody of ID speech in the preverbal period (Fernald, 1992b).

General Discussion

In this series of experiments investigating infants' responsiveness to affective vocalizations in different languages, four major findings emerged. First, 5-month-old infants showed an overall tendency to respond with more positive affect to Approvals and more negative affect to Prohibitions. Thus infants showed small but significant differences in their emotional responses to affective vocal expressions in the absence of affective facial expressions. Second, ID vocalizations elicited differential emotional responses in infants, while AD vocalizations did not. Third, contrary to expectations, infants did not look consistently longer to Approvals than to Prohibitions, suggesting that looking-time and emotional responsiveness may be affected by different acoustic features of vocal expressions. Finally, infants familiar only with English showed evidence of differential responsiveness to affective vocal expressions in German, Italian, nonsense English, and natural English ID speech, but not in Japanese.

The finding that 5-month-old American infants show more positive affect to Approvals and more negative affect to Prohibitions, spoken in two unfamiliar languages as well as in nonsense and natural English, provides the first evidence that young infants respond differentially to positive and negative vocal expressions presented without facial affect. These results extend Haviland and L eliccia's (1987) finding that adult facial-plus-vocal displays of happiness and anger induced matching facial affect in 10-week-old
infants. However, while Haviland and Lel-wica implied that adult facial expressions were critical in inducing appropriate emo-
tional responses in infants, the present find-
ings call this interpretation into question. In Experiments 1, 2, 3, and 5, ID vocal expres-
sions presented without affective facial ex-
pressions were sufficient to elicit positive and negative affect from 5-month-old in-
fants. Research showing that 7-month-old in-
fants fail to categorize happy and angry facial expressions without concurrent vocal affect (Caron et al., 1988) lends further support to the view that infants at this age attend more to vocal than to facial cues when responding to emotional expressions. An early reliance on auditory rather than visual cues in pro-
cessing emotional displays would not be sur-
prising, given that infants' auditory percep-
tual abilities are more mature than their visual perceptual abilities in the first months of life (Aslin, 1987).

While the evidence for positive affect in response to Approvals was robust across all ID speech samples except Japanese, the evidence for negative affect was similar but less convincing. Infants responded with mixed affect to both kinds of vocalization, but when they showed negative affect it was signifi-
cantly more likely to occur in response to Prohibitions. The mean negative affect scores in response to Prohibitions, even when reliably different from the negative af-
fact scores for Approvals, were generally low, reflecting an overall tendency toward neutral affect. However, the relatively low frequency of negative affect in these experi-
ments needs to be understood in terms of certain basic limitations both of infants and of the experimental procedure. The pro-
cedure involved eight presentations each of positive and negative vocal stimuli in quasi-
random order within a 7-10-min test ses-
sion. While it is possible to make an infant smile repeatedly, eliciting repeated alterna-
tions between distress and smiling is less feasible. In fact, whenever a subject became really distressed in response to a stimulus vocalization, the test session was discon-
tinued and eliminated from the sample. Moreover, Approvals and Prohibitions were pre-
presented at equivalent loudness levels, al-
though under natural conditions Prohibi-
tions would typically be more intense.

It is therefore not surprising that indi-
vidual infants in this procedure did not alter-
nate between extremes of smiling and dis-
tress. Instead, those infants who smiled frequently to Approvals tended to become}

sober in response to Prohibitions, but not to frown or cry, while those infants who showed considerable distress to Prohibi-
tions tended to brighten, but not to smile, in response to Approvals. This effect may ex-
plain the pattern of results in Experiment 2 with Italian vocalizations. The English-
speaking adult listeners who made category judgments about the auditory stimuli consis-
tently commented that the Italian vocaliza-
tions were the most emotionally intense of all the stimuli, while the Japanese stimuli were the least emotionally intense. Experi-
ment 2 had the highest attrition rate due to infant distress, and many infants who com-
pleted the test session responded with ex-
treme negative affect to the Italian Prohi-
bitions. Frequent negative responses to prohibitions may have resulted in an attenu-
ation of positive affect in response to Italian Approvals. Moreover, almost all of the sub-
jects who reacted negatively to Italian Prohi-
bitions also showed some negative affect to Approvals. Such carryover effects are well
-known in procedures involving presentation of negative emotional signals to infants. Given that infants cannot switch back and forth between positive and negative affect over repeated trials, a design better suited for eliciting both extremes might involve blocks of positive and negative trials, sepa-
rated by a substantial break. As it was, in-
fants' negative reactions to Prohibition vo-
calizations were probably underestimated here, given the compromises necessary to keep attrition to a minimum.

Infants' display of differential affect in response to positive and negative vocaliza-
tions in these languages was not consistently accompanied by differences in looking-time. When listening to German, infants looked longer and showed more positive affect to Approvals. When listening to Italian, infants also tended to look longer to Approvals, al-
though this effect was qualified by an inter-
action with side of presentation. However, both nonsense English and natural English ID speech elicited differential affect without corresponding differences in looking-time. One interpretation consistent with the find-
ings of Experiments 1—3 is that infants at-
tend more to vocal stimuli with greater F0-
modulation, regardless of whether they "prefer" these vocalizations in the sense of liking them better. Wide-range vocal signals may simply be more compelling, just as si-
rens are compelling although not necessarily pleasant to listen to. Thus when Approvals and Prohibitions were matched in F0-range
and \(F_0\)-variability, as in the English nonsense and Japanese stimuli, the looking-time difference disappeared. However, infants still responded with differential affect to English nonsense Approvals and Prohibitions, suggesting that acoustic features other than \(F_0\)-modulation distinguished these vocalizations as positive and negative in affective valence. Unfortunately, this interpretation does little to explain why the infants listening to natural English ID vocalizations failed to look longer to Approvals. Given the discrepancies between the looking-time and affect measures across Experiments 1–5, it seems safest to conclude that these behaviors may index different aspects of infants’ responsiveness to acoustic signals. Looking-time may be determined by the relative “compellingness” of auditory stimuli, often correlated with \(F_0\)-modulation, while infant affect may be influenced more by other acoustic features, such as \(F_0\)-contour, intensity, and spectrum.

Why did infants listening to ID-speech in German, Italian, and natural nonsense English respond to Approvals with signs of pleasure? And when they showed displeasure, why was it more likely to occur in response to Prohibitions? The affective preference of 5-month-old American infants for Approvals over Prohibitions in English ID speech could be attributable to previous experience with these types of vocalization. However, before discussing possible effects of experience on infant listening preferences, two alternative explanations will be considered. First, it could be argued that infants were innately sensitive to the meaning of emotional expressions, as Darwin (1872/1965) proposed. This explanation assumes that expressions of vocal affect are similar in form across cultures, as has been documented for facial expressions (Ekman, 1972). Research on universal features of vocal affect shows that adults are fairly accurate in decoding emotional meaning from vocal cues, although there is less consensus about which acoustic correlates differentiate emotional vocalizations (Scherer, 1986). However, several studies indicate that increases in mean \(F_0\) and \(F_0\)-range are typical of expressions of enjoyment and happiness, while decreases in mean \(F_0\) and \(F_0\)-range characterize expressions of irritation and controlled anger (see Scherer, 1986). Thus the wide-range Approvals and narrow-range Prohibitions used as stimuli in Experiments 1, 2, 4, and 5 have prosodic features typical of expressions of happiness and irritation, respectively. Perhaps infants recognize the emotions expressed in these vocalizations and respond, in Darwin’s words, with “an instinct of sympathy” arising from their “innate knowledge of expression” (Darwin, 1872/1965, p. 358). However, the finding that infants did not show differential affect to Approval and Prohibition vocalizations either in AD English or in ID Japanese argues against a simple nativist account.

A second explanation for infants’ emotional responsiveness to Approval and Prohibition vocalizations also derives from Darwin (1872/1965), who observed that the acoustic features of animal calls are often well designed to achieve particular effects on the listener. Perhaps infants smile more to Approvals in ID speech because these exaggerated rise-fall pitch contours are intrinsically pleasing to listen to. Prohibitions, in contrast, are startling in their abrupt onset and harsher in tone quality and thus may elicit more negative affect (see Fernald, 1992a). According to this explanation, infants respond with more pleasure to pleasant sounds, and with more displeasure to unpleasant sounds, without necessarily knowing anything about the emotional states motivating the production of these sounds by the speaker. Of course, since pleasant-sounding Approval vocalizations are generally accompanied by smiles and other indices of the mother’s positive affect, and Prohibitions co-occur with other indices of negative affect, infants may soon come to understand that particular vocal patterns are informative about the speaker’s emotional state. Initially, however, these characteristic vocal patterns could function as unconditioned stimuli, eliciting positive and negative affect by virtue of their intrinsic acoustic properties, although not yet appreciated as cues to the emotional state of the speaker (Fernald, 1992b).

The argument that mothers’ vocal expressions have an immediate emotional effect on young infants must be qualified in light of the finding that American infants were affectively responsive to ID vocalizations in nonsense and natural English and two other European languages but not in Japanese. This finding suggests that affective vocalizations in Japanese differ acoustically from those in English, German, and Italian. The reduced \(F_0\)-range in Japanese mothers’ speech may reflect the attenuation of affect typical of Japanese emotional expressions (Ekman, 1972). While the Japanese and European Approvals share an over-

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all rise-fall F0-pattern, the Japanese vocalizations have less F0-variability, a smoother amplitude envelope, more pronounced vowel elongation, and a distinctive tonal structure, in addition to a narrower F0-range. However, since prosodic contours are complex functions of graded changes along multiple acoustic dimensions, it is not a simple matter to quantify such perceptual differences in terms of acoustic attributes. Future research is needed to identify which prosodic features are universal correlates of vocal affect and how culture-specific display rules influence the acoustic structure of vocal expressions.

One interpretation for the finding that American infants are affectively responsive to English, German, and Italian vocalizations but not to Japanese vocalizations is that by 5 months of age these infants have already become accustomed to the exaggerated affective displays typical in European cultures. For American infants as well as adults, the relatively exaggerated German and Italian vocal expressions may be perceived as similar to those in English, while the less exaggerated Japanese vocalizations may seem less similar. Japanese infants, on the other hand, may become accustomed to the narrower dynamic range of vocal expression typical of their culture. According to this explanation, infants in all cultures are initially responsive to the same vocal cues. However, cultural differences in display rules governing emotional expression may determine the levels and range of emotional intensity to which the infant is routinely exposed and which the infant comes to expect in social interaction with adults. Such a process of cultural “calibration” would account for the finding that American infants were maximally responsive to affective vocalizations in ID German, natural English, and English nonsense speech, perceived to be moderate in emotional intensity by American adults. Italian ID vocalizations, perceived by adults as more intense than English ID vocalizations, were clearly aversive to many American infants, although infants responded in general with appropriate affect. Japanese vocalizations, in contrast, perceived as less intense by adult listeners, failed to elicit a differential emotional response from American infants. Future research focusing on infants from other cultural backgrounds will be necessary to explore further the hypothesis that both universal acoustic features and early experience within a particular culture influence the responsiveness of young infants to affective vocal expressions in parental speech.

References


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