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Distinctive Messages in Infant-Directed Lullabies and Play Songs

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Mothers were recorded singing a song of their choice in both a lullaby style and a play-song style to their 6-month-olds. Adult raters identified the play-song-style and lullaby-style versions with 100% accuracy. Play-song-style renditions were rated as being more brilliant, clipped, and rhythmic and as having more smiling and more prominent consonants. Lullaby-style renditions were characterized as being more airy, smooth, and soothing. Adults observed videotapes (without sound) of 6-month-olds listening to alternating lullaby-style and play-song-style trials and performed at above chance levels when determining which music the infants were hearing. Coding analyses revealed that infants focused their attention more toward themselves during lullaby-style trials and more toward the external world during play-song-style trials. These results suggest that singing may be used to regulate infants' states and to communicate emotional information.

Singing to infants occurs in every known human culture and historical period (Trehub & Trainor, in press). Not only do songs for infants differ structurally from other song categories (Trainor, 1996; Trehub & Trainor, in press; Trehub, Unyk, & Trainor, 1993a; Unyk, Trehub, Trainor, & Schellenberg, 1992), but parents also perform songs differently when singing to their infants than they otherwise do (Trainor, 1996; Trainor, Clark, Huntley, & Adams, 1997; Trehub et al., 1997; Trehub, Unyk, & Trainor, 1993b). The function of infant-directed singing is not well understood, however. One possibility is that caregivers use music to help regulate their infants' states and to communicate emotional information (Trainor, 1996). To test this hypothesis, we examined whether mothers communicate different messages to their infants by using different performance styles. Specifically, we tested whether mothers sing differently when trying to communicate that it is time to sleep versus that it is time to play, regardless of the specific song that is sung.

There is reason to believe that infants are very sensitive to performance style. When interacting with prelinguistic infants, adults modify the prosodic characteristics of their speech utterances, using large pitch contours, a high pitch range, rhythmic patterning, prolonged duration of content words, slower tempo, and greater pauses between utterances (e.g., Fernald, 1991; Fernald & Simon, 1984; Papousek, Papousek, & Haekel, 1987). Furthermore, it appears that mothers, fathers, and older siblings all produce these expanded pitch excursions and that they occur across most, if not all, languages (Fernald, 1991, 1993; Fernald et al., 1989; Gleason, 1973; Grieser & Kuhl, 1988; Papousek et al., 1987; Papousek, Papousek, & Symmes, 1991; Weeks, 1971).

Young infants do not understand word meanings, so what does infant-directed speech communicate to infants? Immediately after birth, infants recognize and prefer the sound of their mothers' voice over that of a stranger (DeCasper & Fifer, 1980). In adults, prosodic features and the vocal quality of speech can communicate emotions such as tension, aggression, happiness, and nervousness, and these emotions can be identified across cultures (Ekman, Friesen, & Scherer, 1976; Frick, 1985; Scherer, 1986; Tartter, 1980). Infants are also sensitive to prosody. Beginning at birth and throughout infancy infants prefer to listen to the exaggerated prosody of infant-directed speech over adult-directed speech (Cooper & Aslin, 1990; Fernald, 1985; Fernald & Kuhl, 1987; Pegg, Werker, & McLeod, 1992). Most interesting in the present context is that the pitch contours of infant-directed speech appear to be meaningful for infants (Fernald, 1992, 1993; Papousek, Bornstein, Nuzzo, Papousek, & Symmes, 1990; Papousek et al., 1991). According to Fernald (1989, 1992), four specific interactional contexts are associated with characteristic prosodic patterns: (a) Rising contours elicit attention; (b) bell-shaped contours with a high fundamental frequency and a wide pitch range are encouraging or approving; (c) falling pitch contours with a narrow and low pitch range are comforting; and (d) short, low pitch contours that have an abrupt onset are negative and inhibiting (Fernald, 1989, 1992). Furthermore, infants respond with more positive affect when listening to speech in an approving manner and with more negative affect when listening to prohibitions (Fernald, 1993).

The prosodic modifications of infant-directed speech, such as its large pitch contours and rhythmic patterning, make the speech more like music. Infants respond to and attend to these musical qualities, which communicate meaning. As summarized by Fernald (1989), the melody is the message. Thus, the infant-directed speech literature suggests that music itself may be an even more powerful medium than speech for affective communication with infants. Music is closely associated with the expression of emotions (Meyer, 1956; Sloboda, 1991). Moreover, Trainor and Trehub (1992) demonstrated that children as young as 3 years of age

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are able to attribute emotional qualities to musical excerpts by using metaphors. Music has been used throughout most of human history as a form of healing and therapy (Hall, 1982; Thayer Gaston, 1968), and in modern Western society, many individuals use music as a form of relaxation therapy to eliminate insomnia and headaches and to reduce muscle tension (Schulberg, 1981).

Given the prevalence of singing to infants and the strong association between music and emotional expression, it is logical to consider whether caregivers use singing to regulate their infants' states. Previous research has established that parents sing differently to their infants than when singing alone (Trainor, 1996; Trehub et al., 1993b, 1997). Across studies, it has been found that the infant-directed versions are higher in pitch and slower and are sung in a more loving or smiling tone of voice than are the non-infant-directed versions (Trehub & Trainor, in press). Trehub et al. (1997) found that men and women of various musical abilities, caretaking backgrounds, and cultural affiliations were all able to identify infant-directed singing even when they were compared with samples in which parents simulated infant-directed singing, that is, attempted to sing as they would to their infants when their infants were not present. Thus, the presence of an infant appears to be a powerful elicitor of the infant-directed style of singing.

To establish that infant-directed singing serves an important communicative function, it is necessary to examine infants' responses. Trainor (1996) found that infants 5 to 6 months of age preferred to listen to infant-directed singing over non-infant-directed singing. Furthermore, the degree of preference was significantly related to adults' ratings of voice quality. Infants preferred to listen to renditions sung in a highly loving tone of voice. This research established that infants prefer and attend to infant-directed singing. However, it did not indicate whether differential affective messages can be communicated to infants through singing. This question is the focus of the present article.

There is suggestive evidence that mothers use different styles of singing with infants. Trehub et al. (1993b) found that the types of songs chosen by mothers varied across cultures. English-speaking mothers usually sang arousing or playful songs to their infants, whereas Hindi-speaking mothers usually sang slower religious songs, suggesting that different singing styles occur across cultures and caretaking contexts. Trainor (1996) asked English-speaking adults to listen to English infant-directed songs and to classify them in one of two ways: (a) attempting to put a baby to sleep or (b) arousing or playing with a baby. The perceived functions were subsequently designated as a lullaby and a play song, respectively. Adults were consistent in classifying most of the musical excerpts. Acoustic analyses revealed that the infant-directed play songs were more rhythmic (e.g., stressed or accented syllables were relatively longer) than their infant-absent pairs, whereas the opposite was true for the lullabies (Trainor et al., 1997). Those songs classified as lullabies were lower in pitch, were less rhythmic, and had less pitch variability and a less emotional voice quality than those classified as play songs (Trainor et al., 1997). However, it was not clear whether adults' lullaby–play-song classifications were based on the singing style of the performer or on the structure of the song (i.e., pitch and durational relations comprising the melody), because the songs classified as lullabies (e.g., "Rock-a-Bye Baby") were different from the songs classified as play songs (e.g., "Skinamerink").

In this article, we examined the effect of singing style independent of song structure by recording mothers singing the same song in a lullaby style and in a play-song style. The first purpose of the present investigation was to determine whether adults could distinguish between a play song and a lullaby on the basis of performance style. The second purpose was to determine the performance or stylistic modifications that might distinguish between infant-directed lullabies and play songs. The third purpose was to determine whether these two singing styles have different meanings for 6-month-old infants. To this end, various behaviors were examined while infants listened to lullaby-style and play-song-style versions.

Experiment 1

Adult participants were asked to listen to recordings of mothers singing the same song (of their choice) twice to their infants and to identify which of the pair was intended to be a lullaby and which a play song. Subsequently, a number of characteristics were rated by separate groups of adults to ensure no carryover effects. We predicted that lullabies would be rated as more soothing, more smooth as opposed to clipped, and more airy in voice quality than would play songs. In addition, we predicted that play songs would be rated as being more rhythmic, having more prominent consonants, being more clipped as opposed to smooth, and being more brilliant and smiling in voice quality than would lullabies.

Method

Participants

The participants were 72 undergraduate students (52 women and 20 men) between 18 and 30 years of age. Data from an additional 3 participants were discarded for failure to answer all the questions.

Stimuli and Apparatus

Nineteen mothers were recorded singing to their 6- to 7-month-old infants (10 boys and 9 girls). Unaware of the hypothesis of the experiment, the mothers were asked to sing a song of their choice in one of two ways: in a manner that would put their child to sleep (lullaby style) or in a playful, arousing manner (play-song style). Subsequently, they were asked to sing the same song with the opposite intent. Thus, two infant-directed recordings of the same song, one in lullaby style and one in play-song style (lullaby–play-song pair), were made for each mother–infant dyad.

Recordings were made in a quiet, comfortable room in the laboratory. The infant was placed in an infant seat on a table, and the mother sat directly in front of her child. By using an omnidirectional video production microphone (Shure VP64), which hung above the mother and the infant, the samples were recorded directly to a Comptech 486 PC running Computerized Speech Research Environment software. With the exception of the microphone, all equipment was located in an adjacent room. The mother was left alone to sing and signaled the beginning and the end of her song by pressing a switch that sounded a buzzer in the adjacent room containing the recording equipment.

Three pairs of lullabies and play songs were unusable because the mothers did not follow the instructions. The remaining 16 pairs of lullabies and play songs consisted of 8 cases in which the mothers sang in the lullaby style first and 8 cases in which the mothers sang in the play-song style first. Thirteen of the songs were sung in English, 1 in French, 1 in German, and 1 in Hebrew. The samples were edited to produce pairs of lullabies and play songs that contained identical segments of music and comparable baby

noises. The mean length of the edited lullaby-style excerpts was 30.62 s and ranged from 8.64 s to 60.86 s. The mean duration of the play-song-style excerpts was 24.71 s and ranged from 6.02 s to 59.13 s.

Four audiotapes were created using Sound Designer II software running on a Macintosh IIci and a Denon precision audio component–stereo cassette tape deck (DRS-610). Both Tape 1 and Tape 2 consisted of the same 16 trials, each separated by 8 s to allow adult raters to record their responses. Each trial consisted of the lullaby–play-song pair of a single mother–infant dyad. For half of the trials, the lullaby-style rendition was first, and for the other half, the play-song-style rendition was first (regardless of the initial order in which they were recorded). The order of the 16 mother–infant dyads on Tape 1 corresponded to the chronological order in which the data were collected. Tape 2 was identical to Tape 1 except that the order of the mother–infant dyads and the order of the lullaby–play song within each dyad were reversed.

Tape 3 contained the 32 recordings (16 lullaby-style renditions and 16 play-song-style renditions) in single-sample trials. Again, trials were separated by 8 s and were presented in random order with the constraint that the lullaby-style and play-song-style renditions by each mother did not occur in succession. Tape 4 was identical to Tape 3 except that the order of the 32 single trials was reversed.

Procedure

Nine groups of 8 adults rated the singing samples. They listened to the recordings on a Sony (TCFX-210) stereo cassette tape deck using Telephonics (TDF-49P) headphones. In the paired-identity group, all participants were told that they would be listening to 16 trials that contained two excerpts, one a lullaby and one a play song. Four participants were required to identify the lullaby on each trial, and the other 4 participants were asked to identify the play song. Half of the participants in each of these groups (i.e., 2) listened to Tape 1, and the other half listened to Tape 2. For each trial, adults were asked to briefly describe the cues they used to come to their decisions.

Adults in the seven paired-quality groups were not informed that they would be listening to lullaby-style and play-song-style pairs. Again, half of the participants (i.e., 4) in each group listened to Tape 1, and the other half listened to Tape 2. One group was asked to identify the excerpt of each lullaby–play-song pair that was more soothing, a second group the excerpt that was more rhythmic, and a third group the excerpt in which the consonants were more pronounced. The rendering of consonants, from highly articulated to very slurred, is a recognized aspect of vocal performance (e.g., Lomax, 1968) that affects the mood that is conveyed. A fourth group was informed that on each trial they would hear two excerpts and that one might sound more clipped and one might sound more smooth. Four participants were asked to identify the excerpt that was more smooth, and 4 participants were asked to identify the excerpt that was more clipped. A fifth group was asked to identify the excerpt that sounded most brilliant (i.e., "like a trumpet"), a sixth group the excerpt that was more airy (i.e., "like a flute"), and a seventh group the excerpt in which the mother sounded like she was smiling more.

Finally, the category-goodness group listened to Tapes 3 (4 participants) and 4 (4 participants). They were required to rate each of the 32 randomly ordered excerpts on a scale ranging from 0 (*sounds like a lullaby*) to 7 (*sounds like a play song*).

Results and Discussion

Preliminary *t* tests revealed no significant differences between adults' ratings on Tapes 1 and 2 (which differed only in the order of trials) for any of the eight paired conditions. Therefore, subsequent analyses were collapsed across tapes.

To examine whether adults were able to identify at a significantly above chance level which excerpt was (a) in a lullaby or play-song style, (b) most soothing, (c) most rhythmic, (d) described as having more prominent consonants, (e) more smooth or clipped, (f) more brilliant, (g) more airy, and (h) rendered with a more smiling tone, we calculated the percentage of "correct" responses for each of the 16 trials across participants. Identification of the lullaby style was considered to be correct for groups choosing the excerpt that was more airy, more smooth, and more soothing. Identification of the play-song style was considered to be correct for groups choosing the excerpt that was more brilliant, rendered with a more smiling tone, more clipped, described as having more prominent consonants, and more rhythmic.

Raters in the paired-identity group identified the lullabies and play songs with 100% accuracy. Performance levels were above chance and high for all of the paired-quality groups, who rated which excerpt was more soothing, more rhythmic, described as having more prominent consonants, more smooth or clipped, more brilliant, more airy, and rendered in a more smiling tone of voice (see Figure 1). These results indicate that caregivers are capable of producing lullabies and play songs that differ dramatically in their performance characteristics and that adult listeners are very consistent at classifying lullabies and play songs according to a variety of performance characteristics.

We examined whether some mothers gave more varied lullaby-style and play-song-style renditions than others. Repeated measure analyses of variance revealed no significant differences across singers (i.e., mothers) for excerpts when rated as rhythmic, brilliant, and having more pronounced consonants. However, there were significant differences across singers for the remaining variables: for soothing, $F(15, 105) = 2.17$, $p < .02$; for smooth and clipped, $F(15, 105) = 3.21$, $p < .0002$; for airy, $F(15, 105) = 2.41$, $p < .005$; and for smiling, $F(15, 105) = 2.11$, $p < .02$. For no variable, however, was the average rating for an individual singer in the opposite direction to that predicted, that is, less than 50% correct.

In all of the aforementioned ratings, the play songs and lullabies were rated with respect to each other. It is also interesting to determine whether mothers actually produced good lullaby and good play-song renditions when rated independently. Participants

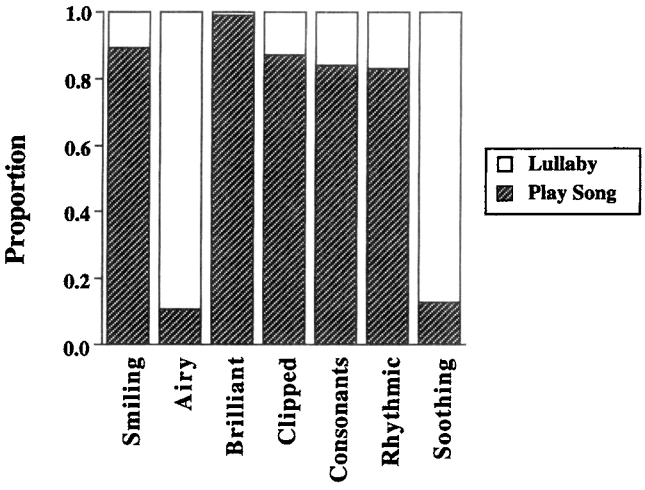

Figure 1. The proportion of raters choosing the play song versus the lullaby for each of the groups in Experiment 1.

in the category-goodness group rated each excerpt on an 8-point scale, with 0 indicating that the excerpt *sounded like a lullaby* and 7 indicating that the excerpt *sounded like a play song*. For each rater, the mean score across the 16 lullabies and the mean score across the 16 play songs were calculated. The mean rating for play songs across participants (5.31) was significantly higher than the neutral value of 3.50, $t(7) = 17.97, p < .0001$. The mean rating for lullabies across participants (2.42) was significantly lower than the neutral value of 3.50, $t(7) = 3.91, p < .003$. These results indicate that, overall, adults perceived the play-song-style renditions to be play songs and the lullaby-style renditions to be lullabies.

However, ratings differed across singers, as revealed in a repeated measures analysis of variance with singer as a between-subjects variable and lullaby–play-song rendition as a within-subjects variable, $F(15, 112) = 8.66, p < .0001$. For all 16 mothers, the play song was rated higher than the lullaby. However, for 2 mothers, both renditions were rated as play songs (i.e., both means were above the neutral value of 3.50), and for 4 mothers, both renditions were rated as lullabies (i.e., both means were below the neutral value of 3.50).

In summary, caregivers produced lullabies and play songs that differed dramatically in style, and adult raters were very accurate at distinguishing between them. Play-song excerpts were rated as being more brilliant, rhythmic, and clipped; as having a more smiling tone; and as having more stressed consonants than their lullaby pairs. In contrast, lullabies were rated as being more soothing, smooth, and airy.

Experiment 2

Experiment 2 examined whether infants perceive and react to the prominent differences between lullaby and play-song singing styles. Accordingly, infants were videotaped while listening to one of four lullaby–play-song pairs from Experiment 1. Infants' reactions were examined in two ways. First, adult raters watched the videotapes with no sound and were asked to determine the trials in which the infants were listening to play songs. Second, the videotapes were coded for particular behaviors. Specifically, the proportion of time infants focused their attention inwardly on themselves was expected to be higher during lullaby-style renditions than during play-song-style renditions because the intended message of the lullaby style is to ignore the environment and go to sleep whereas the intended message of the play-song style is to attend to and interact with the environment. Infants were also expected to focus more attention on their caregivers during play songs. Motoric arousal and rhythmic movements were also expected to be higher during the play-song-style renditions than during the lullaby-style renditions because the play-song style was expected to be more arousing.

Method

Participants

Each of 16 six- to seven-month-old infants listened to one of the lullaby–play-song sequences (see the *Stimuli* section below). An additional 6 infants did not complete the study because of equipment failure (2 infants), interference by the mothers (2 infants), or crying (2 infants). Of the 16 infants who did complete the study, 1 was eliminated for turning his back to the camera more than 50% of the time, and 1 was eliminated because he was much too big for the infant treadmill (see the *Stimuli* section) and therefore showed no motoric movement throughout the study. All 14 of the remaining infants (mean age = 6 months 9 days; 10 girls and 4 boys) were born within 3 weeks of term, and at the time of participation, all were healthy, had no history of ear infection, and required no pressure-equalizing tubes.

Stimuli

Four lullaby–play-song pairs from Experiment 1 were chosen according to the following criteria: Adults independently perceived each play-song-style rendition to be a play song and each lullaby-style rendition to be a lullaby (category-goodness group, Experiment 1), and the lullaby–play-song pairs received the greatest consistency of correct ratings (paired-identity group and paired-quality groups, Experiment 1). It happened that each of the four lullaby–play-song pairs was in a different language: Hebrew ("Havah Nagila"), German ("Schlaf Kindchen Schlaf"), French ("Frére Jacques"), and English ("Witch Doctor: Oou Eee Oou Ah Ah/Tin Tang Walla Walla Bing Bang").

For each of the four lullaby–play-song pairs, two sequences were created for a total of eight conditions. Half the sequences began with a lullaby-style trial and half with a play-song-style trial. Each condition consisted of only one lullaby–play-song pair, with each of the lullaby-style and play-song-style renditions repeated four times in alternation, for a total of eight trials. In three of the lullaby–play-song pairs, the play-song-style rendition was considerably shorter in duration than its corresponding lullaby-style rendition, so the play song was repeated once to roughly match the duration of the lullaby excerpts. This resulted in three pairs of lullaby–play-song trial durations of (a) 28 s and 39 s, (b) 24 s and 21 s, and (c) 20 s and 21 s, respectively. For the fourth pair, the lullaby-style rendition was 52 s, and the play-song-style rendition was 42 s (no repetition was made in this case). Thus, in two cases, the lullaby trials were longer, and in two cases, the play-song trials were longer.

Apparatus

Infants were tested in a sound-attenuating chamber (Industrial Acoustics Company, Bronx, New York) while sitting in a Safety 1st Walk in Place infant treadmill, which allowed the infants to make foot, leg, and torso movements as well as hand, arm, and head movements. The eight lullaby–play-song trials for each condition were presented by means of a Macintosh IIci computer through a Denon amplifier (Model PMA-480R) to audiological loudspeakers (GSI). A video camera (Sony CCD TR200 Handycam) recorded the infants.

Procedure

Each infant was videotaped while listening to the eight trials of one of the lullaby–play-song sequences (see the *Stimuli* section). The parent sat in front of the infant out of the camera's view. Parents were asked to respond minimally but naturally to their children, for example, by returning a smile but without making vocalizations. Sponge earplugs and masking music presented through headphones prevented parents from hearing the lullaby–play-song sequences.

From the video recordings, two videotapes were created for presentation to adult raters, each consisting of 7 of the infants. The videotapes were edited so that before each infant was presented, a title indicating the number of the infant (1 through 7 on Videotape 1, and 8 through 14 on Videotape 2) was shown. For each infant, the onset of each of the eight trials (i.e., alternating lullaby-style and play-song-style versions) was indicated by having a number from 1 to 8 appear on the top left of the screen.

Adults' interpretation of infants' behavior. Fourteen adults (12 women and 2 men) between 17 and 50 years of age filled out musical history and caretaking-experience questionnaires. Each adult watched the videotaped

infants without sound (half watched Videotape 1 first, and half watched Videotape 2 first). Raters were asked to decide for each infant whether the play-song-style rendition was heard on the even trials (2, 4, 6, and 8) or on the odd trials (1, 3, 5, and 7). Recall that for each infant only one lullaby–play-song pair was presented, so each judgment represents whether a rater could tell when an infant was listening to the play-song-style rendition versus the lullaby-style rendition from one lullaby–play-song pair. To help them make their decision, they were asked to jot down a few words about the behaviors observed on each trial. Prior to viewing the videotapes, adults listened to an audiotape of two of the lullaby–play-song pairs to familiarize them with the types of songs the infants heard. Adults were also told that some of the excerpts were repeated in order to roughly match the duration of the pairs and that in some cases the lullaby trials were longer whereas in others the play-song trials were longer.

Infants' behaviors. One adult coded every behavior on all 112 trials. A second adult coded every behavior on 30 of the 112 trials. In two cases (smiles and head bobbing), very few instances of the behavior happened to occur during those 30 trials, so an additional 5 and 4 trials were analyzed, respectively. The correlations between the coders exceeded .94 for every behavior. With the exception of vocalizations, which were done last, the behaviors were coded without sound, and the coders were naive as to when the infants were hearing lullabies or play songs. The following behaviors were coded for every infant. *Attention to self* was defined as the duration of time that infants directed their attention (looked) toward their own bodies, toys they were playing with, their clothing, their pacifier, or the chair the infants were sitting in, divided by the remaining time (i.e., time when attention was not directed to self). *Attention to caregiver* was defined as the duration of time that infants looked in the direction of their caregiver with their eyes raised to the approximate level of the caregiver's eyes or face, divided by the remaining time. *Smiles* was defined as the number of times the corner of infants' mouths turned upward (mouth open or closed) per unit of time. Four behaviors counted toward the *motoric arousal* scores: leg kicks (the number of times infants kicked or slid on the treadmill right, left, backward, or forward with displacement from midline and with each leg counted separately), bouncing (the number of times the trunks of infants' bodies moved up and down as a result of infants pushing themselves off of the ground or the seat of the chair), head bobbing (the number of times infants moved their heads up and down by using neck muscles or pivoting from the neck), and arm banging (the number of times infants moved their right or left arms up and down with at least a 20° displacement from the shoulder joint or elbow joint, with each arm counted separately). *Rhythmic behavior* was defined as the duration per unit time of motor behaviors that were repeated more than two times, with less than 2 s between the repetitions. The most common rhythmic behaviors were leg kicking, head bobbing, and bouncing. *Vocalizations* included the number of times infants vocalized, excluding coughs, sneezes, and vegetative sounds, per unit of time (coded last with sound).

Results and Discussion

Adults' Interpretation of Infants' Behavior

Percentage correct was calculated for each adult rater, and this dependent measure was used in the following analyses. An unpaired t test revealed no significant differences between Videotapes 1 and 2. Therefore, results were collapsed across videotapes. The 14 adults correctly identified the play-song-style trials 66% of the time (SD = 19%), which was significantly above the chance level of 50%, $t(27) = 4.36$, $p < .0001$.

A t test revealed no significant difference between raters with high musical experience (at least 8 years of formal music lessons or currently involved in a musical activity) and those with low musical experience, $p > .94$. Furthermore, neither number of years of formal lessons nor number of years of performing were correlated with participants' responses ($r = .17$, $N = 14$, $p > .55$, and $r = .04$, $N = 14$, $p > .90$, respectively). Amount of caretaking experience (being a parent, daily interactions with an infant under 1 year of age, minimal interactions with an infant under 1 year of age in the past, or no prior experience with young infants) also did not significantly correlate with adults' performance ($r = .39$, $N = 14$, $p > .16$). Finally, the age of adult participants was not significantly correlated with performance ($r = .08$, $N = 14$, $p > .80$). Thus, the experience of the raters appeared to have little effect on their ability to interpret the infants' behavior.

We examined whether some infants were easier than others for adult raters to read. Adults were more accurate with some infants than with others, $F(13, 169) = 3.09$, $p < .0004$. Average adult proportion correct scores ranged from .21 to .86 across infants.

Adult ratings also varied as a function of which song pair the infants heard: The mean proportions correct for the infants hearing the Hebrew, English, German, and French pairs were .77 (SD = .10), .68 (SD = .22), .57 (SD = .30), and .57 (SD = .10), respectively. The adult ratings from Experiment 1 appear to offer no explanation of this variation across song pairs. The mean proportions correct averaged across the groups rating soothing quality, rhythmicity, consonant prominence, smoothness, brilliance, airiness, and degree of smiling from Experiment 1 were high for all of the song pairs: .96, .80, .88, and .88, for the Hebrew, English, German, and French renditions, respectively. All infants were reared in English-speaking environments (i.e., greater than 90% exposure to English speech), so this difference also appears to be unrelated to the infants' familiarity with the language. Although the infants heard predominantly English speech according to parental reports, 3 were exposed to singing in a foreign language more than 10% of the time, 7 between 0% and 10% of the time, and 2 none of the time (this information was unavailable for 2 infants). Correlations between exposure to songs in a foreign language and adult raters' proportion correct were also not significant.

The source of the variation across singers remains unknown. The important result, however, is that, overall, infants reacted differently to the lullaby and play-song singing styles, as measured by adults' ability to determine whether the infants were listening to the lullaby style or the play-song style of singing.

Infants' Behaviors

We expected that infants would show more attention to self during the lullaby-style trials and more attention to caregivers, higher motoric arousal, and more rhythmic behavior during the play-song-style trials. No specific predictions were made for smiles and vocalizations (hence, two-tailed tests were used). Infants focused their attention more toward themselves during lullaby-style trials than during play-song-style trials, $t(13) = 2.88$, $p < .007$, and there was a trend for them to attend to caregivers more during play-song-style trials than during lullaby-style trials, $t(13) = 1.42$, $p < .09$. Infants vocalized more during the lullaby-style trials than during the play-song-style trials, $t(13) = 2.41$, $p < .03$, but there were no significant differences for motoric arousal, rhythmic behavior, or smiling. Contrary to expectations, both motoric arousal and rhythmic behavior were higher, although not significantly so, during the lullaby-style trials. What appeared to

be happening was that the play-song-style renditions were so attention getting that infants often stopped moving.

Because the adult viewers were able to differentiate the play-song-style trials from the lullaby-style trials by viewing the infants' behaviors, to what were the adults attending to make these judgments? Difference scores (mean score on lullaby-style trials minus mean score on play-song-style trials) were calculated for each infant on each of the coded behaviors, except vocalizations. (Adult viewers were unable to use vocalizations to make their judgments because they watched the videotapes without sound.) Interestingly, simple correlations revealed that smiling and rhythmic differences were each negatively correlated with the correct identification of the play-song-style trials ($r = -.62$, $N = 14$, $p < .009$, and $r = -.59$, $N = 14$, $p < .014$, respectively). In other words, adults favored the play-song-style trials when these behaviors were present: In fact, as indicated above, there was no difference between lullaby-style and play-song-style trials for either smiling or rhythmic behavior. However, adult viewers appeared to accurately interpret the attention-to-self behavior ($r = .58$, $N = 14$, $p < .02$; adults' responses favored the lullaby-style trials when this behavior occurred) and the attention-to-caregiver behavior ($r = -.45$, $N = 14$, $p < .05$; adults' responses favored the play-song-style trials when this behavior occurred). Regression analyses showed that together lullaby–play-song differences in attention to self, attention to caregiver, smiles, motoric arousal, and rhythmic behavior significantly predicted adults' rating scores, $R = .86$, $F(5, 8) = 4.62$, $p < .03$. When attention to self and attention to caregiver were added to the model first, they significantly predicted adults' rating scores, $R = .67$, $F(2, 11) = 4.53$, $p < .04$. The addition of the remaining variables—smiles, motoric arousal, and rhythmic behavior—did not contribute significantly to explaining the remaining variance.

Together, these results indicate that infants focus their attention inward to their immediate environment more when listening to lullabies than to play songs and they focus their attention outward more during play songs than during lullabies. Furthermore, there was a trend for infants to focus their attention more on their caregivers when listening to play songs than lullabies. Adults appear to be sensitive to this directing of attention in interpreting infants' responses.

General Discussion

Caregivers readily sing lullabies and play songs that differ stylistically, and adult raters are very accurate at distinguishing them on the basis of a variety of performance characteristics. Adult raters displayed high consistency in classifying the play-song-style excerpts as being more brilliant, rhythmic, clipped, and rendered in a more smiling tone as well as having more pronounced consonants than their lullaby-style pairs. Lullaby-style excerpts were rated as more soothing, smooth, and airy than their play-song-style pairs.

Adults were able to identify the trials on which 6-month-old infants were listening to play-song-style, as opposed to lullaby-style, excerpts at above chance levels. This result confirms that infants of this age do react differently to songs sung in a play-song style versus a lullaby style, strengthening the interpretation that different messages are communicated to infants by lullabies and play songs. The intended message of the smooth, airy, and soothing renditions was to calm down and go to sleep. The coding analyses revealed that infants focused their attention inwardly more when listening to lullaby-style renditions than when listening to play-song-style renditions and, conversely, focused their attention outwardly more when listening to play-song-style renditions than when listening to lullaby-style renditions. Furthermore, adults appeared to use this behavior in deciding whether infants were listening to lullaby-style versus play-song-style renditions. The intended message of the brilliant, rhythmic, and smiling renditions was to pay attention and have fun. Infants tended to look at their caregivers more during play-song-style renditions than during lullaby-style renditions. When infants smiled and looked at their caregivers, adults appeared to use this behavior as evidence that the infants were listening to play songs. Together, these results suggest that play songs engage infants in direct interaction with the singer.

The infants in this study were 6 months of age and therefore presumably had had considerable exposure to infant-directed singing. It is not possible to determine, then, the extent to which infants' behavioral reactions were the result of innate factors or learning. In all likelihood, the infants had been exposed to lullabies during contexts involving sleep and to play songs during contexts involving playful interaction. Infants in Experiment 2 were almost certainly not familiar with the particular songs they heard in this study (most were in foreign languages); however, to the extent that infants' behavioral reactions to the lullabies and play songs were learned, the infants had extracted the important acoustic features that distinguish lullaby and play-song singing styles. It remains for future research to determine which of the acoustic features, such as pitch, tempo, rhythmicity, or timbre (voice quality), actually guide infants' stylistic classification.

Contrary to expectations, infants did not increase their motoric and rhythmic activity when listening to the play-song-style renditions. Perhaps the novelty of the treadmill reduced behaviors that typically accompany play songs. Perhaps the play-song style was so attention getting that infants often stopped moving during play-song trials. There were large individual differences in the amount of movement infants displayed, which renders a coding analysis aimed at looking for commonalties across infants difficult. It is possible that these individual differences reflect basic temperamental differences; therefore, future studies should perhaps examine whether there is a relationship between temperament and the behaviors exhibited to musical stimuli.

Adults performed at above chance levels at distinguishing when infants were listening to play-song-style or lullaby-style trials, but performance, at 66% correct, was far from perfect. In part, this was likely due to the demands of the experimental situation. It is probably unrealistic to expect infants to change their behavior every 30 s or so, eight times in a row, in an infant seat in an unfamiliar environment in the physical absence of the singer. Even stronger behavioral differences would likely be found if infants were recorded at home on more than one occasion and with each play-song-style or lullaby-style rendition presented for a longer duration.

The level of performance of the adult raters also probably reflects large individual differences across infants in their behavioral reactions. There are several reasons to expect individual differences. First, infants' mood at the time of testing may have affected their behavior. Infants may have behaved in a more

animated fashion during the trial that best matched their mood. Infants who were in a playful mood during the listening task may have displayed more active and expressive behaviors when listening to the play-song-style renditions, and the upright posture imposed by the treadmill may not have been conducive for eliciting typical lullaby behaviors. In contrast, infants who were more sleepy, or simply overstimulated by the new environment of the laboratory, may have been more at ease during the lullaby-style trials and "frozen" during the play-song-style trials, which they perhaps found overwhelming.

A second reason to expect individual differences is that different infants have different temperaments and therefore may show different reactions to the same musical stimulus. Infants whose general temperament is shy may have exhibited more subtle behavioral changes than infants who are outgoing and therefore may have been more difficult for adult raters to read. The lullaby style may have provided a more appropriate level of stimulation for shy infants, whereas the play-song style may have done so for outgoing infants.

A third factor concerns the infants' musical experience. Infants who listen more often to play songs in their natural environment may have found the unfamiliar lullaby-style trials to be more interesting and therefore may have displayed more interested and animated behaviors during those trials. Indeed, Trehub et al. (1993b) found that many English-speaking mothers tended to sing playful rather than soothing songs to their infants.

In any case, the present results indicate that caregivers do communicate different messages to their infants through their style of singing and that infants generally do show different behavioral reactions to play-song and lullaby styles of singing. To further test the hypothesis that lullabies and play songs communicate different messages to infants, future studies could test directly whether lullabies are indeed more effective than play songs at soothing distressed infants or putting infants to sleep. It would also be worth testing whether listening to lullabies versus play songs induces different physiological effects as measured by heart rate, respiration rate, and frontal electroencephalographic asymmetries.

The purpose of music in human society has been widely debated (e.g., see Dissanayake, 1992; Trehub & Trainor, in press), although the strong ties between music and emotion are acknowledged universally. The ubiquity of singing to infants, the existence of special songs for infants across cultures, and the modifications made in infant-directed singing all suggest that music is serving a vital function in development. The results of the present study suggest that at least part of this function involves the regulation of infants' states and the communication of emotional information. Thus, music (along with musical speech) appears to be a central part of the crucial interaction that occurs between caregivers and infants as they develop over the 1st year of life.

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