

Adults Identify Infant-Directed Music Across Cultures

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Paired excerpts of lullabies and comparison songs from different areas of the world were presented to Western adult listeners, who were required to identify the lullaby in each pair. In Experiment 1, when presented with original field recordings, adults successfully differentiated the lullabies from the other songs. In Experiment 2, this effect was replicated with a more diverse sample of listeners. In addition, feedback about correct performance failed to improve the accuracy of lullaby identification. In Experiment 3, adults successfully identified the lullabies even when all songs were electronically filtered to remove the words. In Experiment 4, adults were unsuccessful in lullaby identification when the melodies were synthesized to remove residual cues associated with voice quality. However, performance on the synthesized materials was correlated with performance on the original materials. Parallels between infant-directed music and infant-directed speech are noted.

infants music songs lullabies

The lullaby is a "soothing refrain used to please or pacify infants" (*Oxford English Dictionary*, 1989), "a type of song sung by mothers and nurses the world over to coax their babies to sleep" (Brakeley, 1950, p. 653). The relative paucity of psychological and musical research on lullabies is surprising in the context of this ubiquitous vocal genre. Its neglect in scholarly musical circles is sometimes attributed to the dismissal of lullabies as unimportant, being the sole prerogative of mothers (B. Cass-Beggs & M. Cass-Beggs, 1969). Moreover, gender inequities within particular cultures have sometimes led women's music (usually laments and lullabies) to be excluded from consideration as music and therefore from the scrutiny of outside scholars (Sakata, 1987). For example, some Afghani (Hazara) songs that community members identify as lullabies ("stylized lullabies") are sung exclusively by men, sometimes to the accompaniment of an instrument played only by men (Sakata, 1987). These songs are not *for* babies but are rather *about*

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babies. It is the women, however, who actually sing to infants, lulling them in a distinctive singing style ("functional lullabies," Sakata 1987).

The available information on lullabies stems largely from anthropological sources, where interest has centered principally on lullaby texts in individual cultures (e.g., Sands & Sekaquaptewa, 1978; Spitz, 1979). Nevertheless, such work has provided provocative clues to the musical form of lullabies and more extensive description of their social function. For example, the lullabies of the San Blas Cuna Indians of Panama (McCosker, 1974) differ from other songs in their more liberal textual and melodic improvisation. Cuna children hear lullabies several times a day from birth until 4 years of age. Lullabies, sung exclusively by women, provide an introduction to the social customs of this matriarchal society. The sung text, sometimes accompanied by a gourd rattle (Densmore, 1925; Vandervelde, 1940), is highly repetitive, featuring frequent word reduplication, sequence repetition, and the repeated use of common words. Moreover, the text is incorporated into repetitive rhythmic patterns.

In contrast to other Cuna songs, which are of fixed length, Cuna lullabies are of indefinite length, continuing until a child is quieted or a singer interrupted. Melodically, these lullabies have relatively few pitches (three main tones), a narrow pitch range, and repeating pitch contours. Overall, these melodic, rhythmic, and textual features confer a distinctive style as well as function to Cuna lullabies compared with Cuna songs in general.

Although descriptions of lullaby form and function are considerably more sparse for other cultures, features characteristic of Cuna lullabies are often encountered. For example, the Vietnamese lullaby (Cong-Huyen-Ton-Nu, 1979) is also a vehicle for enculturation, its text outlining Vietnamese values and advocating good conduct. The notion is that Vietnamese infants, too young to understand the verbal message, will ultimately internalize the familiar melody, at which time they will attend to the meaning. Moreover, early and frequent exposure to lullabies is considered to ensure a strong and enduring emotional response to these songs well into adulthood.

In a description of Hazara lullabies (i.e., those actually sung to infants) in the mountains of central Afghanistan, Sakata (1987) noted "the use of words or sounds for the effect of the sound rather than for the sake of the meaning" (p. 91), including the deliberate alteration of words to produce mellifluous sounds. Indeed, humming and common nonsense syllables such as *loo-loo*, *lo-lo*, *lulla*, *ninna*, *nana*, *bo-bo*, *do-do*, and other untranslatable vocables pervade the lullabies of very different language groups (Brakeley, 1950; Brown, 1980; B. Cass-Beggs & M. Cass-Beggs, 1969). Similarly, smooth repeating contours, narrow pitch range, strong tonal center, extended vowels, and repetitive rhythms have been noted in conjunction with Norwegian (Kortsen, 1970), Vietnamese (Cong-Huyen-Ton-Nu, 1979), Hazara (Sakata, 1987), Columbian (List, 1973), and North American Indian (Curtis, 1921; Hilger, 1952; Sands & Sekaquaptewa, 1978) lullabies.

Some of these features are reminiscent of infant-directed speech, which is characterized by smooth, simple pitch contours, rhythmicity, and repetitiveness (Fernald, 1984; Fernald & Simon, 1984; Fernald et al., 1989; M. Papoušek, H. Papoušek, & Haekel, 1987; Stern, Spieker, & MacKain, 1982). Although expanded pitch contours and high pitch are often viewed as the most salient and distinctive features of infant-directed speech (e.g., Fernald & Simon, 1984; Fernald et al., 1989; Grieser & Kuhl, 1988), these features are especially characteristic of arousing, attention-getting utterances (Fernald, 1989; Stern et al., 1982). By contrast, soothing infant-directed utterances are usually marked by low, falling contours, a narrow pitch range, and a gentle tone (Fernald, 1989; Fernald & Simon, 1984; M. Papoušek & H. Papoušek, 1981; M. Papoušek, H. Papoušek, & Symmes, 1991). Nevertheless, soothing maternal utterances have received less descriptive and experimental attention than have playful utterances despite the obvious importance of soothing in infant care.

Adults are aware of some but not all of their vocal modifications in interacting with infants (Fernald & Simon, 1984; H. Papoušek & M. Papoušek, 1987). The consequences of such modifications seem to be obvious, in any case, to adult listeners, who readily distinguish maternal prosody associated with approval, attention bid, prohibition, comfort, and game playing (Fernald, 1989). It is notable that similar communicative categories are less prosodically distinctive in adult-directed speech, except for the category of comfort or soothing vocalizations (Fernald, 1989). It is not clear, however, whether soothing infant-directed vocalizations are perceptually distinct from functionally similar adult-directed vocalizations.

Although descriptions of lullabies within a number of cultures point to some common qualities, it is not known whether any of these qualities is universal and, therefore, whether infant-directed music or lullabies in particular would be recognizable in cultures with widely disparate languages and musical systems. Numerous attempts to document musical universals have met with very limited success (Harwood, 1976). Nevertheless, just as common structural features are absent in adult-directed speech but present in infant-directed speech across cultures (Fernald et al., 1989), such universals may emerge in infant-directed music.

Available translations of lullaby texts indicate that there is considerable variation across cultures in the verbal message that accompanies the lulling melody (Brakeley, 1950; B. Cass-Beggs & M. Cass-Beggs, 1969). Commonly, the singer reassures or praises the infant, sometimes promising rewards for falling asleep (e.g., a mocking bird), sometimes prophesying a bright future (e.g., becoming a harpooner or president, avenging an old vendetta); Brakeley, 1950). In some cases, she accompanies her praise with threats of punishment for staying awake (B. Cass-Beggs & M. Cass-Beggs, 1969; Curtis, 1921) or a description of nasty events, including kidnapping and death, that

might befall the sleeping infant (Spitz, 1979). Thus, frightening bogeymen (human and animal monsters) appear frequently in lullabies as do benign sandmen (*La Dormette, Willie Winkie*). For example, a German lullaby warns of sheep that will nip the child's toes if he does not sleep and a French lullaby substitutes a werewolf (*un loup garou*) (Spitz, 1979). Similarly, *El Coco*, an evil Spanish Moor, devours crying babies, and no bad behavior escapes *Hotei*, a Japanese monster with eyes in the back of his head (Brakeley, 1950). In still other instances, the lullaby singer bemoans her lot in life, including her irresponsible husband and the lack of freedom to do as she pleases (B. Cass-Beggs & M. Cass-Beggs, 1969; Spitz, 1979). What remains unclear, however, is whether the emotional tone of the text is reflected in the melody or whether the plaintive, joyful, or threatening message can coexist with sweet singing. This issue is difficult to disentangle because most of the translated materials are available in written as opposed to recorded form.

Our interests related principally to the possibility of cross-cultural similarities in the infant-directed songs of diverse cultures. The existence of such similarities would be suggestive of a biological basis for the communication of emotion as expressed in infant-directed singing. As a first step toward this broad objective, we sought to ascertain whether adult listeners could distinguish lullabies or soothing forms of infant-directed singing from other songs in the same culture. To this end, we assembled 30 lullabies and comparison songs from widely different cultures and geographic regions. Each lullaby was paired with another song (not infant-directed) that was similar in tempo and musical style, two potentially obvious cues. The relatively slow tempo of comparison songs raises the possibility that these songs were also soothing and therefore less distinct from lullabies than typical (adult) songs. Nevertheless, adult listeners were required to judge, on a forced-choice basis, which song in each pair was intended for infants. The forced-choice procedure was selected because of the widely divergent musical styles represented in this cross-cultural collection of songs.

EXPERIMENT 1

Method

Subjects. The participants were 40 adults (28 females, 12 males, 18–50 years old) from the university community, about half (48%) of whom had no formal training in music. The others reported music lessons spanning a few months to over 8 years.

Materials. The 30 lullabies were obtained from recorded collections (see Appendix) representing a variety of cultures and geographic regions (African, Asian, European, and North American Indian). For our purposes, a song designated as a lullaby by a scholar of that musical culture was consid-

ered to be a lullaby. Most of the lullabies (57%) were solo renditions from the field recordings of various scholars. For 28 lullabies, an adult comparison song was selected from the same group of collected materials (i.e., from a single researcher or research team). Not only did the comparison songs come from the same culture, but they were also selected, to the extent possible, for similar tempo, singing style, and orchestration. For two lullabies, however, a matching children's song was used because no available adult song met the aforementioned criteria of similarity. There were 14 song pairs that were European in origin or musical style (e.g., Norwegian, Czechoslovakian, Irish, Russian), the remaining songs emanating from cultures with an oral tradition (i.e., no musical notation system) and a musical style that was much less familiar to Western listeners. In nine pairs of songs, there was instrumental accompaniment and two additional pairs (Balinese, Japanese) had instrumental music without voice. In a few instances, the lullaby or comparison song was unaccompanied but the other was not. In five pairs, the sex of the singer differed across song types, the lullaby being sung at times by a male and at times by a female. None of the songs was sung in English.

Four audiotapes were prepared, each including 20-s excerpts of each pair of songs. Tapes 1 and 2 contained excerpts from the beginning of each song, with the order of presentation of song pairs and the position of the lullaby in each pair (first or second) randomized. Tapes 3 and 4 contained 20-s excerpts (order also randomized) from the middle section of each song. Each excerpt on the tapes was preceded by an announcement of the trial and excerpt number ("Number 1a", "Number 1b"). A 12-s silence followed each pair.

Procedure. Participants were randomly assigned to one of the four tape conditions, resulting in 10 subjects for each condition. They were tested individually in a quiet room containing an audiotape player (TEAC V-300), amplifier (Realistic SA10), and two loudspeakers (Radio Shack NOVA-6). They were told that they would hear 30 pairs of musical excerpts from around the world, one excerpt being a lullaby or song for infants, the other an adult song. For each pair, they were to identify the infant song, recording all responses and judgments on a standardized response sheet. After listening to the 30 pairs of excerpts, they were asked to list the criteria used in selecting the lullabies.

Results and Discussion

Lullaby Identification. The mean proportion of correct identifications was .63, which significantly exceeded chance performance, $t(39) = 11.05$, $p < .0001$. To examine the possible role of age, sex, and musical training, these variables were entered into a multiple regression analysis. Age was categorized into five ranges (≤ 19 , 20–29, 30–39, 40–49, ≥ 50) and musical training into three (none, ≤ 7 years, ≥ 8 years). None of these variables was significantly related to the accuracy of lullaby identification.

Although lullaby identification overall was significantly greater than chance, performance was far from perfect. It was, therefore, of interest to determine whether some lullabies were more readily identified than others or whether performance was roughly equivalent across lullabies. An analysis of variance (ANOVA) with repeated measures revealed significant performance differences across lullabies, $F(29, 1131) = 9.41, p < .0001$. The effects of Western musical style, instrumental accompaniment, children's song as comparison, absence of singing, and sex of singer were examined by means of a multiple regression analysis. None of these factors was significantly predictive of the accuracy of lullaby identification.

It was apparent that listeners exhibited some consistency in their identification and misidentification of lullabies. For example, they were highly successful (.93 proportion correct) in identifying four lullabies (Pygmy, Czechoslovakian, Irish, and Creek Indian) and highly unsuccessful (.29 proportion correct) with four others (Samoan, Ukrainian, Ecuadorian, and Chadian). Recall that Tapes 1 and 2 had excerpts from the beginning of each song (in different order) and Tapes 3 and 4 had excerpts from the middle. In fact, lullaby identification differed as a function of excerpt location (beginning vs. middle), with song beginnings (.67) identified more accurately than middles (.60), $t(38) = 3.42, p < .002$.

Not only were some lullabies systematically identified, but some other songs were systematically misidentified as lullabies. This suggests that listeners may have some abstract conception of a lullaby that defines what a lullaby "should be" rather than what it is, a conception that is relatively culture-free (Trehub & Unyk, 1991). In the absence of feedback, however, this conception may have misled them at times, resulting in less than optimal performance. It is possible, then, that the provision of feedback might enhance performance by guiding listeners in the appropriate use of potential identifying features.

Criteria for Lullaby Identification. A content analysis of listeners' reported (written) criteria for lullaby identification revealed the following frequently noted features together with the percentage of participants reporting each: repetitiveness (43%), soothing quality (38%), softness (28%), simplicity (28%), and slow tempo (25%).

Repetitiveness, soothing quality, and softness, all frequently noted features, figure prominently in descriptions of lullabies in a number of different cultures (e.g., McCosker, 1974) and in descriptions of soothing infant-directed speech (Fernald, 1989; Fernald & Simon, 1984). Simplicity, which was noted by 28% of participants, and repetitiveness by 43%, are in line with the greater simplicity of infant-directed over adult-directed speech (e.g., Fernald & Simon, 1984). What is surprising, however, was the mention of slow tempo by 25% of participants. Recall that comparison songs were

selected partly on the basis of similar tempo so that tempo differences were unlikely to have had any systematic association with lullabies. In fact, a precise tabulation of the number of notes per minutes revealed no differences between the categories of lullabies and comparison songs. It may be, then, that qualities arising from the repetitive, soft, and soothing nature of the music created the illusion of slow tempo. Alternatively, aspects of the phrasing of lullabies, such as the distinctive marking of phrase boundaries (e.g., by pitch or temporal accents), may have facilitated the parsing of such songs (Krumhansl & Jusczyk, 1990), promoting the perception of slow tempo. In Cuna lullabies, for example, most phrases end on the lowest scale note and with the word *maloye* (McCosker, 1974, p. 55). This marking of phrase boundaries in infant-directed music parallels the prosodic marking of important syntactic boundaries in infant-directed speech (Hirsh-Pasek et al., 1987; Kemler Nelson, Hirsh-Pasek, Jusczyk, & Wright Cassidy, 1989).

In sum, the results of this experiment indicate that adult listeners reliably but imperfectly identify infant-directed music from different cultures. Moreover, lullaby identification seems to be independent of listeners' musical training or their familiarity with the musical style in question. Despite a lifetime of exposure to Western music and Western culture generally, adults were no more proficient at identifying lullabies of European origin than those originating in vastly different societies and music cultures. To the extent that listeners were able to identify lullabies, then, it was not musical knowledge, explicit or implicit, that guided such identification. Thus, this experiment establishes infant-directed singing as a topic worthy of further psychological investigation.

EXPERIMENT 2

The purpose of this experiment was twofold. First, we sought to replicate the lullaby identification findings of Experiment 1 with a sample of listeners outside the university community. Second, we evaluated the effect of trial-by-trial feedback on the accuracy of identification. In other experimental contexts with indistinct cues (Trehub, Schneider, Thorpe, & Judge, 1991), such feedback is often used to improve performance.

Method

Subjects. The subjects were 84 adults (46 females, 38 males, 18–50 years old), about half (54%) of whom had no formal training in music.

Materials and Procedure. The materials were the same as in Experiment 1, except that only excerpts from song beginnings were used (Tape 1). Participants were randomly assigned to feedback ($n = 43$) or no-feedback ($n = 41$)

conditions. They were tested individually in a quiet room in their own home or in one of several testers' homes. The experimenter remained in the test room for the duration of the test session. As before, participants were told that they would hear 30 pairs of musical excerpts from around the world and that one excerpt in the pair was a lullaby or song for an infant and the other was an adult song. After listening to each pair, they indicated to the experimenter which excerpt was the infant song. In the feedback condition, participants were told, immediately after responding (choice and confidence rating), whether or not their choice was correct.

Results and Discussion

The mean proportion of correct identifications was .66 for the feedback condition and .65 for the no-feedback condition, this performance being highly similar to the comparable condition (song beginnings) from Experiment 1 (.67). Performance in both conditions significantly exceeded chance levels, $t(42) = 13.13$, $p < .0001$, for the feedback group and $t(40) = 13.25$, $p < .0001$, for the no-feedback group, but did not differ from one another, $t(82) = .53$.

In Experiment 1, four lullabies had been consistently identified correctly. The proportion of listeners correctly identifying these lullabies across conditions in this experiment was .86. On the other hand, the four lullabies consistently rejected in Experiment 1 were correctly identified by only 25% of listeners. Independent ratings of how appropriate each of the four consistently identified and four consistently rejected lullabies was as a song for soothing infants (on a 7-point scale) revealed substantially higher ratings for the former over the latter. These ratings indicate that the identifiability of lullabies is largely derived from properties of the lullabies themselves as opposed to features of the comparison songs.

In short, the results of this experiment replicate and extend the findings of Experiment 1. First, they add weight to the contention that adults can distinguish foreign lullabies from other songs when the comparison songs are matched in tempo and general singing style. Moreover, they reinforce the conclusion that listeners have some conception or mental representation of lullabies, which facilitates their identification of most lullabies from widely different cultures. Second, these findings indicate that simple trial-by-trial feedback about lullaby identification performance does not lead to improved performance in the time frame used here. The ineffectiveness of such feedback makes it unlikely that very simple cues such as pitch level or pitch range underlie lullaby identification. Rather, the highly varied nature of the materials may have made it especially difficult to apply information gained from any song pair to subsequent song pairs. In making their judgments, adults may simply adopt a global, intuitive strategy, the basis for which remains unclear.

EXPERIMENT 3

Although listeners in Experiments 1 and 2 were relatively consistent in distinguishing infant-directed songs from other songs, the cues underlying these judgments are not known. It is possible that the lyrics of the songs, the voice quality of the singer, or aspects of the melody, either singly or in combination, provided potential cues about the intended audience. Many researchers consider infant-directed speech to be syntactically, semantically, and phonologically simpler than adult-directed speech (Malsheen, 1980; Snow, 1977; but see Newport, 1977). It is the intonation contour, however, that seems to be most salient for infant listeners (Fernald, 1992; Fernald & Kuhl, 1987). The melody of lullabies, which is the counterpart of intonation in spoken messages, may play a comparable role. Nevertheless, its independent contribution to lullaby identification could not be derived from Experiments 1 and 2.

The lullaby lyrics, although sung in foreign languages, still embodied potential cues to the identity of the songs. For example, repetition of individual words or word sequences, repetitive nonsense syllables, extended vowels, onomatopoeia, and diminutives are found in lullabies of the Cuna (McCosker, 1974), Yuma (Curtis, 1921), Mohave (Devereux, 1948), Arapaho (Hilger, 1952), Chippewa (Hilger, 1951), Hopi (Sands & Sekaquaptewa, 1978), Spanish (List, 1973; Raz, 1956), French (Mills, 1963), Scandinavian (Karpeles, 1956), Rumanian (Suliteanu, 1975), Caribbean (Morse, 1958), African (Thomas, 1950), and Asian (Tsugawo, 1959) cultures. It is possible, then, that the lyrics in this sample of lullabies provided comparable cues.

To ascertain whether infant-directed music was distinguishable from other music in the absence of the lyrics, the 30 pairs of excerpts from Experiment 1 (beginnings only) were electronically filtered so that the words became unrecognizable. The filtered songs still retained much of their original melodic, rhythmic, and vocal quality.

Method

Subjects. The subjects were 20 adults (11 females, 9 males, 18–29 years old) from the university community, about half (55%) of whom had no formal training in music.

Materials and Procedure. The 30 pairs of excerpts from Experiment 1, Tape 1, were low-pass filtered at 500 Hz (i.e., frequencies above 500 Hz eliminated), with a roll-off of 30 dB per octave. This resulted in the elimination of the words while preserving the melody and much of the rhythmic information and voice quality. The procedure was the same as in Experiment 1, with the exception that all participants listened to the same tape.

Results and Discussion

The mean proportion of correct identifications was .60, which significantly exceeded chance performance, $t(19) = 4.33, p < .001$. Performance on the filtered materials of this experiment was compared to performance by similar (i.e., university) listeners on the unfiltered original version (Experiment 1, Tapes 1 and 2). Not surprisingly, the filtering of materials significantly depressed performance, $t(38) = 2.79, p < .01$. Nevertheless, performance on the filtered and unfiltered versions was highly correlated, $r = .74, p < .001$. Filtered versions of the four well-identified and poorly identified lullabies from Experiments 1 and 2 were identified by 74% and 36% of listeners, respectively.

It is impressive that, even with the words eliminated, the lullabies in this cross-cultural sample were still identifiable at above-chance levels. This parallels adults' ability to identify broad categories of intended meaning (e.g., approval, prohibition, comfort) in filtered speech (Fernald, 1989). Nevertheless, the reduction in identification accuracy implies that the lyrics of foreign lullabies contribute to listeners' ability to recognize the intended audience. Moreover, features that survive the filtering process, such as melodic form and aspects of voice quality, are likely to play a key role, but their role was inseparable in this experiment. Also, the continuing distinctiveness of the four well-identified lullabies implies that they may embody important melodic and vocal features that guide listeners' judgments.

EXPERIMENT 4

The songs of Experiment 3 had been transformed by electronic filtering, a process that removed the words but left many other features intact, including the melody (i.e., pitch and rhythmic structure) and some aspects of vocal quality. The purpose of this experiment was to examine the exclusive role of melody in lullaby identification. Would adult listeners perceive a melody as soothing and sleep-inducing even when it was stripped of the soothing voice quality of the singer? To examine this question, we generated a synthesized version of the lullabies and comparison songs with uniform (piano) timbre. To do so, we transcribed the melody line from the original recordings, eliminating any accompaniment and all of the vocal embellishments. Each synthesized melody was prepared by using the transcriptions in conjunction with repeated listening to the original recorded version. In this way, we attempted to match the dynamic structure of the original as closely as possible. Nevertheless, the resulting lullabies and comparison songs sounded much more similar than they had originally, not only within pairs but also across pairs. Indeed, much of the distinctive "foreign" quality of many of the songs was now absent.

Method

Subjects. The subjects were 20 adults (12 females, 8 males, 18–39 years old) from the university community, about half (45%) of whom had no formal training in music.

Materials. Tapes 1 and 2 from Experiment 1 were used as the basis for creating two additional tapes of paired excerpts of lullaby–nonlullaby comparisons. The melody line from each of the 20-s paired excerpts was transcribed and then performed in real time on a touch-sensitive Casio HT-6000 keyboard connected through a MIDI interface to a Yamaha TX-816 tone generator set at a piano timbre. The pitches and durations of tones and overall tempo were matched as closely as possible to the original recordings. These paired excerpts were recorded on two tapes, corresponding to the order of excerpts on Tapes 1 and 2 of Experiment 1. Two pairs of instrumental excerpts from the original tapes were excluded because their melodic form could not be captured with a single melody line.

Procedure. The procedure was the same as in Experiment 1, with listeners assigned randomly to Tapes 1 or 2.

Results and Discussion

The mean proportion of correct identifications was .51, which did not differ from chance performance, $t(19) = .91, p < .38$. Nevertheless, the well-identified and poorly identified lullabies were still distinct, being identified by 74% and 21% of listeners, respectively. Despite the fact that listeners did not reliably distinguish lullabies from other songs when the materials were stripped of many qualities associated with performance in context, it is possible that they still used strategies similar to those used by listeners in the previous experiments. A Pearson product-moment correlation revealed a significant relation between the average proportion correct on the original versions of the 28 lullabies (from Tapes 1 and 2 in Experiment 1) and the synthesized versions in this experiment, $r = .52, p < .01$. Finally an ANOVA on lullaby identification scores across the 28 pairs of songs in the original (Experiment 1, Tapes 1 and 2), filtered (Experiment 3), and synthesized (Experiment 4) versions (beginnings only) revealed a highly significant effect of stimulus version (original, filtered, synthesized), $F(2, 57) = 15.3, p < .0001$. Newman-Keuls tests indicated that performance on the original version ($M = .67$, range = 57–82) significantly exceeded performance on the filtered version ($M = .60$, range = 37–77), which, in turn, exceeded performance on the synthesized version ($M = .51$, range = 43–71).

In sum, the results of this experiment indicate that the total elimination of voice cues degrades lullaby identification performance beyond that associated

with the elimination of lyrics. In fact, lullaby identification fell to chance levels on the synthesized songs. Nevertheless, performance still remained good on lullabies associated with the best performance in Experiments 1, 2, and 3. Moreover, the correlation of performance on synthesized and intact materials implies that some melodic cues to the identity of lullabies were still operative in these very reduced versions of the songs.

GENERAL DISCUSSION

It is clear from these experiments that the category of music known as lullabies has psychological as well as musical reality, at least for adult listeners. This hypothesis was subjected to a particularly stringent test in this investigation. In the course of matching the tempo of lullabies and comparison songs, we were forced to exclude many adult songs, which tended to be much faster paced than infant songs. It is possible, then, that the restriction of tempo likewise restricted the mood and function of comparison songs. As is generally the case for recorded folk music (i.e., music in the oral tradition) from other cultures, there was limited documentation of song function. There is evidence, however, of a cross-cultural category of adult-directed comfort songs, including those for healing the sick. For example, the Menominee Indians (materials from 1925–1929) sing healing songs with descending melodies, preferring to sing them in the night because quiet and freedom from interruption are considered favorable for healing (Densmore, 1972a). Similarly, one Yuma healing song (material from 1922) is described as monotonous, although cheerful, having short phrases separated by pauses (Densmore, 1972b). These characteristics seem equally suitable for promoting sleep and are noted, as well, in descriptions of native lullabies (e.g., Curtis, 1921; McCosker, 1974).

Perhaps slow, adult-directed songs share the gentle, soothing tone of lullabies, aimed as they are at calming the distressed (e.g., sick, mourning, jilted) listener or touching the heart of a loved one. It is possible, then, that infant-directed songs, in general, are much more distinct from other songs than is suggested by this examination of the subcategory of soothing songs known as lullabies.

We had no information about whether the specific lullabies in this investigation were actually recorded in appropriate contexts (i.e., lullabies for actual lulling, or “functional lullabies”), or whether they were usually sung to infants but not in this instance. It is likely that the performing context has considerable impact on song features just as infant-directed speech differs in actual and simulated contexts (M. Papoušek et al., 1987). No doubt various aspects of the infant’s state and demeanor would influence the manner in which a song unfolds over time. These influences may be mediated by the singer’s experienced emotions and by the singer’s explicit or implicit attempts

to alter the infant's state and corresponding behavior. There are indications, for example, that facial gestures (e.g., smiling) and body movements alter the shape of the vocal tract, the acoustic characteristics of a song, and the singer's emotional expressiveness (Fonagy, 1981; Laver, 1980; Sundberg, 1973, 1982). Perhaps these gestures confer a distinctive timbre or voice quality on materials sung to infants. In future research, it should be possible to specify the vocal alterations and acoustic consequences of singing the same materials to infants compared to others. Only then will it be possible to separate the contributions of song structure and performance features to the identification of infant-directed songs in general or lullabies in particular.

Adults' consistency in identifying and misidentifying lullabies provides evidence that they associate complex auditory patterns such as songs with complex social functions such as caretaking. Moreover, the irrelevance of the listener's musical training or familiarity with the musical culture is indicative of cross-cultural universals in the perception or interpretation of songs. A subset of songs seemed to match adults' conception or stereotype of soothing infant-directed song, the as yet undetermined features of this stereotype being applicable to widely disparate musical materials and styles. What was remarkable, moreover, was that lullaby identification remained above chance under degradation by filtering and that performance on the most degraded (i.e., synthesized) materials was still correlated with that on the original materials. It is unclear whether the relevant cues simply survived such degradation or whether the presence of multiple cues ensured the retention of some of these cues under various transformations.

In an attempt to identify acoustic features that differentiated the lullabies from the comparison songs, Unyk, Trehub, Trainor, and Schellenberg (1992) conducted a musicological analysis that included measurements of pitch, pitch range, phrase length, contour complexity, and contour type. None of these features, either separately or in combination, reliably distinguished the lullabies from the nonlullabies. However, some features were associated with the accuracy of lullaby identification performance in these experiments. Specifically, listeners were more likely to accept as lullabies songs with prominent descending contours and to reject those with many contour changes. In other words, listeners were in considerable agreement on the defining features of soothing infant-directed songs, even if the resulting category excluded some lullabies and included some adult songs.

The most frequently cited criterion for lullaby selection, repetitiveness, captured a clearly perceptible quality in the consistently identified lullabies. Nevertheless, this quality was particularly difficult to quantify. In searching for repetition, is exact repetition necessary or would near repetition suffice? Should one search for repetition of individual notes or of musical phrases? If the latter, how could one reliably demarcate phrases in foreign musical systems? To illustrate the relative repetitiveness of the lullabies, we generated

a visual schematization of the songs by plotting the melody line of three consistently identified lullabies together with the relevant comparison song from each culture (see Figure 1). Inspection of these schematic representations reveals substantial repetitiveness in the lullabies. Some repetitiveness was also apparent in the comparison songs, but these repetitions occurred over a larger time frame. Thus, although global properties such as repetitiveness may play a key role in lullaby identification, they are not readily amenable to parametric analyses.

Adults' modest success in identifying the intended function of songs parallels their success in identifying the affective meanings embodied in infant- and adult-directed intonation patterns (Fernald, 1989). In the case of speech, adult listeners have been presented with highly contrastive meanings and intonation/acoustical forms from their own culture such as those associated with stereotyped solicitations of attention, sudden prohibitions of an action, and soothing. By contrast, the forms embodied in the foreign song pairs in

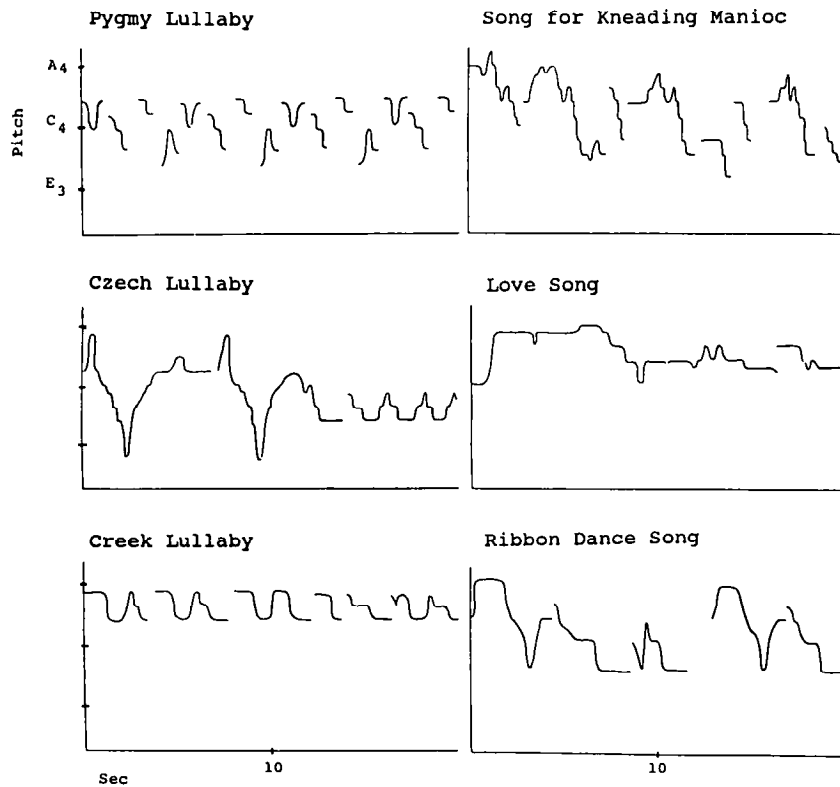


Figure 1. The pitch of the melody line is plotted against time for three consistently identified lullabies and corresponding comparison songs. The letters [A, C, E] refer to musical note names and the numerical subscripts, to the relevant octave (C₄ is middle C and E₃ is in the octave below). The fundamental frequencies associated with A₄, C₄, and E₃ are 440, 262, and 165 Hz, respectively.

these experiments were much less stereotyped and much less familiar. Moreover, adult listeners have had minimal practice discerning the external meanings of music (if such meanings exist) compared to a lifetime of practice with the subtleties of speech. In this light, their lullaby identification performance is all the more impressive. Perhaps the perceived simplicity of lullabies plays a role in this regard. Unyk et al. (1992) presented adult listeners with the same lullabies and comparison songs and asked them to choose the simpler of each pair. Lullabies were selected as simpler significantly more often than were the other songs whether they were presented in the original, filtered, or synthesized form.

Adults listeners may also be capable of tapping primitive emotional meanings that are common to infant-directed speech and music. Nonverbal but vocal aspects of speech are presumed to convey emotional meanings that are independent of cultural conventions (Frick, 1985). Infant-directed songs may convey similar emotional meanings through vocal and melodic features.

In short, these findings establish infant-directed singing as an important, likely universal, and universally recognizable form of caretaking. Lullaby singing as a part of caretaking is unlikely to have persisted over centuries and across continents without proven soothing or soporific effects. Nevertheless, the impact of lullabies on their intended audience (infants), although widely documented anecdotally, remains to be established formally. We do know, however, that infants process musical sequences in an adult-like manner (Trehub & Trainor, 1990), categorizing melodies on the basis of their pitch contour (Trehub, Thorpe, & Morrongiello, 1987) and rhythm (Trehub, & Thorpe, 1989), encoding *good* melodies in greater detail than *bad* ones (Trehub, Thorpe, & Trainor, 1990), even exhibiting sensitivity to the musical phrase structure of Mozart minuets (Krumhansl & Jusczyk, 1990). We know, as well, that infants exhibit attentional and affective preferences for infant-directed over adult-directed speech (Cooper & Aslin, 1990; Fernald, 1985; Fernald & Kuhl, 1987; Pegg, Werker, & McLeod, 1992; Werker & McLeod, 1989) and for approving over disapproving pitch contours typical of infant-directed speech (M. Papoušek, Bornstein, Nuzzo, H. Papoušek, & Symmes, 1990). It is very likely, then, that they would be capable of differentiating the various songs, perhaps exhibiting listening preferences for one form over the other. Finally, the adult singer's act of lulling may soothe the singer as well as the listener and this self-soothing quality may have contributed equally to the survival of lullaby singing.

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APPENDIX: DISCOGRAPHY

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