CHILD DEVELOPMENT

Child Development, July/August 2017, Volume 88, Number 4, Pages 1207–1215

# Infants Prefer Infant-Directed Song Over Speech

Christine D. Tsang
*Huron University College at Western*

Simone Falk
*Ludwig-Maximilans-University Munich and Université Paris 3 - Sorbonne Nouvelle*

Alexandria Hessel
*Huron University College at Western*

In their everyday communication, parents do not only speak but also sing with their infants. However, it remains unclear whether infants' can discriminate speech from song or prefer one over the other. The present study examined the ability of 6- to 10-month-old infants ($N$ = 66) from English-speaking households in London, Ontario, Canada to discriminate between auditory stimuli of native Russian-speaking and native English-speaking mothers speaking or singing to their infants. Infants listened significantly longer to the sung stimuli compared to the spoken stimuli. This is the first study to demonstrate that, even in the absence of other multimodal cues, infant listeners are able to discriminate between sung and spoken stimuli, and furthermore, prefer to listen to sung stimuli over spoken stimuli.

Caregivers communicating with infants worldwide change their vocal characteristics to a more "musical" mode (Fernald, 1989). Two forms of vocal expression to infant listeners are prevalent during caregiving interactions: (a) Infant-directed (ID) singing, a musical form of vocal expression, is an integral and frequent part of caregiving practice, and (b) ID speaking, which, when directed toward infants, changes considerably into a "musilanguage," presenting prominent tonal contours and rhythmic structure not typical of adult-directed (AD) speech. Both forms of vocalizations have high affective value and engage infants' attention more effectively than AD communication (e.g., Kitamura & Lam, 2009). ID singing and ID speaking both utilize words and exploit similar acoustic resources (e.g., fundamental frequency, temporal sequences of events) to build their prosodic structures (e.g., Falk, 2011a; Trainor, 1996). However, adults readily distinguish between speech and song as two different stimulus categories, such that different neural activation patterns are found in some areas of the brain for singing compared to speech (e.g., Callan et al., 2006; Ozdemir, Norton, & Schlaug, 2006). Whether infants are also able to discriminate between these two vocal forms remains unclear, making it difficult to establish definitive connections between musical and language enculturation via these early inputs during infancy.

ID communication differs structurally from non-ID or AD communication. The most noticeable acoustic differences are higher pitch; slower tempo; a loving voice timbre; shorter, more repetitive utterances; and longer pauses (Fernald & Kuhl, 1987; Trainor, Clark, Huntley, & Adams, 1997). Emotionality is also correlated to the exaggerated acoustics of ID stimuli and makes ID stimuli more attractive for infant listeners (Kitamura & Lam, 2009; Trainor, Austin, & Desjardins, 2000). ID speech and ID singing effectively regulate infants' arousal and emotional state, in particular, via the use of distinct pitch contours communicating emotive and directive contents such as anger, approval, warning, or admonition

This research was supported by a SSHRC-MCRI AIRS research grant to Christine D. Tsang and Simone Falk and a FASS research grant from the Huron University College to Christine D. Tsang. Thank you to Dr. Sandra Trehub and Dr. Judy Plantinga for providing the English stimuli. We thank Dr. Judy Plantinga for her comments on an early draft. Thanks to Alina Schmajew and Elena Maslow for their help with Russian and Turkish stimulus analyses and to Emma Fogel for assistance with infant testing.

Dr. Simone Falk is affiliated with the Department of German Philology, Ludwig-Maximilians-University Munich and LPP, UMR 7018, CNRS/Université Paris 3 - Sorbonne Nouvelle.

Correspondence concerning this article should be addressed to Christine D. Tsang, Department of Psychology, Huron University College at Western, London, ON N6G 1H3. Electronic mail may be sent to ctsang33@huron.uwo.ca.

[*Correction added on November 5, 2016 after original online publication on October 31, 2016*: Dr. Simone Falk's department and laboratory affiliation was added to the authors' acknowledgements.]

[*Correction made on January 10, 2017, after original online publication on October 31, 2016:* An error was found in the following sentence: "The analysis of the first half data found a significant main effect of stimulus, $F(1, 62) = 6.026$, $p = .17$, $\eta^2 = .089$, with infants looking longer to ID song stimuli than to ID speech stimuli." The p-value is .017, not .17.]

 0009-3920/2017/8804-0017
DOI: 10.1111/cdev.12647

(Fernald, 1989; Papoušek, Papoušek, & Symmes, 1991). Infants are sensitive to the affective messages contained in ID communication. At 6 months, infants listen longer to comforting than directive utterances in ID speech (Panneton, Kitamura, Mattock, & Burnham, 2006) and respond to pitch and tempo changes in song stimuli based on affective context (Conrad, Allen, Walsh, & Tsang, 2011; Tsang & Conrad, 2010). Overall, infants discriminate ID versions of both speech and song from non-ID or infant-absent communication (e.g., Cooper, Abraham, Berman, & Staska, 1997; Trainor, 1996). Infants as young as 7 weeks of age show a preference for ID compared to non-ID stimuli (Pegg, Werker, & McLeod, 1992), which is maintained throughout the 1st year (Werker & McLeod, 1989; Werker, Pegg, & McLeod, 1994). In sum, the enhanced structural and emotional properties of both ID speech and ID singing attract infants' attention, sustain early communication, and may lead to benefits for processing and later development (Falk, 2011b; Thiessen, Hill, & Saffran, 2005; Trainor & Desjardins, 2002).

Yet, there are a number of structural properties that differ between ID speech and ID song. Due to its combined musical and linguistic nature, ID song displays some key characteristics of musical signals, such as a regular beat, recurring rhythmic patterns, and the repeated occurrence of stable pitch relations (i.e., intervals; Trainor, 1996). These features do not appear as frequently in ID speech, although some studies report higher rhythmic regularity, increased accentual prominence, and occasional interval structure in ID speech (e.g., Fernald & Mazzie, 1991; van Puyvelde et al., 2010). On the other hand, increased pitch range and dynamic pitch excursions are unique features of ID speech (Fernald & Kuhl, 1987), whereas ID singing typically has a more restricted pitch range and higher pitch stability (Trainor, 1996), allowing for the perception of discrete pitch classes. Furthermore, the duration of vowels compared to consonants is much greater in sung (i.e., 5:1) than in spoken words (i.e., 1:1; Eckardt, 1999).

Despite the fact that ID singing and ID speech show significant functional and structural differences, the question of whether infants are able to discriminate between speech and song stimuli, and the extent to which one form of vocal expression is more engaging is not well established in the literature. The present study attempts to develop a clearer understanding of the perceptual differences during infancy between these two vocal forms.

Unfortunately, the few studies examining speech and song perception during infancy are inconsistent in their findings. Nakata and Trehub (2004) found that 6-month-old infants discriminated between speech and song by showing enhanced responsiveness to audio–visual episodes of maternal ID singing in comparison to maternal ID speech. However, it remains unclear how infants' bias for song stimuli was impacted by the visual component (rather than the auditory component) in this study. For instance, smiling accompanying the sung productions or facial expressions linked to song may convey more positive affect in the ID singing episodes in comparison to the ID speech episodes.

In contrast to Nakata and Trehub (2004), two other studies examining infant listening preferences showed no attentional differences in song and speech (Corbeil, Trehub, & Peretz, 2013; Costa-Giomi & Ilari, 2014). Costa-Giomi and Ilari (2014) presented 11-months old infants with an unfamiliar French folk song sung or spoken in an ID-like manner. In Corbeil et al. (2013), infants aged 4–13 months listened to unfamiliar Turkish ID-like speech and ID-like singing. Infants in this study were attracted to vocal expressions of positive affect, regardless of whether it was speech or song, a finding consistent with previous reports (e.g., Kitamura & Burnham, 1998).

However, methodological differences between these previous studies make it difficult to compare the results and develop a more generalized understanding of infants' perception of speech and song. The stimuli used by both Corbeil et al. (2013) and Costa-Giomi and Ilari (2014) were in an unfamiliar language, recorded by a singer in the absence of an actual infant. Hence, attractive ID characteristics of both speech and song may have been attenuated, as the presence of an infant generates more typical ID features in adults' speech and song (Smith & Trainor, 2008). In contrast, Nakata and Trehub (2004) invited mothers to sing and speak freely in the presence of their own infants, without any script, presumably creating very rich ID stimuli in terms of acoustic characteristics and emotional expression. Moreover, these stimuli were in the infants' native language, whereas the other studies (Corbeil et al., 2013; Costa-Giomi & Ilari, 2014) used non-native languages. As infants become increasingly attuned to native language structures over the 1st year of life (e.g., Jusczyk, Frederici, Wessels, Svenkreund, & Jusczyk, 1993; Seidl & Cristia, 2008), we would expect language-related differences in the perception of speech and song, a factor not directly compared in previous studies.

The results of the few previous studies on speech and song perception in infants are inconclusive, with open questions about the influence of maternal language, natural ID characteristics, and

modality of presentation that need to be further clarified. The present study examined infants' ability to discriminate between naturalistic ID song and ID speech stimuli in their native (i.e., English) and a non-native (i.e., Russian) language. The stimuli were presented auditorily in order to establish if infants could discriminate speech and song stimuli based on acoustic differences alone. We ensured that these acoustic differences were typical of ID speech and ID song by choosing the stimuli on the basis of adults' perception of good instances of both types of vocalization. We predict that infants should discriminate between the two types, and that they should find the song stimuli more attentionally engaging (Nakata & Trehub, 2004). Furthermore, infants should attend longer to native language stimuli. To our knowledge, this is the first study to directly compare native versus non-native ID speech and song discrimination in infant listeners using the auditory modality only.

## Method

### *Participants*

Sixty-six 6- to 10-month-old infants (37 girls, $M_{age}$ = 8.07 months) from primarily middle to upper class families in London, Ontario, Canada (a midsized, urban center in southern Ontario) participated in this study. Infants were from primarily monolingual English-speaking households in London, Ontario (see also Statistics Canada, 2012). None of the families reported familiarity with Russian. At the time of testing, infants were healthy, had no reported history of ear infections or familial hearing loss, and had no reports of any developmental difficulties with language acquisition. An additional four infants who participated were excluded from the analysis due to fussiness or reported head colds. All data were collected between January 2012 and August 2014.

### *Stimuli*

In order to control for familiarity with culturally popular songs and for infants' recognition of familiar words in the stimuli, the test stimuli were constructed from two different naturalistic corpora of ID speech and song, one in Russian and one in English.

#### *Russian Material*

The Russian ID material (10 mothers) was derived from Falk (2011a, 2011b). The English ID corpus (eight mothers) was recorded by Trehub (personal correspondence). The recordings contained samples from typical play songs, lullabies, rhymes, and conversations of mothers singing and speaking in the presence of their infants in the 1st year of life. In a preliminary study, we chose samples from the Russian corpus that were clearly perceived as two different categories of stimuli, speech or song. Twenty-four native English-speaking adults listened to 49 short ID samples from this corpus and rated each sample on a 7-point scale (1 = *definitely speech* and 7 = *definitely singing*). Based on the adult ratings, six samples with a mean rating of 1.5 or less ($s$ = 0.15–1.01) were chosen as the ID speech stimuli, and five samples with a mean rating of 6.5 or higher ($s$ = 0.15–0.87) were chosen as the ID song stimuli. The samples came from eight different Russian mothers (one mother was represented in both sets). As the speech samples were, on average, shorter in length than the song samples, six speech samples were needed in order to equate the total duration of the samples (mean duration of speech samples = 2.06 s, $s$ = 0.87; mean duration of song samples = 2.93 s, $s$ = 0.62).

Acoustic analyses were done in order to determine major structural differences between the Russian speech and song stimuli. We examined variables known to differ between speech and song: overall pitch range (i.e., the difference in semitones between minimum and maximum pitch in a sample), pitch variability in the vowel (the mean difference in semitones between minimum and maximum pitch in a vowel), tempo (i.e., syllables per second), and the mean percentage of vowels (Table 1; see also Falk, Rathcke, & Dalla Bella,

Table 1
*Acoustic Measures Across Both Language Stimulus Sets*

| Measures | Stimulus set | ID song mean | ID speech mean | Significance (speech vs. song) |
|---|---|---|---|---|
| Pitch range (st) | Russian | 8.0 | 19.8 | ** |
| | English | 7.4 | 17.6 | ** |
| Pitch variability (st) | Russian | 1.6 | 2.9 | * |
| | English | 1.3 | 3.9 | ** |
| Vowels (%) | Russian | 63.4 | 44.5 | ** |
| | English | 60.1 | 43.3 | ** |
| Tempo (syllables/s) | Russian | 2.5 | 4.6 | ** |
| | English | 3.3 | 4.8 | * |

*Note.* ID speech stimuli differed significantly (*$p$ < .05. **$p$ < .01) from ID song stimuli. Russian and English language stimuli did not differ in any of the variables. ID = infant-directed.

2014). Stimuli perceived as speech showed larger pitch range, faster tempo, more variable vowel pitch, as well as smaller vowel percentage than the song stimuli.

*English Material*

The English stimulus set was chosen from 41 excerpts of ID speech and singing taken from the Trehub corpus. In parallel to the Russian stimuli, five song samples and six speech samples from eight Canadian mothers were selected (three mothers were represented in both sets). The English samples were chosen such that they matched the acoustic differences as closely as possible with the Russian speech and song samples. (Mann–Whitney *U* comparisons of the stimuli' acoustics showed no significant differences between the English and Russian sets [for acoustic comparisons on ID speech *p*s > .18, for comparisons on ID song *p*s > .15]).

To ensure that no single sample in either of our stimulus sets was affectively different from the other stimuli, a group of 10 adult listeners rated each of the 11 Russian stimuli and another group of 6 adult listeners rated each of the 11 English stimuli that were used in our study on a scale of 1–7 of "happy sounding" (1 = *not loving/happy*, 7 = *very loving/happy*). An analysis of internal consistency showed that no single stimulus across all the speech and song stimuli used in the study was perceived as "happier" than any other individual stimulus in the entire stimulus set (Cronbach's $\alpha$ = .7–.78). Thus, we conclude that affective differences are unlikely to be a factor in driving infants' discrimination of speech and song.

For each language, the selected ID speech samples were concatenated separately and repeated five times in a different order, such that the same individual recorded sample did not repeat in succession. The same was done with the ID song stimuli. This procedure created four stimulus sets: a Russian and an English ID song stimulus set, each made up of five individual "sung" recordings (i.e., each of these individual recordings repeated a total of five times), and a Russian and an English ID speech stimulus set, made up of six individual "spoken" recordings (i.e., each of these individual recordings repeated a total of five times). The random order of samples within the sets was implemented to control for order effects and to minimize infants' ability to predict the next successive recording.

*Procedure*

The study followed a between-subject design. Nearly half of the infants were randomly assigned to the Russian condition ($N$ = 34; $M_{age}$ = 8.2 months, age range = 6.0–10.0 months; 16 female) and the other half to the English condition ($N$ = 32; $M_{age}$ = 7.9 months, age range = 6.0–10.27 months; 20 female). Infants were tested individually in a behavioral head-turn preference procedure (Kemler-Nelson et al., 1995; Tsang & Conrad, 2010). Here, looking time is measured from the moment the infant orients toward a speaker playing one of the two stimulus sets (see Supporting Information for more details).

For any given stimulus presentation during a test trial, a continuous stream of either speech or song samples (see Stimuli) played continuously until the infant looked away (45° head turn) for at least 2 s. Depending on the length of the infant's attention to the stimulus, the infant could hear the individual samples once or several times. However, all the recordings within a given trial were from a single stimulus set (either ID speech or ID song). In order to ensure that the infant heard the entire stimulus set over the course of the experiment, the next trial on the same side (i.e., the next presentation of the same stimulus set) began where the previous trial left off.

The following trial occurred on the other side of the infant, and consisted of the other stimulus set (e.g., ID speech on right) and the same visual display (i.e., Mickey Mouse). ID speech and ID song trials alternated until the infant had completed 20 trials in total (i.e., 10 ID speech trials and 10 ID song trials). Infants were counterbalanced for both types of stimuli (i.e., half started with ID speech and half started with ID song) and for direction (i.e., half started on the left and half started on the right).

## Results

To establish that there were no effects of side of presentation and first stimulus presented, a preliminary analysis of variance (ANOVA) was conducted with looking time (in seconds) as the dependent variable and first side of presentation (right or left) and which stimulus was heard first (ID speech or ID song) as between-subject variables. No significant effects were found. Thus, we collapsed side of presentation and first side of presentation for the subsequent analysis.

We conducted a 2 × 2 × 2 × 2 ANOVA with stimulus (ID speech/ID song) as a within-subjects variable and language (Russian/English) as the between-subjects variable. As infants often habituate to stimuli over the course of several trial presentations, we also included session half (first 10 trials/second 10 trials) as a within-subjects variable in the analysis. To explore whether there were any age-related differences, we also split the sample into two age groups (34 infants between 6 and 7 months of age [$M_{age}$ = 6.83 months, range = 6.0–7.9 months] and 32 infants between 8 and 10 months of age [$M_{age}$ = 9.32 months, range = 8.08–10.27 months]).

The analysis revealed a main effect of age, $F(1, 62) = 5.533$, $p = .0001$, $\eta^2 = .082$, such that younger infants looked longer than older infants, a typical finding in looking time studies (Greenberg, Uzgiris, & Hunt, 1970; Wetherford & Cohen, 1973). Furthermore, a main effect of stimulus, $F(1,62) = 4.151$, $p = .046$, $\eta^2 = .63$, such that infants looked longer to the song than to the speech stimulus, and a main effect of language were found, $F(1, 62) = 147.137$, $p = .0001$, $\eta^2 = .704$, such that infants looked longer overall to Russian than to English stimuli. The analysis also revealed a significant three-way interaction of Stimulus × Language × Session Half, $F(1, 62) = 4.305$, $p = .042$, $\eta^2 = .65$ (see Figure 1).

In order to break down the interaction found with Session Half, we conducted two further 2 × 2 × 2 analyses of variance, holding session half constant (first 10 trials/second 10 trials), and using stimulus (ID speech/ID song) as a within-subjects factor and language (English/Russian) as a between-subjects factor. The analysis of the first half data found a significant main effect of stimulus, $F(1, 62) = 6.026$, $p = .017$, $\eta^2 = .089$, with infants looking longer to ID song stimuli than to ID speech stimuli. They also looked longer to Russian stimuli than to English stimuli as confirmed by a main effect of language, $F(1, 62) = 141.485$, $p = .0001$, $\eta^2 = .695$. There were no significant interactions. The analysis of the second half data showed only the significant main effect of language, $F(1, 62) = 44.494$, $p = .0001$, and no significant interaction involving either stimulus or language.

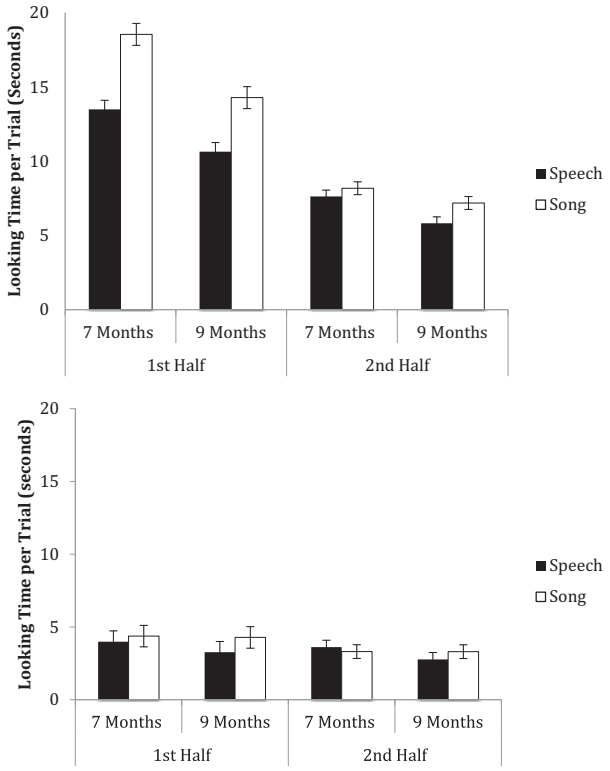


*Figure 1.* Looking time per trial to speech versus song stimuli in the first 10 trials (first half) and the second 10 trials (second half) for 7- and 9-month-old infants in the Russian language condition (top panel) compared to the English language condition (bottom panel).

## Discussion

The results of the present study show that, without other additional sensory (e.g., visual) or affective cues, infants can discriminate between ID singing and ID speech stimuli, and can do so as early as 7 months of age. Moreover, we found an attentional preference for ID singing. The findings are consistent with those of Nakata and Trehub (2004), who found that infants show higher engagement with maternal singing than maternal speech in a multimodal setting. They also extend previous research (Corbeil et al., 2013; Costa-Giomi & Ilari, 2014) by showing that infants are able to perceptually discriminate speech from song stimuli in a foreign language and can do so using only auditory cues. Finally, we showed that infants' increased attention for ID song stimuli was not affected by age.

Interestingly, we found that infants' attentional preference for song was considerably more extreme in the Russian (non-native) than in the English (native) language. Thus, the main effect of stimulus appears to be largely driven by the Russian condition (Figure 1). Although the direction of a preference in English ($M$ = 4.33 s for ID singing, over $M$ = 3.63 s for ID speech) is consistent with the results in the Russian condition, the overall pattern of looking times seems less clear cut in the English

condition. Overall, the considerably longer looking times to Russian over English stimuli are likely due to a novelty effect (i.e., infants' lack of familiarity with Russian). However, the small observed difference between attending to ID song over ID speech in the English condition may arise due to high variability in infant's attentional preferences for ID stimuli in the age range tested in this study. For instance, Hayashi, Tamekawa, and Kiritani (2001) showed that 4- to 6-month-olds and 10- to 14-month-olds prefer native language ID speech contrasts over native language AD contrasts, whereas 7- to 9-month-olds, the actual age group tested in our study, show no ID preference. The shifting preferences between ID and AD during infancy in native language stimuli may partly explain the lack of significant difference between speech and song in the English condition. Future research should more explicitly address the question of variability in differential attention to native and non-native language with respect to speech and song, possibly by increasing the age ranges of infants tested.

The extreme observed preference for Russian song stimuli in the present study may also indicate that low language experience (i.e., low familiarity) heightens attention to the exaggerated acoustic features present in song. In fact, song may provide features that are particularly attractive, pleasurable, and/or accessible to infants when experience with segmental structure is not available (see Kuhl, 1979; Papoušek et al., 1991). Melodic contours and slow spectrotemporal fluctuations are known to attract infants' attention, especially at a very young age, when language experience is minimal (see Hillenbrand, Minifie, & Edwards, 1979; Sambeth, Ruohio, Paavo, Fellman, & Huotilainen, 2008). Segmental linguistic features may also be implicated, as infants prefer to listen to long duration vowels (Kitamura & Notley, 2009). Vowels are discriminated even by newborns (Mehler, Dupoux, Nazzi, & Daheane-Lambertz, 1996), so it seems plausible that pitch and temporal information carried by vowels may be important features influencing infants' attentional preferences for song. Moreover, longer vowel portions and increased pitch stability in ID song are likely to make the individual vowels more physically and perceptually distinct for infant listeners (Uther, Knoll, & Burnham, 2007). Increased vowel distinctiveness in maternal speech is positively correlated to later infant speech discrimination abilities (Liu, Kuhl, & Tsao, 2003). Although infant language acquisition was not explicitly tested in this study, infants' heightened attention to sung stimuli may bootstrap infants' phonetic learning, a promising avenue for future research (Lebedeva & Kuhl, 2010).

Previous research has often underlined the idea that infants in their 1st year of life are intrinsically attracted by the musical qualities (e.g., prominence of pitch contour, heightened rhythmicity) of sound signals and that they may process ID speech in a musical listening mode (e.g., Brandt, Gabrian, & Slevc, 2012; Fernald, 1989, 1992). It may be the case that infants discriminated both stimuli sets on the degree to which the acoustic characteristics were more musical. However, it is intriguing that neither Corbeil et al. (2013) nor Costa-Giomi and Ilari (2014) found a difference in infants' perception of their speech and song samples. To further examine this issue, we conducted the same acoustic analyses as done in the present study on the Turkish samples used by Corbeil et al. (2013); see Table S1). The acoustic differences between speech and song stimuli in Corbeil et al. (2013) are less extreme than in our samples in almost all respects, particularly in tempo, and hence, in the durational characteristics of vowels. The differences in our stimuli may have been more pronounced because we chose the best samples of perceived "song-ness" and "speech-ness" in a naturalistic ID corpus. Differences in the acoustic features between speech and song stimuli in the present study are likely factors related to infants' ability to discriminate and prefer ID song over ID speech. Nevertheless, it remains for future research as to what specific combination of acoustic features most impact infant song and speech perception.

Recent studies have indicated that infants at this age are also highly attuned to the affective context in which singing often occurs, and the context can mediate infants' sensitivity to pitch and tempo (Corbeil et al., 2013; Tsang & Conrad, 2010). Therefore, beyond physical acoustics of the stimulus, another possible reason for infants' attentional bias to song may be that singing fulfills some communicative functions during infancy more effectively than speech. Worldwide, singing is utilized to transmit cultural values and beliefs (Chatwin, 1987), promote social cohesion (Booth, 1981), and has been documented to be a universal aspect of childrearing, such that virtually all cultures utilize singing to promote caregiver–infant bonding (Trehub, 2000). Infant listeners are particularly responsive to emotional messages in song (Rock, Trainor, & Addison, 1999). Engaging in interactive music experiences involving singing fosters infants' communicative and social development (Gerry,

Unrau, & Trainor, 2012). Synchronous movement experiences enhance prosocial behavior toward others (Cirelli, Einarson, & Trainor, 2014; Trainor & Cirelli, 2015), especially in infants at the end of their 1st year (Tunçgenç, Cohen, & Fawcett, 2015). Thus, ID singing may help to promote prosocial behavior, as its rhythmic structure can facilitate experiences of synchronous body movements between infants and caregivers (van Puyvelde et al., 2014). Our results also suggest that songs to infants may provide more prominent affective information in comparison to speech, which is particularly important to prelinguistic infants. As infants become increasingly familiar with their native language, future studies may examine whether attentional engagement with speech stimuli will increase and attention to song will decline throughout the 2nd year of life.

In sum, singing may provide a means of vocal communication that is accessible for infants and responds to their communicative needs in caregiving contexts (e.g., Trehub, Unyk, & Trainor, 1993). Infants showed greater attentional preference to ID song over ID speech in our study, despite the variation in speakers and utterances. This suggests that infants are able to abstract some characteristics of "song-ness" and "speech-ness" on which to base their discrimination and subsequent preference. Therefore, our results support the notion that by 7 months, infants recognize some of the fundamentals that assist in establishing communicative and functional distinctions between music and language as two important and prevalent forms of human vocal expression and interaction. Structural aspects of ID singing (e.g., increased vowel durations and prominent prosodic features) may not only assist infants' musical enculturation but may also facilitate processing communicative messages and linguistic structures—another promising avenue for future research. Regardless, the results of the present study provide support for the idea that ID song is at least an equally important auditory signal as ID speech, especially for preverbal infant listeners.

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## Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

**Table S1.** Differences Between Acoustic Variables of Speech and Song Samples in the Study of Corbeil et al. (2013) Compared to the Present Study.

**Appendix S1.** Head-Turn Preference Procedure Full Description.