CHILD DEVELOPMENT

Child Development, November/December 2015, Volume 86, Number 6, Pages 1685–1692

Infants Prefer Tunes Previously Introduced by Speakers of Their Native Language

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Infants show attentional biases for certain individuals over others based on various cues. However, the role of these biases in shaping infants' preferences and learning is not clear. This study asked whether infants' preference for native speakers (Kinzler, Dupoux, & Spelke, 2007) would modulate their preferences for tunes. After getting equal exposure to two different tunes introduced by two speakers, 7-month-olds ($N = 32$) listened longer to the tune that was introduced by a native speaker compared to the tune that was introduced by a foreign speaker. This suggests that the social-emotional context in which exposure to stimuli occurs influences auditory preferences, and that the early emerging attentional biases might have important ramifications regarding social learning in early infancy.

As adults, we spend most of our lives interacting with other humans in a variety of activities. These social interactions provide us with substantial knowledge, both about the individuals we interact with, and crucially also about our environment. In order to efficiently navigate our social environment and learn most relevant cultural knowledge and behaviors, we have to be able to react to social signals adaptively. It appears that such abilities are already evident in early infancy such that young infants selectively allocate their attention to certain individuals based on various physical and behavioral traits. For instance, infants as young as 3 months of age preferentially attend to faces of familiar race (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Kelly et al., 2005) and gender (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002), or to characters who act prosocially over characters who act antisocially toward others (Hamlin, Wynn, & Bloom, 2010). Five-month-old infants prefer individuals who speak in an infant-directed style as opposed to adult-directed style (Schachner & Hannon, 2011), and by 6 months of age, infants prefer people who speak their native language with a native accent, as opposed to those who speak in a foreign language or with a foreign accent (Kinzler, Dupoux, & Spelke, 2007).

Such looking patterns are likely to predispose infants to engage with their caregivers or with individuals who belong to an infant's social group, and might provide crucial benefits including acquiring most relevant cultural knowledge, behaviors, and preferences (Csibra & Gergely, 2006). To date, however, it is not known whether these remarkably early emerging biases may have any implications for young infants, and whether they shape infants' acquisition of preferences and knowledge. The available evidence shows that this seems to be the case both in childhood and in later infancy, when social preferences based on cues like gender and language are also observed on more explicit measures such as selective social interactions or explicit friendship choices (Kinzler et al., 2007; La Freniere, Strayer, & Gauthier, 1984; Maccoby & Jacklin, 1987; Martin, 1989). For instance, 4- and 5-year-old children tend to prefer novel activities or toys that are preferred by the members of their own gender (Shutts, Banaji, & Spelke, 2010). Similarly, young children favor a native-accented speaker's demonstration of a novel object's function or prefer the

This research was supported by grants from the European Community's Seventh Framework Programme (FP7/2007-2013): ERG Grant 323961 (UNDER CONTROL); Cooperation Grant 613465—(AThEME), the Spanish Ministerio de Economía y Competitividad (PSI2012-34071; Consolider-Ingenio 2010-CDS-2007-00012) and the Catalan Government (SGR 2014–1210). Núria Sebastián-Gallés received the prize "ICREA Acadèmia" for excellence in research, funded by the Generalitat de Catalunya. We thank B. Özdemir for his help with the creation the musical stimuli and A. Gutiérrez, A. Pinyol, and M. Martin for assistance. We also thank all families who have participated in the study.

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 0009-3920/2015/8606-0002
DOI: 10.1111/cdev.12408

label provided by a native-accented speaker for a novel object over that of a foreign-accented speaker (Corriveau, Kinzler, & Harris, 2013; Kinzler, Corriveau, & Harris, 2011). The influence of social preferences on learning and patterns of preference behaviors is evident by 12 months of age. After being offered food by a speaker of their native language and by a speaker of a foreign language, 12-month-old infants selectively reach for the food that had been offered by the native speaker (Shutts, Kinzler, McKee, & Spelke, 2009). At 14 months of age, infants were more likely to imitate a novel action, if it was performed by a native speaker rather than a foreign speaker (Buttelman, Zmyj, Daum, & Carpenter, 2013). Similarly, 16-month-old infants selectively adopt prosocial rather than antisocial puppets' preferences for food (Hamlin & Wynn, 2012).

A question arising from these findings is whether the effects of biases for social agents on the acquisition of preferences and knowledge are evident at younger ages, when infants' biases for social agents are typically reflected in their visual preferences. While the construction of the social world is arguably much less sophisticated within the 1st year of life, it is nevertheless possible that the effects of the social context on the acquisition of preferences could be observed in young infants. For example, infants' preference for certain agents might be transferred to stimuli that these agents are associated with, perhaps via certain associative tagging mechanisms (e.g., DeHouwer, Thomas, & Baeyens, 2001; Manis, Cornell, & Moore, 1974).

Young infants already have marked preferences for some sensory stimuli over others. In many cases, these preferences arise through exposure (e.g., Zajonc, 1968), and starting in the mother's womb, infants respond differently to familiar compared to unfamiliar stimuli. Such behaviors are extensively demonstrated in the auditory domain. For instance, newborns and even fetuses respond differently to their mother's voice (DeCasper & Fifer, 1980; Kisilevsky et al., 2003) or to specific stories or tunes that they were previously exposed to in the womb (DeCasper & Spence, 1986; Hepper, 1991; Kisilevsky, Hains, Jacquet, Granier-Deferre, & Lecanuet, 2004). Likewise, newborns prefer the sound of their native language (Moon, Panneton-Cooper, & Fifer, 1993; Nazzi, Bertoncini, & Mehler, 1998), and around 6 months, infants exhibit a preference for the tunes with familiar rhythms that are prevalent in their culture's music (Soley & Hannon, 2010). Various potential reasons could underlie preferences for familiar stimuli (for a review, see Bornstein, 1989). Familiar stimuli might be easier to process due to some form of expertise and might be preferred by young infants as well as older children and adults for that reason. Indeed, processing advantages for native structures have been reported in the domains of speech and music (Hannon, Soley, & Levine, 2011; Hannon & Trehub, 2005; Iverson et al., 2003; Kuhl et al., 2006). Likewise, it might be an evolutionary adaptation for humans as well as other animals to prefer stimuli that are familiar and likely safe, because of the potential risk attached to unfamiliar and unknown stimuli (e.g., Bronson, 1968). However, it is also possible that, in addition to exposure, infants' social environments start to influence acquisition of preferences at an early age, such that infants prefer those stimuli that they get exposed to through certain social partners. In other words, familiar stimuli might also be preferred due to their emotional or social significance for young infants (Burnham & Dodd, 1999).

While exposure clearly plays an important role in the formation of preferences, because most of infants' exposure to various stimuli occurs in a social context, the role of this context over and above the role of exposure per se for the acquisition of preferences is not easily discernible. On the one hand, these preferences might simply be acquired due to exposure to whatever happens to be common in the infants' environment, independently of any links that might exist between infants and their social partners. On the other hand, infants might prefer stimuli that they are exposed to in certain social-emotional settings. For example, infants might not only prefer familiar songs because they are familiar, but also because they have heard them from preferred social partners.

In this study, we investigated the role of early emerging social biases in infancy on the acquisition of preferences by taking advantage of previously shown preferences for native over foreign speakers (Kinzler et al., 2007). As young infants show sensitivity to musical stimuli already starting in the mother's womb, and can remember and easily distinguish familiar from unfamiliar tunes after repeated exposure (Hepper, 1991; Kisilevsky et al., 2004; Plantinga & Trainor, 2005; Saffran, Loman, & Robertson, 2000; Trainor, Wu, & Tsang, 2004), we asked, after getting equal amounts of exposure to two novel tunes, if infants would prefer the one that was previously introduced by a native speaker. Given infants' discrimination among languages based on their rhythmic properties (Nazzi, Jusczyk, & Johnson, 2000), and following previous research showing native speaker preferences (Kinzler et al.,

2007), we contrasted languages from two distinct rhythmic classes, namely, Spanish (syllable-timed) and German (stress-timed; see Ramus, Nespor, & Mehler, 1999).

Method

Infants were first equally familiarized with two tunes, one associated with a speaker of their native language and one associated with a speaker of a foreign language. Following this, they were tested on their preference for the tunes, by measuring how long they would listen to each of them.

Participants

Thirty-two infants (18 girls; M_{age} = 7 months 14 days, range = 7 months 2 days to 7 months 28 days) were retained for the final analysis. Infants were recruited by visiting maternity rooms at private hospitals: the Hospital Quiron and the Clínica Sagrada Família, Barcelona, Spain. Data collection took place between February 2012 and January 2013. All infants came from predominantly (> 67%) Spanish-speaking families, where the mother spoke to the infant in Spanish. Among these infants, 23 were reported to be exposed to other languages, including Catalan (21); French, Russian, and Armenian (1); and English (1). None of the infants was reported to hear German. An additional 38 infants were tested but were excluded from the final sample because they met one of our exclusion criteria (see below). All infants were born full term and parents reported no hearing problems or illness in their infants on the day of testing. Parents gave informed consent prior to their participation and they received partial travel reimbursement and a small present for their infants.

Exclusion Criteria

We excluded infants for the following reasons: equipment failure or experimenter error (5), fussiness (4), not meeting language criteria (6), or being too old on the day of testing (1). To ensure equal exposure to both speakers and tunes, we excluded infants who did not watch at least 75% of the total of the familiarization videos or showed a preference for one speaker over the other (> 75% looking at one speaker). These criteria ensured that infants watch the familiarization videos and did not end up being more familiar with one tune than the other, because they looked longer to one speaker (e.g., the native speaker) than the other. Twenty-two infants were excluded due to these criteria. Twenty infants were excluded due to attending to < 75% of the total familiarization videos (1 infant who only watched 8% of the familiarization videos also simultaneously violated the other criterion of attending to one speaker by exclusively watching the Spanish speaker's videos). Two infants were excluded due to infants' attendance to the native speaker for more than 75% of the time. The analyses are reported in the Results section both with and without these additional infants (except 1 infant mentioned above, who did not attend to the familiarization videos at all). This sample included 10 girls and 11 boys; M_{age} = 7 months 10 days, range = 7 months 1 days to 7 months 28 days) All participants came from predominantly (> 65%) Spanish-speaking families where the mother spoke to the infant in Spanish. Among these infants, 15 were reported to be also exposed to Catalan. None of the children was reported to hear German.

Stimuli

Videos

Familiarization stimuli consisted of videos of two German-Spanish bilingual speakers. Each actor was recorded individually, uttering three different sentences in both Spanish and German, yielding six different videos per actor. The sentences had identical content in German and Spanish. Each video was then paired with two different tunes (Tune A and Tune B), yielding 24 familiarization videos in total.

In each video, the actor first smiled and spoke in infant-directed style for ~10 s (e.g., "Hi little one! How are you? Today, I am going to play a song for you, let's listen to it together"). Following this, the actor ostensibly pressed a button on a music player placed next to her (~1 s) and smiled silently while a tune was played for ~7 s (one repetition). After the tune was finished, the actor spoke again in infant-directed style (e.g., "I really like this song. Goodbye!") and smiled silently (~5 s). During the test phase, all auditory stimuli accompanied the same visual (nonrhythmic) portion of a novel video (Attenborough, 1991). This video constituted animated drawings of a variety of animal species.

Tunes

Musical stimuli consisted of two new melodies composed for the purposes of the experiment. They were synthesized using the piano instrument in

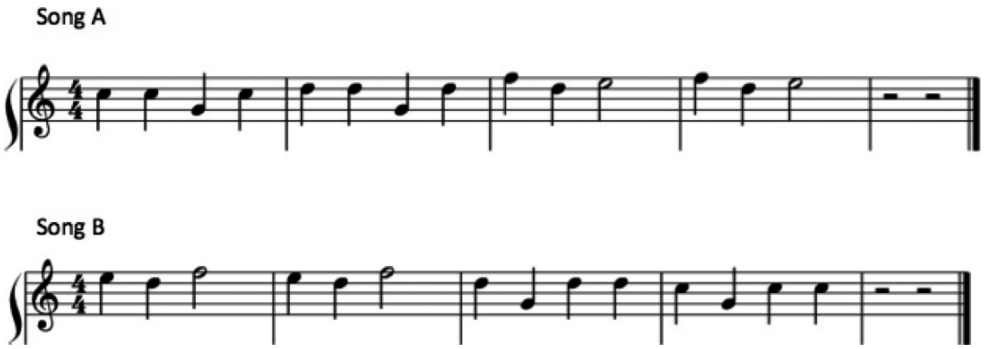

Figure 1. The melodies used in the experiment, presented in musical notation.

Logic Pro (Apple Inc., Cupertino, CA; see Figure 1 for the notation). Thus, the tunes were unfamiliar to all infants, but conformed to the conventions of Western music. The second tune (Tune B) was the temporal reversal of the first tune (Tune A). As a result, the tones, intervals between successive tones, contours, length and tempo were identical in both tunes. To maximize the infants' interest, both tunes were transposed to four different pitch levels, yielding eight musical sequences in total.

Design and Procedure

Testing took place in the Infant Laboratory at Pompeu Fabra University in Barcelona, Spain. Each infant was tested on a parent's lap in a dimly lit, soundproofed testing room with three monitors (Apple, 24-in. LED backlit widescreen display) located approximately 70 cm in front of the infant. Two loudspeakers (M-Audio Studiophile AV30, M-Audio, Cumberland, RI) were hidden centrally behind the monitors. Parents were discouraged from speaking or intervening during the experiment. Throughout the experiment they listened to classical music over modified ear protectors (SE 1340) with built-in speakers.

A flashing red screen preceded each trial to attract infants' attention. During the familiarization phase, speakers were introduced on left and right screens and their sides were kept constant across trials. Each speaker appeared in alternation for three times totaling six familiarization trials. The trial durations during the familiarization phase were fixed and lasted 23 s each.

During the test phase, the novel video accompanying auditory stimulus was presented on the center screen. During each trial, the melodic sequence was repeated up to a maximum of 60 s or until the infant looked away from the display for more than 2 s. Each infant was presented with a total of eight test trials.

Actor–language pairings, the order and the side of the native and foreign language presentation, were counterbalanced across infants. Tune–language pairings were also counterbalanced: For half of the infants, Tune A was paired with Spanish, and for the other half, Tune B was paired with Spanish. Furthermore, the order of the test items was counterbalanced: Half of the infants were first presented with Tune A and half were first presented with Tune B during the test phase. While the pitch level of the tunes was kept constant during familiarization, during the test phase, each infant was presented with each tune at all four pitch levels. During the test phase, the presentation order of the pitch levels was quasi-random, with the restriction that both tunes had to be first presented at a pitch level different from the pitch level they were presented in the familiarization phase. A MacPro4.1 Quad-Core Intel Xeon 2.66 GHz computer controlled the presentation of stimuli. An observer, blind to the condition recorded infants' looking times by pressing a button, using the program Habit X (version 1.0; Cohen, Atkinson, & Chaput, 2004). Final looking-time measurements were recorded off-line by another experimenter (blind to condition), who performed frame-by-frame coding of looks using Supercoder v.1.5 (Holich, 2005).

Results

Infants' average looking times to the videos associated with two languages across the six familiarization trials (three of each speaker) and average looking times across the eight test trials (four of each song) were calculated. Infants' looking times to the videos associated with two languages during familiarization did not differ from each other (M = 19.03 s, SD = 2.3 s for the videos where

infants heard Spanish; M = 19.2 s, SD = 2.08 s for the videos where infants heard German), $t(31) = 0.283$, $p = .78$. Critically, at test, infants listened longer to the tune that was introduced by the Spanish speaker (M = 17.48 s, SD = 11.13 s) compared to the tune that was introduced by the German speaker (M = 14.47 s, SD = 9.48 s), $t(31) = 2.42$, $p = .02$ (see Figure 2). Twenty-two of 32 infants showed a preference for the tune that was previously associated with their native language during test (binomial test, $p = .05$). To assess whether infants actually listened longer to tunes associated with the native speaker, and whether this preference was driven by a strong preference for one of the tunes, we submitted the average listening durations during test to an analysis of covariance (ANCOVA) with the within-participant factor tune (Tune A or B) and the between-participant factor Tune–language pairing (Tune A paired with Spanish speaker vs. Tune B paired with Spanish speaker during familiarization). We calculated proportion attended to the videos associated with the Spanish speaker and included this as a covariate in our analysis to assess whether the preference for the tune associated with the native speaker still holds when this covariate is included. We found attendance to native speaker/tune during the familiarization phase (fam native attendance) to be significantly related to listening times during the test phase, $F(1, 29) = 4.84$, $p = .036$. We also found a significant interaction between tune and tune–language pairing, $F(1, 29) = 5.37$, $p = .028$, after controlling for the effect of attendance to the native speaker during familiarization. The main effect of tune–language pairing, $F(1, 29) = 2.23$, $p = .15$, as well as of tune, $F(1, 29) = 0.39$, $p = .53$, and the interaction between tune and fam native attendance, $F(1, 29) = 0.5$, $p = .48$, were not significant, suggesting that infants had no preference for specific tunes, but rather preferred the tune that was initially associated with the native speaker. In other words, infants who heard Tune A paired with the Spanish speaker during familiarization tended to listen to it longer (M = 14.24 s, SD = 8.11 s) compared to Tune B (M = 12.34 s, SD = 7.79 s) at test and infants who heard Tune B paired with the Spanish speaker during the familiarization phase, showed the opposite pattern: These infants tended to listen longer to Tune B (M = 20.72 s, SD = 12.96 s) compared to Tune A (M = 16.60 s, SD = 10.74 s) during the test phase. We repeated the above analyses also including those 21 infants who were initially excluded from our final sample. Infants' average looking times (N = 53) to the videos associated with two languages during the familiarization phase did not differ from each other (M = 16.78 s, SD = 4.05 s for the videos where infants heard Spanish; M = 16.34 s, SD = 5.1 s for the videos where infants heard German), $t(52) = 0.67$, $p = .51$. During the test phase, infants listened longer to the tune that was introduced by the Spanish speaker (M = 17.18 s, SD = 11.13 s) compared to the tune that was introduced by the German speaker (M = 14.54 s, SD = 9.29 s), $t(52) = 2.86$, $p = .006$. Thirty-five of 53 infants showed a preference for the tune that was previously associated with their native language during the test phase (binomial test, $p = .027$).

We also conducted an ANCOVA on this sample. With this sample, attendance to native speaker/tune during the familiarization phase was not significantly related to listening times during the test phase, $F(1, 50) = 0.24$, $p = .62$. Crucially, we found a significant interaction between tune and tune–language pairing, $F(1, 50) = 7.07$, $p = .01$ as before. The main effect of tune–language pairing, $F(1, 50) = 1.39$, $p = .24$, as well as of tune, $F(1, 50) = 1.71$, $p = .19$, and the interaction between tune and fam native attendance, $F(1, 50) = 1.41$, $p = .24$, were not significant. Thus, including those infants who were initially excluded did not result in a significant difference in our finding that after getting equally exposed to two different tunes presented by two speakers during the familiarization phase, during the test phase, infants listened longer to the tune that was introduced by a native speaker compared to the tune that was introduced by a foreign speaker.

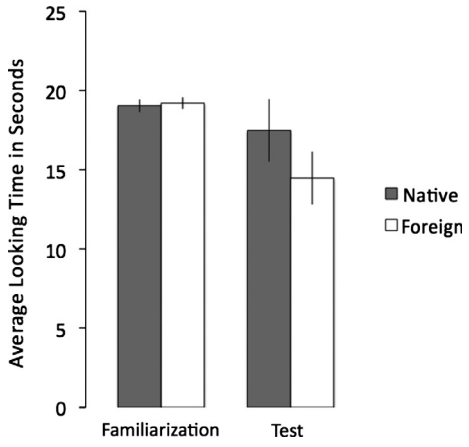

Figure 2. Infants' average fixation times (in s) at the displays during the familiarization and test phases. Error bars represent standard errors.
*$p < .05$.

Discussion

The present study asked whether young infants would prefer stimuli that are associated with preferred social partners, such as speakers of their native language. To this end, preverbal infants from predominantly Spanish-speaking families were equally familiarized with two novel tunes, one introduced by a Spanish speaker and one by a German speaker and later their preferences for the two tunes were assessed. Results showed that infants listened longer to the tunes that were introduced by the Spanish speakers.

Previous research shows that infants can reliably remember musical excerpts after repeated exposure varying from 1 to 2 weeks (Plantinga & Trainor, 2005; Saffran et al., 2000; Trainor et al., 2004). Strikingly, in this experiment infants heard each tune only three times paired with different speakers. Still, this limited exposure was sufficient for infants to develop a bias to prefer the tune associated with the native speaker. Thus, our results allow for two conclusions. First, infants' preference for musical tunes can be modulated by introducing these tunes by different speakers. Second, such preferences can be formed in a remarkably quick fashion.

The design of our study allows us to rule out a number of possibilities regarding the interpretation of the current findings. First, during the familiarization phase, when infants heard the tunes, the actors were silent. Thus, the presence of the actors was the only aspect of the stimulus presentation that connected the tunes and the native speech and this cue was removed during test, when the preference measurements were assessed. Hence, during the test phase, infants could not rely on any cues that they had become familiar with during the familiarization phase, except the tunes. Second, as the test presentation took place on the center screen as opposed to the side screens where the speakers appeared during the familiarization phase, a simple side bias cannot account for the current findings. Third, our findings indicate that infants' tune preferences during the test phase are not driven by infants' intrinsic preferences for either one of the tunes, but are rather modulated by the speaker who previously introduced them. Importantly, this finding holds, even when infants' attention to the native speaker/song during the familiarization phase is controlled for.

These findings are consistent with at least two possible interpretations. One possibility is that this observed preference is specific to social agents: Infants like native speakers and they also like the tunes they play (perhaps because they think the native speaker likes that tune). A second possibility is that infants like the sound of their native language and hence the native speaker (or anything that is associated with it) and they therefore also like the tunes that are associated (via the actors) with the native language. In this case, anything that is paired with the native language should be preferred by the infants through perhaps general associative process of affective tagging (DeHouwer et al., 2001). Previous research showed that infants' visual preferences for faces associated with forward native speech (as opposed to faces paired with reversed speech) disappears when the speech and nonspeech are paired with moving geometric shapes instead of human faces (Kinzler et al., 2007). While this finding suggests that the observed speech-based visual preferences might be specific to social agents, the current findings leave open the possibility that infants' tune preferences might be driven by domain-general associative mechanisms.

Nevertheless, these findings contribute to a growing body of evidence demonstrating infants' social and cultural learning, suggesting that very early emerging social biases of young infants might have important ramifications for infants' acquisition of preferences, and possibly their learning. Moreover, such effects are not only evident when the consequences of possible choices are critical for survival such as in the case of food preferences (e.g., Hamlin & Wynn, 2012; Shutts et al., 2009), but also when they might be related to the transmission of culture, such as acquiring preferences for musical tunes. Specifically, we show the influence of the language a person speaks on infants' promptly forming preferences for an external stimulus (i.e., the music played by a machine and not related to or produced by the speaker's face or voice). In fact, most of previous research focused on the reverse question of whether infants' preferences for the structures of their own culture (e.g., their native language) would lead them to prefer certain individuals to others. Such results left open the possibility that infants might be able to use cues to identify in-group members, but that these preferences might have no further ramifications. If so, infants would forgo important benefits from learning in a social environment, from an effective route to learn about culturally important stimuli to preferentially learning by observing preferred social partners. The current results show that such biases do indeed shape infants' auditory preferences, raising the possibility that they might use their early biases in the service of effectively processing the stimuli of their social

environment. For example, it is possible that these social biases facilitate acquisition of culture-specific perceptual abilities by allocating infants' attention to culturally relevant stimuli. In other words, infants might show enhanced processing of the structures they are exposed to, if they are exposed to these structures via in-group members. Such questions will, therefore, be important issues for future research.

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