2015

Infants' Memory for Melody and Words in Sung Songs

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INFANTS' MEMORY FOR MELODY AND WORDS IN SUNG SONGS

by

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Submitted in Partial Fulfillment

of the requirements for the degree of

Bachelor of Arts

in

Honours Psychology

Faculty of Arts and Social Science

Huron University College

London, Canada

April 27, 2015

HURON UNIVERSITY COLLEGE

FACSIMILE OF CERTIFICATE OF EXAMINATION
(The Original With Signatures is on file in the Department)

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entitled:

Infants' Memory for Melody and Words in Sung Songs

is accepted in partial fulfilment of the requirements for the degree of

Bachelor of Arts

in

Honours Psychology

April 27, 2015
Date

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Abstract

Past research suggests that infants' recollection of melodic information is hindered when linguistic and melodic properties of music are presented simultaneously over a short duration of time. The purpose of the present study is to examine infants' memory for melody and lyrics when the two stimuli are presented simultaneously over a prolonged exposure time. The design is a head turn preference paradigm. Thirty 6- to 8- month-old infants were familiarized to a song at home for a seven-day period. On day eight, infants were tested and randomly assigned to one of two conditions. The Melody Condition compared the familiar melody to a novel melody, and the Lyric Condition compared the familiar lyrics to novel lyrics. Infants' looking times to the novel or familiar stimuli were recorded. Results indicated no significant difference in head turn preferences to the novel or familiar stimuli in either condition. The implications of these findings are discussed.

Keywords: Infant, Language, Melody, Song

Acknowledgements

Completing my thesis in the Honors Psychology program at Huron University College has been a remarkable journey, one that would have not been made possible without the support of so many people. First and foremost, I would like to take this opportunity to thank my thesis advisor Dr. Tsang. It is difficult for me to summarize how grateful I am to have had your guidance over the past four years in such a short paragraph. You have an innate ability to teach your students how to think critically, while also giving them the opportunity to grow academically and personally, and for that I cannot say thank you enough. I truly feel honoured to have had the opportunity to be one of your thesis students; it has been the highlight of my undergraduate career! I look forward to keeping in touch as I begin the next chapter of my life!

I would also like to extend my gratitude to my second reader, Dr. Cole. Your feedback over this past year was incredibly helpful and served to be invaluable! I would also like recognize Huron's entire psychology department. It has been a pleasure to have been taught by so many professors who are passionate about their discipline and the development of their students. I feel blessed to be completing a program knowing I have a vast set of skills and knowledge that will no doubt assist me in my future endeavours.

Finally, to my beautiful family and my best friend Kate Clark, I am forever indebted to you for your unconditional encouragement throughout this past year. Your thoughtfulness and patience got me through!

It has been a pleasure to be apart of the Huron community, and I am extremely proud to graduate alongside my fellow 4880E classmates!

Infants' Memory for Melody and Words in Sung Songs

Infants are exposed to auditory information at an extremely early phase of development. By the third trimester of gestation, the neural structures that support in-utero hearing begin to function, indicating that first sounds, including voices and music, are experienced during the fetal period for approximately 12 weeks before an infant is even born (Eliot, 1999; Al-Quahtani, 2005). For example, when fetuses are exposed to a 15-second piece of melody and lyrics, fetal heart rate and motor movements significantly increase in comparison to pre-stimulation, indicating that exposure to music and voice can alter fetal behavior (Al-Qahtani, 2005).

Historically, it was thought that infants were unable to store information in memory during infancy, otherwise known as infantile amnesia. However, over the past 50 years, research has confirmed that infants do hold and use memory. For instance, DeCasper & Spence (1986) have revealed how prenatal auditory experiences can affect postnatal auditory preferences. For the last six months of their pregnancy, expectant mothers read aloud a written passage every day. After the birth of the infant, newborns showed a significant preference for the passages that were recited in utero compared to passages that were not, demonstrating that infants learn about auditory information through exposure and are able to hold a memory for this information.

The experience-expectant paradigm suggests that all infants are predisposed to learn a language due to an intrinsic brain mechanism (Chomsky, 1959). The experience-dependent mechanism, however, suggests that construction of knowledge is idiosyncratic to the infant**,** and that environmental influences shape what an infant learns. For instance,

although each language has phonemes in words, syntax, and meaning, which implies a predisposition for language, the fact that they are each culturally specific demonstrates the significance of experience (Werker & Tees, 2005). Before infants learn how to communicate with language, they need to understand the phonemes that are individualistic to their native language. Research has indicated that 6-8 month old infants are able to discriminate non-native phonemes from native phonemes; however, at 10-12 months old, infants are no longer able to discriminate the non-native phonemes and show discrimination only for native phonemes (Werker & Tees, 1984). This research demonstrates that an infant has the ability to distinguish the differences between two languages provided that they have familiarity with at least one of the two languages (Jacques, Jusczyk, Lamberts, Halsted, Bertoncini, & Amiel-Tison, 1988). It is therefore evident that, although there is an innate predisposition to learn a language, an infant's ability to discriminate between languages and to show a preference to their native language is made possible through experience.

As has been made clear, infants initially start off with a broad perceptual sensitivity to native as well as non-native perceptual inputs (Lewkowicz, 2014). However, selective exposure to native inputs has been shown to be a key component in perceptual narrowing as we have seen in speech perception, and this also holds true for music perception (Lewkowicz, 2014). Similar to the evidence from speech perception, research conducted on music perception also suggests that infants' musical narrowing occurs with increased exposure to prominent musical features of their culture (Lewkowicz, 2014). For instance, Hannon & Trehub (2005) showed that 6-month-old North American infants can detect when there is a violation of complex and simple meters in non-Western music, but when

infants reach 12-months, they are unable to detect these violations. These findings reveal that selective experience with native inputs lead to perceptual narrowing of musical information (Hannon & Trehub, 2005).

Cooper & Aslin (1990) have shown that during exposure to native inputs infants prefer to listen to infant-directed speech in comparison to adult-directed speech. Infant-directed speech is when an adult talks to a child in a higher pitch than adult-directed speech, and it is more rhythmic and often contains more exaggerated pitch contours (Trainor, Clark, Huntley & Adams, 1997). Due to the prosodic and musical components of infant-directed speech, one could refer to it as musical speech. Both speech and music contain multiple simultaneous levels of structure. Speech contains phonetic information, and prosodic (melodic) information, so when songs combine both lyrics and melody, they, too, possess these multiple simultaneous levels of structure. It has been found that, when songs are presented independently from one another, infants are able to differentiate the levels of structure. Jusczyk and Hohn (1997) have shown that following a 14-day exposure period, infants are able to encode words from a story into long-term memory. By 6 months, infants begin to develop awareness for semantic relationships between spoken phonemes and objects in the world (Tincoff & Jusczyk, 1999). Furthermore, studies examining infants' sensitivity to phonetic cues have found evidence that by 8 months of age, infants are sensitive to word boundaries in speech (Saffran, Aslin, & Newport, 1996). In the domain of music, infants can discriminate between familiar and unfamiliar melodies, indicating that infants are able to form a memory of a familiarized melody (Trainor, Wu & Tsang, 2004). Plantinga and Trainor (2005) have also demonstrated that infants are still able to do so even when the melody was presented

in an altered musical key. It is, therefore, evident that between the ages of 6-to-8-months, an infant's overall sensitivity to auditory information is elevated.

Despite the fact that auditory skills develop early, auditory inputs are unlike other sensory inputs in that the development is gradual and continues to improve into early childhood (Eliot, 1999). In a study by Kuhl, Tsao, & Liu (2003) English-learning 9-10 month old infants who were exposed to a Mandarin Chinese speaker during a number of play sessions were better at discriminating between a Mandarin Chinese phonetic contrast than infants who did not get the exposure to the Mandarin Chinese speaker. Furthermore, it has been shown that if 12-month old infants receive a two-week exposure to non-native inputs, this exposure is enough to restore discrimination between the non-native inputs (Lewkowicz, 2014). As Werker & Tees (1984) have indicated, infants at 12-months of age show phonetic narrowing to their native language that is similar to that of adults, yet this mere exposure of 2 weeks allows infants to discriminate between non-native and native phonemes analogous to that of 6-month old infants. Therefore, if an infant is periodically exposed to non-native inputs, then they can remember an event over the entire infantile-amnesia period (Rovee-Collier, 1999).

As has been demonstrated, infants are able to discriminate between melodies and linguistic information individually. However, it is generally the case that both types of stimulation are presented simultaneously, as in children's nursery songs. Lebedeva and Kuhl (2010) investigated infants' discrimination abilities when both pitch and lyrics occur simultaneously in songs and found that 11-month-old infants' remember melodic information when lyrics are not presented simultaneously. However, when linguistic information is presented in concurrence with melodic information, linguistic information

takes precedence. Tsang, Longfield and Morton (2011, unpublished manuscript) found that 8-month-old infants are able to distinguish a difference between novel and original nonsense lyrics but are unable to detect the difference between a new and old melody when familiarized for 3 minutes to simultaneous presentation in both levels. It is evident from Lebedeva and Kuhl (2010) and Tsang et al. (2011, unpublished manuscript) that an infant's recollection of melodic information is hindered when linguistic and melodic information is presented simultaneously. One possible explanation for infants' inability to recognize familiar melodies in the context of phonetic information might be that infants become biased to linguistic information. For the reason that most of infants' auditory experience is probably language based rather than melodic based, meaning that during such a short familiarization stage, phonetic information becomes particularly salient. Given that melodic information unfolds over a broad time frame, whereas phonetic information develops over a much shorter time frame and contains many quick changes in tempo, rhythm and pitch, linguistic information provides a much more noticeable and recognizable stimulus for the infant listeners.

What is unclear from previous studies is whether more prolonged exposure to both the melody and lyrics (presented concurrently) would strengthen these already existing results or allow the infants to remember the melody as well. During short-term familiarization of a song, an infant may have a natural bias towards lyrics simply because they are more familiar with words. Therefore, if you increase exposure times to other levels of stimulus – like melodic information – it may cause attraction towards these stimuli as well. Taking into consideration that linguistic information has melodic-like components, it is reasonable to assume that babies who are prelinguistic will be attracted

to a melodic level if they have longer exposure times. Tevel (2012) familiarized infants to a song containing both lyrics and a melody for a 7-day period, to determine if melodic information could be remembered in the presence of linguistic information. During testing, Tevel compared infants' head turn preference for a novel melody and familiar lyrics to a familiar melody and novel lyrics. Unfortunately, Tevel's study included a confound such that a demonstrated preference was not interpretable because both stimuli sets contained a familiar and novel component. The current study will extend and clarify the results from Tevel (2012), by using a similar preferential looking time, as well as the same stimulus used by Tevel; however, it will differ in the experimental design in that there will be two test conditions. Melody Condition will compare the familiar melody to a novel melody, and the Lyric Condition will compare the familiar lyrics to novel lyrics. It is hypothesized that in both conditions, there will be a preference for either the familiar or novel stimuli. If there is a preference for both lyrical and melodic information, after an extended time interval (7 days), this study can more firmly establish, that with increased exposure, melodic recognition is no longer disrupted by phonetic information, indicating that infants can successfully store both auditory stimuli in their long-term memory.

Method

Participants

A total of thirty infants aged 6.0- to 8.5- months of age (18 males, 12 females) participated in the experiment (mean age = 7.11 months, range = 6.0 months to 8.4 months). All of the families were contacted through the developmental participant database maintained by the Department of Psychology at the University of Western Ontario. All families in the database were contacted previously (either at the time of the

infant's birth, or through previous developmental research participation at Western), and provided consent to be contacted in the future for research participation. Families in the database were under no obligation to participate in future studies. All of the families were contacted by phone and were provided with a brief description of the nature of the study. Five infants who were tested were excluded from the final data analysis, four due to fussiness, and one due to a neck condition that led to a preference for left head turns. As a consequence, test results of 25 infants (14 males, 11 females) were used in the final analysis. All of the infants were healthy at the time of testing, and none of the infants had reported history of hearing impairment at the time of testing.

Stimuli

Two distinct melodies (Melody A and Melody B) and two distinct nonsense word lists (Lyrics A and Lyrics B) were used in the present study. The melodies used were stimuli originally created by Longfield (2007) and Myles (2007) to examine simultaneous perception of melodic and lyrical information in song. Both melodies had 17 notes and had equivalent rhythmic properties and a similar pitch range. Melody A was in the key of C Major and B was in the key of G Minor, and both melodies were of equal duration (45 seconds). Both melodies were sung by the same female voice at a rate of two to three notes per second with no instrumental accompaniment. In both nonsense word lists, the lyrics were comprised of 12 different syllables (see Saffran et al., 1996 for the full syllable list). The syllables used were arranged so that they created four nonsense "words" in each Lyric Condition. For the duration of seven days (familiarization phase) each infant was exposed to a distinct song in which Melody A was synchronized with Lyrics A, by pairing each note of the Melody Condition with every syllable of the Lyric

Condition. Therefore, in the present experiment, one song was used during the familiarization phase, and the distinct melodies and nonsense word lists were compared in the two test conditions.

Apparatus

Testing was conducted in a quiet laboratory room at Huron University College. The experimenter sat behind a small desk, facing the infant throughout the entire study. Each adult was asked to sit in a chair (with the child in his or her lap) that was placed across from the experimenter. The chair that the adult and infant sat in was positioned so that one of the two 13-inch CRT computer monitors was to the right and the other was to the left of them. Both of the monitors were placed inside a cabinet and were connected to an Apple Mac Mini computer that controlled the entire experiment using a Matlab custom deigned code to operate the experiment. The computer was connected to a Yamaha amplifier/receiver, which itself was connected to two Bose 201-V sound speakers located on top of the two cabinets holding the left and right monitors.

Procedure

There were two phases in the experiment: a familiarization phase and a test phase. During the familiarization phase, parents were provided with an MP3 download via e-mail of a song (Melody A and Lyrics A). The parents were asked to play this song at a comfortable listening level six times every day for seven days, which was approximately 5.5 minutes of familiarization to the song per day. Parents were asked to keep a "Baby Listening Log" to record the number of times the baby heard the song in a day, at what times the baby heard the song, and any additional comments that they thought were relevant to include (see Appendix I for the Baby Listening Log). Each adult

accompanying the infant was asked to bring the baby listening log **t**o the scheduled appointment.

After seven days of exposure to the song, the accompanying adult and infant came in for testing on Day 8, commencing the test phase of the study. When the accompanying adult and infant arrived for their appointment, the researcher met them at the front doors of Huron University College and led them personally to the laboratory room. There, the accompanying adult was given the consent form and hearing questionnaire to fill out. During this time, the infant and the researcher became acquainted before testing began. Once the child was comfortable with the researcher and in a good mood (i.e., not fussy or crying) the caregiver and infant were brought into the testing room. The caregiver was directed to sit in a chair placed directly across from the researcher, having his or her infant on his or her lap throughout the entire preference task. Both the caregiver and the researcher listened to masking music (played through headphones) in order to be "deaf" to the song that the infant was listening to. Each trial was initiated by the experimenter pressing a key on the keyboard when the infant was attentive and facing forward. The trial began with a monitor flashing a picture of "Mickey Mouse" in a cabinet, either on the right side or the left side of the infant. When the infant looked at the flashing monitor, the experimenter pressed another button, which caused the computer to begin playing one of the two stimuli in each test condition (e.g., the novel melody in the Melody Condition or the familiar lyrics in the Lyric Condition), and also caused the monitor to stop flashing the Mickey Mouse and display a stagnant Mickey Mouse on the monitor for the infant to look at. The trial ended when the infant looked away (45 degree head turn) for at least 2 seconds, at which time the experimenter pressed another button to terminate the auditory

presentation and the visual display. The next trial occurred on the opposite side of the infant, and consisted of the other stimulus version (e.g., the familiar melody in the Melody Condition or the novel lyrics in the Lyric Condition) and the same visual display. Trials presenting the two stimuli (novel melody vs. familiar melody or familiar lyrics vs. novel lyrics) alternated until infants completed 20 trials in total (10 trials on the left side and 10 trials on the right**)**, but the total time of testing typically was completed within 15 minutes (see Table 1). The dependent measure in this experiment was the relative amount of time the infants spent looking at the monitor that played the familiarized melody compared to looking times at the monitor that played the novel melody in the Melody Condition, or the relative amount of time infants spent looking at the monitor that played the familiar lyrics in comparison to the monitor that played the novel lyrics for the Lyric Condition.

The experiment was counterbalanced to ensure that half of the participants began their experiment on the right hand side and vice versa. Furthermore, half of the infants in the Melody Condition began with exposure to the novel melody and the other half began with exposure to the familiar melody. Moreover, in the Lyric Condition, half of the infants were exposed to the novel lyrics first and the familiar lyrics second, whereas the other half began with the familiar lyrics followed by the novel lyrics. Once the study was completed the adult accompanying the child was given an oral debriefing, and as a reward for their participation, the infant was given a "Junior Scientist" certificate as well as a choice of a small board book. The adult was then thanked for his or her time and escorted to the front of the building.

Results

A 2x2x2 Analysis of Variance with Stimulus Type (Familiar/Novel) and Test Session Half (First 10 Trials/ Second 10 Trials) as within-subjects factors and Condition (Melody/Lyrics) as a between-subjects factor was conducted. The dependent variable was the infant looking time (in seconds). The analysis revealed a significant main effect of half, F (1, 23), = 11.02, p = 0.003, partial η = 0.32, such that, infants' had longer looking times in the first 10 trials *(*M = 29.91, SD = 1.96) compared to the second 10 trials (M = 23.70, SD = 1.71). There was no significant main effect of stimuli, F (1, 23), = .01, p = 0.92, partial η = 0.00, and no significant main effect of condition, F (1, 23) = 0.01, p = 0.91, partial η = 0.001. The results indicated no significant interactions (Stimulus x Condition, F (1, 23) = 0.00, p = 0.10, partial η = 0.00; Half x Condition, F (1, 23) = 1.50, p = 0.23, partial η = 0.06; Stimuli x Half, F (1, 23) = 1.75, p = 0.20, partial η = 0.07; Condition x Stimuli x Half, F (1, 23) = 0.004, p = 0.95, partial η = 0.00). Figure 1 shows the looking times toward the stimuli in the Melody condition, and Figure 2 shows the looking times toward the stimuli in the Lyric condition.

Discussion

The results from the current study demonstrated that infants showed no significant difference in looking time to familiar or novel melodies, or to familiar or novel words, suggesting that infants do not recognize the familiar melody or familiar lyrics. These results are comparable to Tevel's (2012) findings. In Tevel's study, infants were similarly familiarized to a song containing both lyrics and a melody. However, during testing, Tevel only had one condition, which compared infants' head turn preference to a novel melody and familiar lyrics to a familiar melody and novel lyrics. While the present study had two conditions: Melody Condition which compared infants' preferences to the

familiar melody to a novel melody, and the Lyric Condition, which compared the familiar lyrics to novel lyrics. Both Tevel and the present study found that infants do not show a preference to either melody or lyrics after being exposed to the same melody and lyrics for seven days.

Using the same stimuli as in the present study, Tsang et al. (2011) gave infants 3 minutes of familiarization to a song stimulus. This song stimulus had two levels of information presented simultaneously: a melody level and a word level. The results showed that 7-month-old infants showed recognition of melody only when melody was presented alone. When melody was presented simultaneously with lyrics, infants showed only recognition of the word information, and showed no recognition of the melody. These results suggest that infants selectively attend to linguistic (word) information, which comes at a cost of melodic perception. Lebdeva and Kuhl (2010) found a similar result with 11-month-old infants, lending support to the notion that word level information is preferentially processed by infants in the second half of the first year. In other words, infants show a linguistic bias. The results of the present study, coupled with the results from Tevel (2012) show that a 7-day familiarization period may eliminate the linguistic bias.

Over a 7-day period, infants in the present study were exposed to both melodic and linguistic properties of the same song. If the infants were only paying attention to the linguistic information of the familiarized song, then the infants should have shown a preference to the linguistic information, as demonstrated in past studies (Lebdeva & Kuhl, 2010; Tsang et al, 2010). Given that the infants did not show a preference in the Lyric Condition, it can be assumed that the 7-day familiarization period increased

infants' processing of the melodic information such that infants demonstrated word bias was decreased. While the exposure to the stimulus was not enough for the infants to show a preference during testing, it was sufficient in eliminating the infants' linguistic bias.

In order to better understand the role of familiarization in the development of attentional biases, future research should study populations of people who are often exposed to a lot of melodic information. For example, trained musicians who spend a significant amount of their life working with melody based information, may show different attentional biases than non-musically trained individuals who have somewhat less musical exposure and processing experience.

The basis of infants' linguistic bias may be that infants are innately tuned to highly species-relevant stimuli. Arguably, language is an ability unique to the human species, and it is not uncommon for infants to show biases to highly relevant stimuli. For example, infants prefer viewing faces over other visual stimuli. However, it may also be the case that infants learn which stimuli are highly relevant. Stephens (1988) found that while 6-week old infants do not have a preference for faces over other non-face stimuli, three-month old infants do – a result that suggests that it takes a few months for infants to learn that faces convey a wealth of information and should be attended to. It has been suggested by Diamond & Carey (1986) that we form the ability to make complex discriminations between faces from years of exposure to faces. Thus, one interpretation of the results from the present study in the context of Tsang et al. (2011) is that increased exposure time (7 days rather than 3 minutes) increased the salience of the melody information such that the melodic information was no longer disrupted by phonetic

information. It remains for future research to determine whether it is possible that a longer exposure duration may have increased the salience of the melody such that it becomes the preferred stimulus.

With a null result in a preference paradigm, it should be considered, that a lack of preference does not necessarily mean an infant cannot discriminate between the novel and familiar stimuli (see Aslin, 2007 for a review). In the present study the infants' preferences for the novel or familiar stimuli could have varied based on exposure times during the given exposure. Although there were no significant differences between the two stimuli, in both the Melody and Lyric Conditions, it does not mean that the infants did not retain a memory for both the melodic and phonetic properties of the familiarized song. All that can be definitively concluded is that infants do not selectively attend longer to one stimulus over another. Aslin (2007) further reports that if the familiarized stimulus were not repeated with enough salience, then the infants would likely not show a preference, despite the ability to discriminate between the novel and familiar stimuli. However, if future studies were to expose the infants to the familiarized song before testing, and increase the exposure of the stimulus, then perhaps there would be enough salience to show a preference.

Future researchers may wish to consider using the habituation-dishabituation paradigm to determine whether infants can discriminate between a familiarized stimulus and novel stimulus. Infants could be familiarized to Melody A and Lyrics A, 12 times a day for seven days. On Day 8, infants could again be exposed to the familiar song. Once habituation is reached, the researchers could expose infants to an altered version of the song. Infants could be counterbalanced in two test conditions; Melody Condition, which

would introduce Melody A (familiar) and Lyrics B (novel) during dishabituation, and the Lyric Condition, which would introduce Melody B (novel) and Lyrics A (familiar) during dishabituation. If infants were to show discrimination in both test conditions, then it would show that more exposure increases the saliency of the melodic information, and allows the infants to pay attention to both the linguistic and melodic components of the song.

In both Lebedeva and Kuhl (2010) and Tsang et al. (2011, unpublished manuscript) the infants were immediately tested following exposure to the lyrics and melody. In the present study, based on caregivers reports in the listening log that infants' were exposed to the song the day before testing. It is assumed then, that the infants heard the song roughly 10 to 24 hours before being tested. Therefore, it is suggested that when testing for long-term recognition, researchers should expose infants to the familiarized song immediately before testing. By familiarizing the infants before the test phase begins, infants can then recall the "learned" stimuli, and more easily discern any preferences between the novel and familiar stimuli. Furthermore, it would control for any additional variables that could have made the stimuli less salient during familiarization.

A number of methodological problems arise when considering the familiarization phase of the study. The caregiver was asked to play the familiarized song for seven days before coming into the lab. Every caregiver was instructed to play the song at a comfortable listening level for seven days, six times in each listening session. In the attempt to control for these factors, the researcher asked the caregivers to record the number of times they repeated the song in a listening session, as well as any additional comments they considered informative. All caregivers were asked to bring the log to their

scheduled appointment. The caregivers were also asked to play the song when it was convenient for them. As such, the researcher had no control over the time of the day that the infant heard the song during the familiarization phase. Therefore, variable times of exposure could have led to diverse levels of attention during testing. For instance, an infant is less likely to be alert before feeding time, or near naptime/bedtime, in comparison to playtime and other mid-day hours when infants are attentive. Additionally, distractions while listening to music could have affected an infant's attentiveness to the song. In the listening log, it was often noted that infant were eating or doing another activity while listening to the music; subsequently, these distractions could have taken the infant's attention away from the song. Moreover, the listening level of the song during exposure likely varied across households. For that reason, some infants could have found the song more attractive than others, thus leading those infants to find the stimulus more salient. Taken together, these limitations could have decreased the saliency of the melodic information, resulting in no preference during testing. It is recommended that future studies instruct the caregivers to play the song at the same time every day, at a time when the infant is most alert and not distracted, and to therefore schedule their appointment during that time frame as well.

When evaluating the limitations of the familiarization phase, it should be noted that only two caregivers reported that the infant had less than five days of exposure (Table 2 has the full list of exposures per day). However, for Participant 19, the caregiver indicated that an additional listening session was added to their last day so the infant had equivalent to five days of exposure. And the caregiver of Participant 23 noted that on the last day of familiarization the infant was exposed to three listening sessions, so that the

infant had equivalent to six days of exposure. None of the infants were exposed to the song more than what was requested (six times per day for seven days). However, there were participants in the present study who did not meet the requirements of familiarization. The unequal exposure times across participants make it difficult for researchers to how much exposure is sufficient for infants' to show a preference, seeing as exposure time could not be controlled for. Perhaps then, future researchers should expose infants to the stimulus for double the amount of time (12 times per day for seven days), in order to insure that the saliency of melody is increased during familiarization.

It is assumed that as an infant develops, exposure to language will increase. During infancy, the use of exaggerated pitch contours and rhythmic properties in infant-directed speech, are likely relevant to infants' preference of infant-directed speech over adult-directed speech (Cooper & Aslin, 1990; Trainor, Clark, Huntley & Adams, 1997). But, as infants learn language, the use of infant-directed speech, which contains melodic properties, will decrease. Therefore, it would be interesting to see if infants at 6, 8, 10, and 12 months of age would all show discrimination in both conditions, or if older infants would only show discrimination in the Lyric Condition, because they would have more exposure to language and thus need to be exposed to the familiar stimulus longer**.**

If future research is able to more definitively demonstrate that with increased exposure to melodic information infants have the ability to discern melodic information from linguistic information when presented concurrently, then many implications can be drawn. For instance, parents who want their infants to be musically talented can begin exposing their infants to songs repeatedly throughout childhood. With increased exposure, infants would have the ability to encode both melodic and linguistic

components of a song into memory, both helping with musical ability and learning a language.

It is evident from previous research that infants have exposure to auditory information in utero. While such exposure allows infants' between the ages of 6 to 8 months to have an increased sensitivity to auditory information, the development of auditory inputs continues to improve into early childhood. Previous research has found that infants are able to discriminate between melodic and linguistic information individually, however, when linguistic information is presented in concurrence with melodic information, linguistic information takes precedence. While there may be an innate predisposition for infants to learn language - and therefore show a linguistic bias - an infant's ability to discriminate between languages and to show a preference to their native language is possible only through experience. The purpose of the present study was to determine if more prolonged exposure to both melody and lyrics (presented concurrently) would increase attraction towards the melodic stimuli as well. While the null results indicated that there might not have been enough exposure for the infants to show a preference during testing, the 7-day exposure was sufficient to eliminate infants' linguistic bias. The possibility that increased exposure during familiarization can affect what an infant encodes, may offer clues to understanding how infants encode auditory information into long-term memory.

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Table 1.

Design of Experiment

Phase	Song Stimuli Presented
Familiarization	Melody A + Lyrics A
Testing	
Melody Condition:	Melody A (Familiar) vs. Melody B (Novel)
Lyric Condition:	Lyrics A (Familiar) vs. Lyrics B (Novel)

Table 2.

Infant Listening Log Data

Participant	Number of Exposures/Day	Number of Days of Exposure/Week
1	6	7
2	6	7
3	5-6	7
4	3-4	6
5	6	6
6	6	7
7	6	7
8	6	7
9	5	7
10	2-6	7
11	6	7
12	4-5	7
13	5-6	7
14	6	7
15	6	7
16	3-6	7
17	6	7
18	6	6
19	6	4
20	6	7
21	3-6	6
22	6	7
23	6-18	4
24	6	7
25	6	7

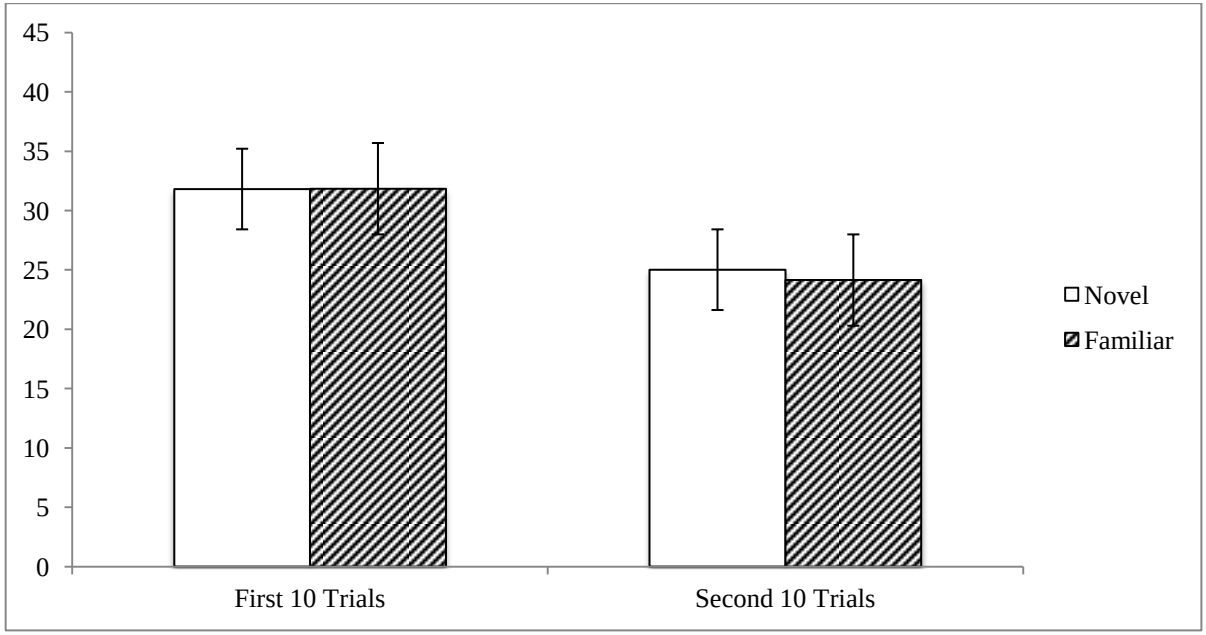

Figure 1. Mean infant looking time across ten trials towards the familiar and novel stimuli in the Melody Condition, at first half (i.e., first 10 trials) and second half (i.e., second 10 trials). Error bars represent the standard error of the mean.

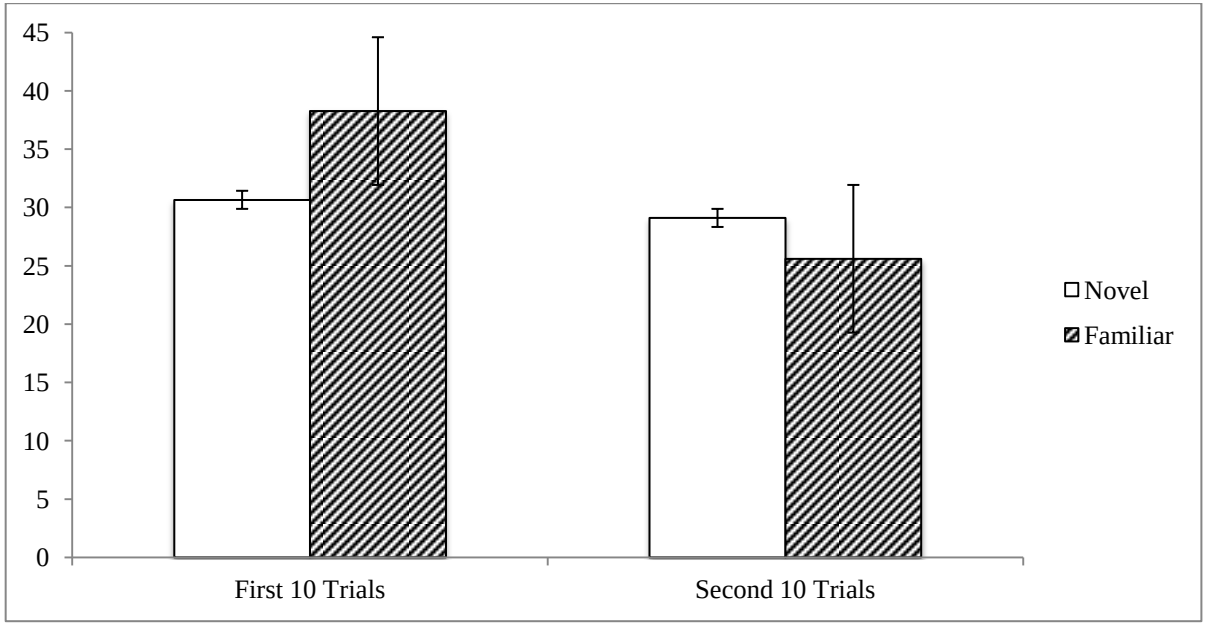

Figure 2. Mean infant looking time across 10 trials towards the familiar and novel stimuli in the Lyric Condition, at first half (i.e., first 10 trials) and second half (i.e., second 10 trials). Error bars represent the standard error of the mean

Appendix I

Participant ID: (for office use only)

Baby Listening Log

Use this Listening Log to track when you played the music file to your baby and how many times you played the music file on each day. In the "Notes" field, please note what your infant was doing while listening to the music, and/or any other information you may feel is relevant to the listening time (e.g., "My baby wanted to hear it more than once!" or, "My baby fell asleep during the listening."). If you miss a day, please note the missed day on in the "Notes" field.

DAY	Played Music	Number of Times per Day	Notes
1	Yes/ No (circle)	6 times ____ More than 6 times _____ Less than 6 times ___	
2	Yes / No		
3	Yes / No		
4	Yes / No		
5	Yes / No		
6	Yes / No		
7	Yes / No		

Lab Appointment Date and Time: _____

Thank you for your participation! Please bring this completed log with you to your lab appointment.

If there are any questions, or if you need to re-schedule your lab appointment, please contact us at the Huron Infant and Child Development Lab, (519) 438-7224 ext. 359, or by email at: ldelucia@uwo.ca or ctsang33@uwo.ca

Curriculum Vitae

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