

Infants: Research Published in 2009--Abstracts

1. Does the message matter? The effect of song type on infants' pitch preferences for lullabies and playsongs. Tsang CD, Conrad NJ. *Infant Behav Dev.* 2009 Dec 25. [Epub ahead of print]

Preverbal infants are attuned to the different emotional messages contained in playsongs and lullabies. However, it is unclear which performance properties of singing underlie infants' perception of the communicative intent of infant-directed singing. Volkova, Trehub, and Schellenberg (2006) recently demonstrated that **6- and 7-month-old infants preferred low-pitched to high-pitched renditions of lullabies**, suggesting that pitch may be one performance characteristic that conveys the communicative intent in infant-directed singing. In the current study, we evaluated 6- and 7-month-old infants' natural preferences for unfamiliar, expressive lullabies and playsongs as a function of pitch using a head-turn preference procedure. **Infants preferred low-pitched over high-pitched versions of lullabies and high-pitched over low-pitched versions of playsongs.** Results suggest that the overall pitch of a song is communicative to infants and that the affective nature of music can have an effect on infants' pitch preferences. That is, infants' preferences for pitch are context-dependent.

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PMID: 20036776 [PubMed - as supplied by publisher]

2. Newborns' Cry Melody Is Shaped by Their Native Language. Mampe B, Friederici AD, Christophe A, Wermke K. *Curr Biol.* 2009 Nov 4. [Epub ahead of print]

Human fetuses are able to memorize auditory stimuli from the external world by the last trimester of pregnancy, with a particular sensitivity to melody contour in both music and language [1-3]. Newborns prefer their mother's voice over other voices [4-8] and perceive the emotional content of messages conveyed via intonation contours in maternal speech ("motherese") [9]. Their perceptual preference for the surrounding language [10-12] and their ability to distinguish between prosodically different languages [13-15] and pitch changes [16] are based on prosodic information, primarily melody. Adult-like processing of pitch intervals allows newborns to appreciate musical melodies and emotional and linguistic prosody [17]. Although prenatal exposure to native-language prosody influences newborns' perception, the surrounding language

affects sound production apparently much later [18]. Here, we analyzed the crying patterns of 30 French and 30 German newborns with respect to their melody and intensity contours. **The French group preferentially produced cries with a rising melody contour, whereas the German group preferentially produced falling contours.** The data show an influence of the surrounding speech prosody on newborns' cry melody, possibly via vocal learning based on biological predispositions.

PMID: 19896378 [PubMed - as supplied by publisher]

3. Is beat induction innate or learned? Probing emergent meter perception in adults and newborns using event-related brain potentials.

Honing H, Ladinig O, Háden GP, Winkler I. Ann N Y Acad Sci. 2009 Jul;1169:93-6.

Meter is considered an important structuring mechanism in the perception and experience of rhythm in music. Combining behavioral and electrophysiological measures, in the present study we investigate whether meter is more likely a learned phenomenon, possibly a result of musical expertise, or whether sensitivity to meter is also active in adult nonmusicians and newborn infants. The results provide evidence that meter induction is active in adult nonmusicians and **that beat induction is already functional right after birth.**

PMID: 19673760 [PubMed - indexed for MEDLINE]

4. Newborn infants detect the beat in music. Winkler I, Háden GP, Ladinig O, Sziller I, Honing H. Proc Natl Acad Sci U S A. 2009 Feb 17;106(7):2468-71. Epub 2009 Jan 26.

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To shed light on how humans can learn to understand music, we need to discover what the perceptual capabilities with which infants are born. Beat induction, the detection of a regular pulse in an auditory signal, is considered a fundamental human trait that, arguably, played a decisive role in the origin of music. Theorists are divided on the issue whether this ability is innate or learned. **We show that newborn infants develop expectation for the onset of rhythmic cycles (the downbeat), even when it is not marked by stress or**

other distinguishing spectral features. Omitting the downbeat elicits brain activity associated with violating sensory expectations. Thus, our results strongly support the view that beat perception is innate.

PMID: 19171894 [PubMed - indexed for MEDLINE]

5. Melody recognition by two-month-old infants.

Plantinga J, Trainor LJ. J Acoust Soc Am. 2009 Feb;125(2):EL58-62.

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Music is part of an infant's world even before birth, and caregivers around the world sing to infants. Yet, there has been little research into the musical abilities or preferences of infants younger than 5 months. In this study, the head turn preference procedure used with older infants was adapted into **an eye-movement preference procedure so that the ability of 2-month-old infants to remember a short melody could be tested.** The results show that with minimal familiarization, 2-month-old infants remember a short melody and can discriminate it from a similar melody.

PMID: 19206833 [PubMed - indexed for MEDLINE]

6. Development of infant mismatch responses to auditory pattern changes between 2 and 4 months old. He C, Hotson L, Trainor LJ.

Eur J Neurosci. 2009 Feb;29(4):861-7. Epub 2009 Feb 6.

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In order to process speech and music, the auditory cortex must learn to process patterns of sounds. Our previous studies showed that with a stream consisting of a repeating (standard) sound, younger infants show an increase in the amplitude of a positive slow wave in response to occasional changes (deviants) in pitch or duration, whereas older infants show a faster negative response that resembles mismatch negativity (MMN) in adults (Trainor et al., 2001, 2003; He et al., 2007). MMN reflects an automatic change-detection process that does not require attention, conscious awareness or behavioural response for its elicitation (Picton et al., 2000; Näätänen et al., 2007). It is an important tool for understanding auditory perception because MMN reflects a change-detection mechanism, and

not simply that repetition of a stimulus results in a refractory state of sensory neural circuits while occasional changes to a new sound activate new non-refractory neural circuits (Näätänen et al., 2005). For example, MMN is elicited by a change in the pattern of a repeating note sequence, even when no new notes are introduced that could activate new sensory circuits (Alain et al., 1994, 1999; Schröger et al., 1996). **In the present study, we show that in response to a change in the pattern of two repeating tones, MMN in 4-month-olds remains robust whereas the 2-month-old response does not. This indicates that the MMN response to a change in pattern at 4 months reflects the activation of a change-detection mechanism similarly as in adults.**

PMID: 19200074 [PubMed - indexed for MEDLINE]

7. Infants prefer the musical meter of their own culture: a cross-cultural comparison. Soley G, Hannon EE. Dev Psychol. 2010 Jan;46(1):286-92.

Department of Psychology, Harvard University, USA.

Infants prefer native structures such as familiar faces and languages. Music is a universal human activity containing structures that vary cross-culturally. For example, Western music has temporally regular metric structures, whereas music of the Balkans (e.g., Bulgaria, Macedonia, Turkey) can have both regular and irregular structures. We presented **4- to 8-month-old American and Turkish** infants with contrasting melodies to determine whether cultural background would influence their preferences for musical meter. In Experiment 1, **American infants preferred Western over Balkan meter, whereas Turkish infants, who were familiar with both Western and Balkan meters, exhibited no preference.** Experiments 2 and 3 presented infants with either a Western or Balkan meter paired with **an arbitrary rhythm with complex ratios** not common to any musical culture. **Both Turkish and American infants preferred Western and Balkan meter to an arbitrary meter.** Infants' musical preferences appear to be driven by culture-specific experience and a culture-general preference for simplicity. Copyright 2009 APA, all rights reserved.

PMID: 20053025 [PubMed - in process]

8. Finding the pitch of the missing fundamental in infants. He C, Trainor LJ.

J Neurosci. 2009 Jun 17;29(24):7718-8822.

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Pitch perception is critical for the perception of speech and music, for object identification, and for auditory scene analysis, whereby representations are derived for each sounding object in the environment from the complex sound wave that reaches the ears. The perceived pitch of a complex sound corresponds to its fundamental frequency. However, **removal of energy at the fundamental does not alter the pitch because adults use the harmonics to derive the pitch** (Bendor and Wang, 2005; Trainor, 2008). Although sound frequency is represented subcortically, **the integration of harmonics into a representation of pitch does not occur until auditory cortex** (Bendor and Wang, 2005). Given that auditory cortex is immature in young infants, we examined the development of cortical representations for pitch by measuring electrophysiological (EEG) responses to pitch changes that required processing the pitch of the missing fundamental. Adults and infants 4 months and older showed a mismatch negativity response to these pitch changes, but 3-month-old infants did not. **Thus, cortical representations of the pitch of the missing fundamental emerge between 3 and 4 months of age, indicating that there is a profound change in auditory perception for pitch in early infancy.**

PMID: 19535583 [PubMed - indexed for MEDLINE]

9. Neural representation of transposed melody in infants at 6 months of age. Tew S,

Fujioka T, He C, Trainor L. Ann N Y Acad Sci. 2009 Jul;1169:287-90.

We examined adults' and 6-month-old infants' event-related potentials in response to occasional changes (deviants) in a 4-note melody presented at different pitch levels from trial to trial. **In both groups, responses to standard and deviant stimuli differed significantly;** however, adults produced a typical mismatch negativity (MMN), **whereas 6-month-old infants exhibited a slow positive wave.** We conclude that 6-month-old infants, like adults, encode melodic information in terms of relative pitch distances, but that the underlying

cortical activity differs significantly from that of adults.

PMID: 19673795 [PubMed - indexed for MEDLINE]

10. The effects of music listening on inconsolable crying in premature infants.

Keith DR, Russell K, Weaver BS. J Music Ther. 2009 Fall;46(3):191-203.

Over the decades, medical staff have developed strategies to manage crying episodes of the critically ill and convalescing premature infant. These episodes of crying occur frequently after infants are removed from ventilation, but before they are able to receive nutrition orally. Not only are these episodes stressful to infants and upsetting to parents, but they are also stressful and time consuming for the staff that take care of these patients. Although the literature supports the benefits of music therapy in regard to physiological and certain behavioral measures with premature infants, no research exists that explores the use of music therapy with inconsolability related to the "nothing by mouth" status. This study explored the effects of music therapy on the **crying behaviors of critically ill infants classified as inconsolable. Twenty-four premature infants** with gestational age 32-40 weeks received a developmentally appropriate music listening intervention, alternating with days on which no intervention was provided. The results revealed a **significant reduction in the frequency and duration of episodes of inconsolable crying as a result of the music intervention, as well as improved physiological measures including heart rate, respiration rate, oxygen saturation, and mean arterial pressure.** Findings suggest the viability of using recorded music in the absence of a music therapist or the maternal voice to console infants when standard nursing interventions are not effective.

PMID: 19757875 [PubMed - in process]

11. Effects of music on crying behavior of infants and toddlers during physical therapy intervention. Rahlin M, Stefani J. Pediatr Phys Ther. 2009

Winter;21(4):325-35.

PURPOSE: This study was designed to investigate the effects of music on the amount of time that infants and toddlers cried during physical therapy sessions.

METHODS: An A-B-A withdrawal multiple single-subject design was used with 9

infants and toddlers with or at risk for developmental disabilities. **Music was played during therapy in the intervention period but not in the baseline periods.** The number of minutes that the participants cried was documented in a Crying Log. Results were analyzed using a celeration line approach and descriptive statistics. RESULTS: Responses to music varied among the participants, **with 6 of 9 children crying less when music was used during therapy.** CONCLUSIONS: Infants and toddlers with or at risk for developmental disabilities may benefit from the use of music during physical therapy to reduce crying. Effects of music on other aspects of infant and toddler behavior need to be studied.

PMID: 19923973 [PubMed - in process]

12. Effect of Music by Mozart on Energy Expenditure in Growing Preterm Infants. Lubetzky R, Mimouni FB, Dollberg S, Reifen R, Ashbel G, Mandel D. Pediatrics. 2009 Dec 7. [Epub ahead of print]

Objective: The rate of weight gain in preterm infants who are exposed to music seems to improve. A potential mechanism could be increased metabolic efficiency; therefore, we conducted this study **to test the hypothesis that music by Mozart reduces resting energy expenditure (REE) in growing healthy preterm infants.** DESIGN: A prospective, randomized clinical trial with crossover was conducted in 20 healthy, appropriate-weight-for-gestational-age, gavage-fed preterm infants. Infants were randomly assigned to be exposed to a 30-minute period of Mozart music or no music on 2 consecutive days. Metabolic measurements were performed by indirect calorimetry. Results: REE was similar during the first 10-minute period of both randomization groups. During the next 10-minute period, **infants who were exposed to music had a significantly lower REE than when not exposed to music (P = .028). This was also true during the third 10-minute period (P = .03). Thus, on average, the effect size of music on REE is a reduction of approximately 10% to 13% from baseline, an effect obtained within 10 to 30 minutes.** Conclusions: Exposure to Mozart music significantly lowers REE in healthy preterm infants. We speculate that this effect of music on REE might explain, in part, the improved weight gain that results from this "Mozart effect."

PMID: 19969615 [PubMed - as supplied by publisher]

13. **Music for medical indications in the neonatal period: a systematic review of randomised controlled trials.** Hartling L, Shaik MS, Tjosvold L, Leicht R, Liang Y, Kumar M. Arch Dis Child Fetal Neonatal Ed. 2009 Sep;94(5):F349-54. Epub 2009 May 28.

Alberta Research Center for Health Evidence, University of Alberta, Edmonton, Canada.

OBJECTIVE: To conduct a systematic review of the efficacy of music for medical indications in term or preterm neonates. METHODS: **We searched 17**

electronic databases, subject bibliographies, reference lists and trials registries. Two reviewers independently screened studies for inclusion, assessed methodological quality, and extracted data. Meta-analysis was not feasible due to heterogeneity in outcomes so a qualitative analysis is presented. RESULTS: Nine randomised trials were included. The methodological quality was generally poor (median Jadad score = 1). The outcomes most commonly reported were physiological measures (heart rate (HR), respiratory rate, oxygen saturation (SaO₂)), behavioural state and pain. Six studies evaluated music for the painful procedures circumcision (three trials) and heel prick (three trials). For circumcisions, **one high quality pilot study (n = 23) showed benefits of music for the outcomes of HR, SaO₂ and pain**, while two low quality studies showed no difference. **For heel prick, three low quality studies provided some evidence that music may be beneficial primarily for measures of behaviour and pain.** The remaining studies evaluated the use of music in preterm infants to improve physiological and behavioural parameters (n = 31; **benefits observed for behavioural parameters**), to reinforce non-nutritive sucking via use of a pacifier activated lullaby (n = 32; significant increase in feeding rates), and to influence physiological stability and behaviours in infants with chronic lung disease (n = 22; no significant differences for outcomes assessed).

CONCLUSIONS: The heterogeneity in study populations, interventions and outcomes precludes definitive conclusions around efficacy. There is preliminary **evidence for some therapeutic benefits of music for specific indications; however, these findings need to be confirmed in methodologically rigorous trials.**

PMID: 19477913 [PubMed - indexed for MEDLINE]

14. The effect of decibel level of music stimuli and gender on head circumference and physiological responses of premature infants in the NICU.

Cassidy JW. J Music Ther. 2009 Fall;46(3):180-90.

The purpose of this study was to examine different protocols with regard to the presentation of music stimuli and compare gender differential reactions to those stimuli. Subjects for this study (N = 63) were premature infants in the Neonatal Intensive Care Unit (NICU) between the gestational ages of 28 and 33 weeks. Half of the experimental infants listened to 20 mins of lullaby music (female voice with orchestral background) on 2 days followed by 20 mins of classical music (Mozart string music) on 2 days. The other half listened to the same music in the reverse order. One quarter of the males and one quarter of the females listened to music presented at an average of 65 dB, one quarter at an average of 70 dB, one quarter at an average of 75 dB, and one quarter did not listen to any music and served as control subjects. Head circumference data were collected four times by the researcher: (a) upon receipt of parental consent, (b) on the first day of music presentation (1 week after consent), (c) on the last day of music presentation, and (d) 1 week after music presentation. Physiological data (heart rate, respiratory rate, oxygen saturation) were recorded by the researcher at 2-minute intervals starting 4 minutes prior to and ending 4 minutes after music presentation. There was a significant difference ($p < .0001$) in average daily head growth across time, but this seems unrelated to the music condition as the same curvilinear trend (larger gain during days of treatment, smaller gain during baseline before and after treatment) was noted for control infants who did not listen to music. Results indicate **a significant ($p = .002$), but biologically unimportant, decrease in heart rate over the course of data collection**. No differences due to gender were noted.

PMID: 19757874 [PubMed - in process]