



Music, a piece of many puzzles in developmental science

1 | INTRODUCTION TO THE SPECIAL ISSUE “MUSIC IN DEVELOPMENT”

When psychologist Sandra Trehub passed away in January 2023, many of her colleagues noted her role in putting music on psychologists' radar—especially research on music in development.

Quoted in the *New York Times*, Laurel Trainor explained: “Back then, there were very few people in psychology and neuroscience who were studying music at all as a human behavior. Sandra said, look, music is universal, we spend a lot of time and energy on music. What is its purpose? Why do we do this?” (Whang, 2023). Writing on the Cognitive Development Society listserv, developmental scientists Roberta Golinkoff, Janet Werker, Kathy Hirsh-Pasek, David Lewkowicz, and others echoed this view.

Nearly a half-century has elapsed since Trehub's trailblazing papers on the foundations of music perception in infancy (Chang & Trehub, 1977a, 1977b; Trehub et al., 1984), which themselves built on foundational findings in speech perception (Eimas et al., 1971; Morse, 1972), including her own (Trehub, 1976). In that time, music research has influenced the course of nearly every domain of psychology and cognitive neuroscience.

These domains include:

- psychological universality and cross-cultural variability (Castellano et al., 1984; McDermott et al., 2016; Mehr et al., 2019; Sievers et al., 2013);
- neuroanatomy (Albouy et al., 2020; Grahn & Brett, 2007; Norman-Haignere et al., 2015);
- cognitive and neurodevelopmental disorders (Kotler et al., 2019; Levitin et al., 2003; Mas-Herrero et al., 2014; Peretz, 2016; Sharda et al., 2018);
- social cognition (Lense et al., 2022; Mehr et al., 2016; Soley & Sebastián-Gallés, 2015; Xiao et al., 2017);
- biological and cultural evolution (Honing et al., 2015; Mehr et al., 2020; Savage et al., 2021; Singh & Mehr, 2023; Trainor, 2015);
- emotion (Juslin & Västfjäll, 2008; Krumhansl, 2002);
- language (Creel et al., 2017; Jackendoff, 2009; Liu et al., 2023; Loui et al., 2010; Patel, 2008);
- learning and experience (Hannon & Trainor, 2007; Hannon & Trehub, 2005; Schellenberg, 2019);
- genetics (Mehr et al., 2017; Mosing et al., 2015; Niarchou et al., 2022; Peretz et al., 2007);
- comparative cognition (Bregman et al., 2016; Honing, 2019; James & Sakata, 2017; Schachner et al., 2009);
- motor action and rhythm (Jacoby & McDermott, 2017; Palmer & Meyer, 2000; Repp, 2005; Tierney et al., 2011);
- infant care (Bainbridge et al., 2021; Cirelli et al., 2019; Cirelli & Trehub, 2020; Mehr & Krasnow, 2017; Trehub & Trainor, 1998; Yan et al., 2021);
- personality and individual differences (Anderson et al., 2020; Müllensiefen et al., 2014; Nave et al., 2018);
- health (Cheever et al., 2018; Chen et al., 2022; Hole et al., 2015);
- behavioral data science (Park et al., 2019; Way et al., 2020); and many others.

But the maturation of music perception research into a bona fide area of scientific inquiry, with transdisciplinary ties in both basic and applied science, is not yet complete. Many psychology departments relegate the teaching of a “Psychology of Music” course to an adjunct instructor, or offer no instruction on the topic at all, for example. Music researchers often receive inquiries from students who open with “I'm writing you because there's no lab at my university where I can study music”. Despite its continuing marathon of high-profile discoveries, music is still not ubiquitous in academic psychology.

We hope this Special Issue, “Music In Development”, will further music's establishment as a mainstream area of developmental science research. We received over sixty presubmission inquiries and are eager to present the resulting 15 articles in this collection. We hope you enjoy them.

1.1 | What the issue covers

This issue shows that music can offer a window into many of the foundational puzzles of developmental science.

This is evident from the *breadth* of developmental science research on music. We have findings on the impact of prenatal exposure to music on newborns' neural responsivity to the fundamental frequency of speech stimuli (Arenillas-Alcón et al., 2023), a test of the complexity-grove relationship in children's dance (Cameron et al., 2023), and a measure of degree to which playing instruments asynchronously enhances children's perspective-taking skills (Wan et al., 2023). Imaging techniques help determine whether the infant cortex exhibits selective neural responses to music and speech (Kosakowski et al., 2023), and whether infant brain structure is related to subsequent music aptitude skills (Zuk et al., 2023). There is even a survey of the influence of different acoustic features on children's development



of categories for speech and song (Vanden Bosch der Nederlanden et al., 2023). These and the other findings reported in this special issue showcase the wide range of developmental topics impacted by music.

Further, the research published here documents *mechanisms* of music perception research, a key topic for developmentalists, highlighting overlaps and non-overlaps between the processes underlying music cognition as well as other domains. Based on data from animals, infants, and adults, as well as behavioral, hemodynamic, and electrophysiological measures, the results reported across this special issue detail a range of systematic relationships between variables. For example, Langus et al. (2023) ask whether early exposure to music and infant-directed language enhances infants' categorical perception of linguistic prominence. Paula et al. (2023) combine neural and behavioral measures with a music-listening intervention for infants at risk for developmental language and reading disorders, including dyslexia, and Lenc et al. (2023) relate early-developing neural processes to the emergence of internal representations of musical meter. Results also highlight how music can support healthy development: Bentley et al. (2023) report findings from low-income preschoolers on a music-based self-regulation intervention, while Alviar et al. (2023) explore the impact of infant-directed (ID) song on infants' attention to caregivers' mouths in support of language development.

Last, this issue highlights our field's long-overdue shift in scientific practice away from WEIRD sampling, with projects that solidify our understanding of *cross-cultural and cross-species* results in music. For example, one paper reports Korean infants' preference for Korean and Western traditional songs played by *haegeum*—a two-stringed vertical fiddle used in many traditional Korean musical genre—and cello (Ko et al., 2023). Another compares children's associations between space and pitch across two non-English languages, Dutch and Turkish (Dolscheid et al., 2023). An examination of the biological basis of octave equivalence perception in common marmosets (Wagner et al., 2023) provides a comparative perspective, as does work examining the interplay between biological predispositions and developmental experiences in shaping the temporal patterning of birdsong (James et al., 2023). Contributions like these are essential for a comprehensive developmental science.

1.2 | A bright future for developmental science on music

We see this Special Issue as an existence proof for the vitality, breadth, and importance of music as a core domain of research in developmental science. How can we help this area to thrive?

In our evaluation of science (as journal editors and reviewers) we should not assert that music research is “best suited for a more specialized outlet”. Similarly, as grant reviewers and advocates, we should encourage major funders to provide direct support to researchers making advances in the developmental science of music. As faculty members, we should support students who want to engage in music research, either in our own labs or in collaboration with

music researchers—even if one has never studied music before—and we should encourage the development of our own departments, in terms of the courses we offer and the people we hire. Capable researchers may be put off by the rarified terms of music theory (modulations, harmonic progressions, keys, etc.) but these should not be barriers to engaging with the important issues of the field. It is easy to find a colleague or eager student well-versed in musical jargon to collaborate with scientists who wish to enter the field.

More generally, as scientists, we should disabuse ourselves of the tempting notion that music research is a niche topic of minor importance relative to standard-bearers such as language, social cognition, numeracy, and so on. The evidence is all around us all: just look in your pocket (where a device is available that plays music) or at your credit card bill (where you've likely spent money on music) or at your children's education (which likely includes music). The list goes on—as will research on music in development.

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