Music, hearing, and education: from the lab to the classroom

BY NINA KRAUS

Historically, research assessing the impact of musical training has focused on those children whose families are able to pay for private lessons. In this article however, **Nina Kraus** outlines the findings of one of her recent projects; assessing the impact of community music programmes on neural processing to see if similar changes can be recorded.

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Making music matters

Research shows that making music changes the brain, and that these brain changes have tangible impacts on listening skills, learning and cognition [1,3]. Historically, this research focused on children whose families have the resources to enroll them in private lessons beginning at a young age. New work pushes auditory neuroscience beyond the laboratory to investigate the biological impact of community music training [3].

Community music programmes for primary children

We partnered with Harmony Project (www.harmony-project.org), a community mentorship foundation that provides free music instruction to primary school children from Los Angeles gang reduction zones. After two years—but not one—music training improved the neural processing of sound [2]. More active students (those who played an instrument, in contrast to those who took music appreciation classes) made greater gains. Moreover, unlike the control group whose literacy performance declined - as expected for low socioeconomic status (SES) students - music students stayed on track with national norms. Finally, the ability to understand speech in noisy environments improved in the music group.

In-school music for high schoolers

In a second partnership we worked with the Chicago Public Schools to investigate the impact of music training initiated during adolescence. We found that starting music lessons as late as high school still produced enriching neural effects [9]. Again, gains were apparent only after two years of training, when we found that music students' neural responses to speech were less compromised by background noise compared to their peers in a Reserve Officers' Training Corps (ROTC) fitness-based programme – a training programme that, like music, requires discipline and time investment but, unlike music, does not demand the development of sound-to-meaning connections. After the completion of a third year of training, more brain changes emerged: music students' brain responses were more mature and showed greater sensitivity to sound details. Both ROTC and music students' literacy performance improved, but the gains were greatest for the music group.

The changing, learning brain

Due to the overlap of brain circuits dedicated to speech and music, and the distributed network of cognitive, sensorimotor, and reward circuits

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engaged during music making, we believe that music training is a particularly potent driver of brain plasticity that influences the biological processes important for listening, language, and learning [4]. In fact, individuals who took music lessons as children show stronger neural processing of sound: young adults and even older adults who have not played an instrument for up to 50 years show enhanced neural processing compared to their peers [7,10].

Previous research shows that poverty negatively influences brain function, resulting in less efficient, less consistent, and 'noisier' sound processing [8]. Music training helps erase this poverty signature. In a complementary line of work, we have shown that speaking a second language confers a distinct brain signature for processing sound [5]; this, too, partially mitigates the effects of poverty on neural function [6].

The arts, education, and social policy

Cost-effective school and community-based programmes offer the potential to stimulate biological changes in neural processes important for academic success. The clinical community can use their knowledge of hearing, and its impact on health, wellbeing, and learning, to help advocate for music lessons.

To learn more about the Kraus Lab, visit us online, www.brainvolts.northwestern.edu. Start with the music and neuroeducation pages to get an overview of our work.

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Declaration of Competing Interests:
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