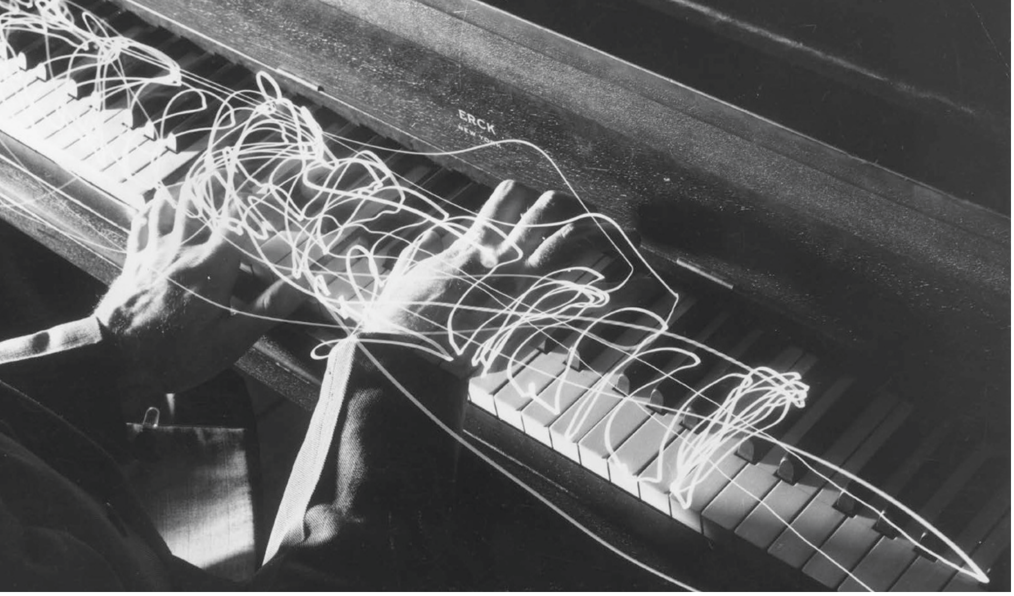


How the human brain processes music remains a mystery.

GEORGE PICKOW/THREE LIONS/GETTY

NEUROSCIENCE

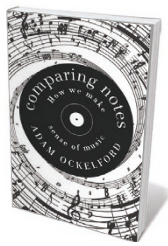
How music meets mind

Elizabeth Hellmuth Margulis explores a study parsing how the brain makes sense of melody and harmony.

Whether tapping a foot to samba or weeping at a ballad, the human response to music seems almost instinctual. Yet few can articulate how music works. How do strings of sounds trigger emotion, inspire ideas, even define identities?

Cognitive scientists, anthropologists, biologists and musicologists have all taken a crack at that question (see go.nature.com/2sdpcb5), and it is into this line that Adam Ockelford steps. *Comparing Notes* draws on his experience as a composer, pianist, music researcher and, most notably, a music educator working for decades with children who have visual impairments or are on the autistic spectrum, many with extraordinary musical abilities. Through this "prism of the overtly remarkable", Ockelford seeks to shed light on music perception and cognition in all of us. Existing models based on neurotypical children could overlook larger truths about the human capacity to learn and make sense of music he contends.

Some of the children described in *Comparing Notes* might (for a range of reasons) have trouble tying their shoelaces or carrying on a basic conversation. Yet before they hit double digits in age, they can hear a complex composition for the first time and immediately play it on the piano, their fingers flying to the correct notes. This skill, Ockelford reminds us, eludes many adults with whom he studied at London's Royal Academy of Music. Weaving together the strands that let these children perform such stunning feats, Ockelford constructs an argument for rethinking conventional wisdom on music education.



Comparing Notes: How We Make Sense of Music
ADAM OCKELFORD
Profile: 2017.

He positions absolute pitch (AP) as central to these abilities to improvise, listen and play. Only 1 in 10,000 neurotypical people in the West have AP — the ability to effortlessly, without context, name the note sounded by a violin or a vacuum cleaner ("That's an F-sharp!"). Among those on the autism spectrum, the number rises to 8%, roughly 1 in 13. For people born blind or who lost their sight early in infancy, it is 45%. AP, Ockelford argues, enables children to sound out and tinker with familiar tunes; that experimentation leads to a deep grasp of musical structure.

Many of the children Ockelford works with were born blind and autistic. For them, the predictability of the keyboard experienced through the lens of AP can trigger obsessive fascination. The US television programme *60 Minutes* featured footage of musical savant Rex Lewis-Clack as a toddler: as he falls asleep next to a keyboard, we see his hand drowsily reaching out to play two last notes before he drifts off. Children with this kind of passion can spend hundreds of hours at the keyboard, mapping sound to movement.

An experiment with Derek Paravicini — one of Ockelford's most accomplished students, now an adult — supports the idea that AP underlies a sense of musical structure rather than being solely responsible for remarkable performances. Ockelford asked Paravicini to play back two versions of the same piece: one flouting the conventional rules of Western harmony, the other following them. Paravicini's performance of the second was much more accurate. This suggests that he relies on intuition about structures typical to Western music, to which he was exposed during some crucial period of brain plasticity.

Ockelford devotes much of *Comparing Notes* to an entertaining but idiosyncratic romp through music theory and psychology, including his own "zygonic theory". This holds that repetition and transformation of musical elements can be perceived as intentional imitation — an insight born in improvisation games with his students. Although few would argue with its central tenet, zygonic theory has not gained much traction, partly because its complex notation does not seem to produce insights different from those of simpler tools. In one diagram, an arrow between two identical notes shows that repetition leads to a sense of imitation and derivation — surely better conveyed in a sentence. The increasingly intricate diagrams do not seem to communicate more than basic concepts such as transposition (the repetition of a pattern of notes at a different pitch level).

Ockelford also misses opportunities to develop his ideas about how structure and repetition work. In comparing music and language, he refers only once to Aniruddh Patel's influential *Music, Language, and the Brain* (Oxford University Press, 2008), which explores this terrain. He never mentions Diana Deutsch's speech-to-song illusion, a demonstration of how repetition can transform a spoken phrase into a perceived song (D. Deutsch *J. Acoustical Soc. Am.* **124,** 2471; 2008), or my 2014 *On Repeat* (Oxford University Press), which takes a psychological approach to understanding how repetition in music 'plays' the mind.

Many examples in *Comparing Notes* rely on the ability to read music, yet the book elucidates topics (such as the definition of a scale) that most people able to follow the examples would already understand. Thus, the target audience seems hazy. For a fuller understanding of how music works, I recommend consulting an overview from musicology, such as Mark Evan Bonds' *Listen to This* (Prentice Hall, 2008), and one from psychology, such as Daniel Levitin's *This is Your Brain on Music* (Dutton Penguin, 2006). Ockelford's perceptive chronicle of his experiences with extraordinary music makers reminds us, however, that this puzzle is one that we need to keep probing. ■

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