

BOOK REVIEW

***Guitar Zero: The New Musician and the Science of Learning* by Gary Marcus, New York: The Penguin Press, 2012, 274 pp. ISBN: 978-1-59420-317-6. Hardcover, \$25.95**

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Photos and brief biographies of the authors are available as supplemental materials.

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Determined to learn the guitar at the ripe young age of 40, developmental psychologist Gary Marcus embarks on a journey of musical discovery. Along the way, he narrates his path from virtual to real-life guitar hero and intersperses his adventure with a tour through the cognitive and neuroscientific underpinnings of the musical mind.

Marcus' book is organized around his foray into learning guitar. At the outset, he admits that notwithstanding his lifelong appreciation for music his own desire to become a musician was seriously compromised by arrhythmia. Now, way past his childhood critical period for absorbing new skills, Marcus sets out to discover whether practice and persistence are enough to teach an old cognitive psychologist a new trick. With guitar in hand he vanishes to a cabin in the woods, fumbling through guitar books and building his fingers calluses. With some initial progress, he later seeks out lessons, and after beginning to feel the beat, sets off to band camp where he joins a team of budding musicians who carry him toward a grand finale, rocking out on stage in a real band! You can hear the final piece with Marcus on bass on his website (<http://gary-marcus.com/bio/music/rushhour.html>) and judge for yourself whether his practice paid off.

Marcus' storytelling is compelling, and readers may find themselves cheering him on. As you wonder whether his practice will make him perfect, Marcus weaves together a lay introduction to the science of skill learning and musical mastery. Marcus also documents his interviews with famous guitarists, including Pat Martino, Pat Metheny, and Tom Morello, and psychologists, including Anders Ericsson, Ray Jackendoff, Phil Johnson-Laird, and Gottfried Schlaug, who weigh in on his adventure. Each step of the way he addresses questions of broad importance and challenges some mainstays of the field. We find out that critical periods for skill acquisition may not be set in stone, and that little research has been conducted on skill acquisition later in life. The musical brain is flexible, and musicians at any level of expertise can make use of a deep set of brain tools that coordinate the heady conceptual stuff of musical theory with the blisteringly fast and precise motor movements needed to shred guitar solos. Although persistence and practice pay off and almost anyone could graduate from guitar-hero video games to bona fide guitar player, Marcus admits that talent is a force to be reckoned with. Some brains are naturally equipped with the tools that make musical ability seem effortless.

These tools are not to be mistaken for a musical module in the brain, but a vast interconnected set of regions that give rise to musical expertise. Still, talent and practice are not the whole story. Adult learners as lifelong music listeners can rely on their intellectual heritage when learning to play, perhaps affording a head-start in grasping music theory and song composition. And, even the most talented and dedicated guitar student may never fully develop his/her skill without the musical eyes and ears of an expert teacher who can guide students toward higher musical plateaus. Musical skill acquisition reaches far beyond technical playing and sight-reading music notation (especially for many guitarists), and Marcus touches on these issues by discussing questions of music aesthetics: why are humans drawn to music, and how does repetition with variation and sonic exploration somehow lead to top 100 hits.

The book is aimed at the general public, and will most obviously appeal to readers with an interest in picking up a guitar. The book will no doubt also interest guitarists and musicians alike who want to reflect and vicariously commiserate over their own experiences in learning an instrument, and who are curious about the internal wiring of the musical mind. For those unfamiliar with the guitar itself, Marcus provides a solid description of the basic components of guitars and the challenges that go into learning to play them. However, *Guitar Zero* should not be confused with a book on learning to play guitar. The main riff of the book is an overarching introduction to the cognitive science and neuroscience of musical skill acquisition, of course relayed distinctively through the buzz (lens) of an amplifier.

As a fellow guitarist and cognitive psychologist, I read the book with enthusiasm, looking for new insights for both enterprises. Given that the book is written for a general audience, it is inevitable that some surfaces must be skimmed, and readers looking for a more in-depth analysis of the state of music research, or looking for advanced guitar techniques, may not be entirely satisfied.

Perhaps the most important theme of the book is to ask whether critical periods are necessary for skill learning. Marcus tackles this issue directly by documenting his experience with learning guitar as an adult. Marcus does not attempt a full frontal assault on the concept of critical periods by systematically dismantling the construct with lists of contradictory evidence. Instead, he points out that little research has focused on skill learning in adulthood, and what research has been conducted suggests that, for the most part, the same host of learning processes shape skill learning in similar ways across the life span.

Another prominent theme is to cast nature against nature, and talent against practice. These issues are never presented dichotomously but instead as intertwined forces. Sure, nature provides some raw equipment, but motoric, perceptual, and conceptual learning processes are a generic set of tools that humans can rely on to become experts in many domains, guitar included. The human brain is a highly plastic system that can flexibly acquire new skills even in adulthood. The musical mind is shaped by changes in the brain that occur with practice. For example, the

motor cortex grows and devotes more tissue for areas that code precise finger movements, the connections between hemispheres in the corpus callosum are thickened, and changes occur in auditory cortex. Musicians' brains are tuned into musical minds.

Of course, the slate is not entirely blank from the beginning: the brain's toolbox comes with genetic biases and may prime some individuals toward musicianship. For example, absolute pitch abilities partly rely on genetic factors and on early exposure to musical training. However, as Marcus points out, many accomplished musicians like Duke Ellington have managed just fine without absolute pitch. Indeed, even those like Gary Marcus who come equipped with congenital arrhythmia can make tremendous strides with practice. Not just a mere 10,000 hr of practice, but deliberate knowledge seeking practice that continuously ups the ante for what is to be learned.

In the process of reviewing the science of learning for a general public, it becomes increasingly clear that in learning guitar, and in learning to write a hit song, there is just as much art involved as there is science. The science of learning has uncovered many important general principles and neuromechanisms of learning, but does not yet prescribe optimal solutions for learning many specific skills like guitar. It perhaps goes without saying that guitar players

would be much better off consulting a guitar teacher than a psychologist for tips. Compared with piano or voice there is relatively scant empirical work on learning to play guitar. There ought to be a great deal of transfer in the learning principles that apply across instruments, however there are likely instrument-specific insights as well. Guitar players are a mixed breed. Marcus suggests that most guitarists do not know how to read music notation, they may have learned to play on their own by ear, by book, or by now youtube. They play a wide range of musical styles, and have learned to effortlessly contort their fingers over the fretboard, which Marcus likens to having to play six pianos at once. Marcus' discussions with professional guitarists and music teachers outline many different practice regimens and methods for learning the guitar, and determining the relative merits of these methods empirically seems like a ripe area for interested experimentalists.

Guitar Zero wonderfully captures the joy of the struggle in learning to play an instrument, and is certainly bound to inspire budding guitarists young and old alike. More than this, Marcus presents an easy to digest, bird's eye view of the science of skill learning that ought to similarly inspire readers to dig deeper into science of music and the mind.

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