

ADVANCE PRAISE FOR

GUITAR ZERO

‘Gary Marcus, one of the deepest thinkers in cognitive science, has given us an entertaining and enlightening memoir, filled with insight about music, learning, and the human mind.’

Steven Pinker, Professor of Psychology at Harvard University and author of *The Better Angels of Our Nature*

‘I enjoyed *Guitar Zero* immensely. Marcus has not only intensified the process itself, but simplified the definition of one’s dedication to it.’

Pat Martino, four-time Grammy nominee

‘Marcus is one of the smartest psychologists around, a deep thinker and an eloquent writer, and the story he tells is informed by the best science of perception and learning and evolution; talent and effort, genius and frustration and success. If you have ever dreamt of becoming a musician, you simply must read *Guitar Zero*.’

Paul Bloom, Professor of Psychology at Yale University and author of *How Pleasure Works*

‘A delightfully inspiring, charming, and detailed musical journey that explodes myths of human limitation, while revealing that the fountain of youth very well may be made of wood and played on six strings.’

Richard Barone, musician and author of *Frontman: Surviving the Rock Star Myth*

‘Captivating and filled with insight, *Guitar Zero* is a look at the challenge of personal reinvention by Gary Marcus, one of our leading psychologists. Whether you are a music lover or not, if you care about reaching your own potential, you should read this book.’

Dr Drew Pinsky, Assistant Clinical Professor of Psychiatry at the University of Southern California and Host of *Celebrity Rehab*

ABOUT THE AUTHOR

Gary Marcus is Professor of Psychology and Director of the New York University Center for Language And Music (CLAM), where he studies evolution, language, and cognitive development. He has written three books about the origins and development of the mind and brain, including *The Algebraic Mind*, *The Birth of the Mind*, and *Kluge*, and is also the editor of *The Norton Psychology Reader*. His scientific articles have been published in leading journals, such as *Science* and *Nature*, and his essays have appeared in *Wired*, the *Wall Street Journal*, the *New York Times*, and many others. He lives in New York City.



GUITAR ZERO



**The Science of
Learning to be Musical**

GARY MARCUS



ONE WORLD

A Oneworld Book

First published in Great Britain and the Commonwealth
by Oneworld Publications 2012

First published by arrangement with The Penguin Press, a member of the
Penguin Group (USA), Inc.

This edition published by Oneworld Publications in 2013

Copyright © Gary Marcus 2012

The moral right of Gary Marcus to be identified as the Author of this
work has been asserted by him in accordance with the Copyright,
Designs and Patents Act 1988

Illustration credits:

Pages 41 and 205: Athena Vouloumanos

Page 140: Gary Marcus

Pages 18 and 218: Meighan Cavanaugh based on sketches by the author.

All rights reserved

Copyright under Berne Convention

A CIP record for this title is available
from the British Library

ISBN: 978-1-85168-962-0

Ebook ISBN: 978-1-78074-100-0

Designed by Meighan Cavanagh

Printed and bound by CPI Mackays, Croydon, UK

Oneworld Publications
10 Bloomsbury Street, London WC1B 3SR

Stay up to date with the latest books,
special offers, and exclusive content from
Oneworld with our monthly newsletter

Sign up on our website
www.oneworld-publications.com

I've been obsessed with the guitar since I was twelve. In many ways my life has been one long conversation about the guitar, interrupted only by the countless hours of deep pleasure I have playing the darn things, as well as some less pleasant time spent doing what needs to be done so that I can get back to playing and chatting about them.

—*Perry Beekman, jazz guitarist*

First you learn your instrument, then you learn the music, and then you forget all that s**t and just play.

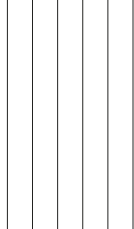
—*Charlie Parker*

CONTENTS

Tuning Up	<i>1</i>
Take Me to the River	<i>11</i>
Learning to Crawl	<i>23</i>
It Don't Come Easy	<i>35</i>
Talking Heads	<i>53</i>
Back to School	<i>65</i>
School of Rock	<i>85</i>
True Talent	<i>97</i>
Into the Groove	<i>107</i>

Onstage	119
The Worst Song in the World	123
Knowing Without Knowing	147
Take It to the Limit	161
Heavy Metal	191
Epilogue	203
Acknowledgements	207
Glossary	211
Notes	220
References	236
Index	264

GUITAR ZERO



TUNING UP

What Does It Take to Become Musical?

Are musicians born or made? All my life I wanted to become musical, but I always assumed that I never had a chance. My ears are dodgy, my fingers too clumsy. I have no natural sense of rhythm and a lousy sense of pitch. I have always loved music but could never sing, let alone play an instrument; in school I came to believe that I was destined to be a spectator, rather than a participant, no matter how hard I tried.

As I grew older, I figured my chances only diminished. Our lives, once we finish school, tend to focus on execution rather than enrichment. Whether we are breadwinners or caretakers, our success is measured by outcomes. The work it takes to achieve those outcomes, we are meant to understand, is something that should happen quickly and behind closed doors. If the conventional wisdom is right, by the time we are adults it's too late to learn anything new. Children may be able to learn anything, but if you wanted to learn French, you should have started when you were six.



Until recently, science supported this theory. Virtually everybody in developmental psychology was a firm believer in ‘critical periods’ of learning. The idea is that there are particular time windows in which complex skills can be learned; if you don’t learn them by the time the window shuts, you never will. Case closed.

But the evidence for critical periods is surprisingly weak. Consider, for example, the often-cited case of Genie, an unfortunate girl who was locked in a silent room for many years. When Genie escaped at the age of thirteen, she was exposed to language for the first time, and she was never able to become fluent. Her vocabulary was good enough to get her started, but her grammar was a mess, filled with utterances like ‘Spot chew glove’ and ‘Applesauce buy store’. Does this mean that Genie’s critical period for language had passed? Most people interpret her case that way, but another explanation, less often considered, is that Genie’s inability to learn language may have come in part from the emotional trauma (and perhaps malnutrition) she had suffered early on. Her case is consistent with the critical period hypothesis, but it certainly doesn’t prove it.

The more people have actually studied critical periods, the shakier the data have become. Although adults rarely achieve the same level of fluency that children do, the scientific research suggests that differences typically pertain more to accent than to grammar. Meanwhile, contrary to popular belief, there’s no magical window that slams shut the moment puberty begins. In fact, in recent years scientists have identified a number of people who have managed to learn second languages with near-native fluency, even though they only started as adults.

If critical periods aren’t quite so firm as people once believed, a world of possibility emerges for the many adults who harbour secret dreams – whether to learn a language, to become a pastry chef, or to pilot a small plane. And quests like these, no matter how quixotic they may seem, and whether they succeed in the end or not, could bring unanticipated benefits, not just for their ultimate goals but for the

TUNING UP

journey itself. Exercising our brains helps maintain them, by preserving plasticity (the capacity of the nervous system to learn new things), warding off degeneration, and literally keeping the blood flowing. Beyond the potential benefits for our brains, there are benefits for our emotional well-being, too. There may be no better way to achieve lasting happiness – as opposed to mere fleeting pleasure – than pursuing a goal that helps us broaden our horizons.



Still, from primary school onward, every musical attempt I made ended in failure. The first time I tried to play guitar, a few years ago, my friend Dan Levitin (who had not yet finished his book *This Is Your Brain on Music*) kindly offered to give me a few lessons. When I came back to him after a week or two of practice, he quickly realized what my primary school teachers had realized long ago: that I had no sense of rhythm whatsoever. Dan offered me a metronome, and when that didn't help, he gave me something my teachers couldn't – a diagnosis: congenital arrhythmia.

And yet I never lost the desire to play. Music hasn't been studied as systematically as language in terms of critical periods, but there are certainly artists who started late and still became first-rate musicians. Tom Morello – guitarist of Rage Against the Machine and *Rolling Stone* magazine's twenty-sixth-greatest guitarist of all time – didn't start until he was seventeen. Patti Smith scarcely considered becoming a professional singer until she was in her mid-twenties. Then there is the jazz guitar legend Pat Martino, who relearned how to play after a brain aneurysm at the age of thirty-five, and the New Orleans keyboard legend Dr John, who switched his primary allegiance from guitar to piano at age twenty-one (after his left ring finger was badly injured in a barroom fight) and won the first of his five Grammy Awards at forty-eight.

GUITAR ZERO

Given my arrhythmia, I had no aspiration of reaching such heights, but at thirty-eight, long after I had completed my PhD and become a professor of cognitive psychology, I realized that my desire to become musical wasn't going away. I wanted to know whether I could overcome my intrinsic limits, my age, and my lack of talent. Perhaps few people had less talent for music than I did, but few people wanted more badly to be able to play.



My first ray of hope came, oddly enough, from a video game, which I bought with the idea that it might improve my rhythm. The game I am referring to is, of course, *Guitar Hero*, perhaps the most mindless yet entertaining game I have ever played. In case you haven't seen it, the basic premise is that coloured dots fall from the top of the screen, in time with music, and as a player your mission consists of nothing more than the pressing of matching coloured buttons on a plastic guitar in time with the falling dots.

What makes it fun is that the game plays a snippet of music each time the player presses a button at the right moment, yielding the illusion that the player is actually playing a song.

Or not. If one's timing is bad enough (as mine was initially), you hear a beep instead of the musical snippet, and worse, the crowd begins to boo. Play badly enough, and the crowd boos you off the stage. I know this rather too well, because every time I tried to play the opening song – a regrettable piece of 1970s blues rock called 'Slow Ride', by Foghat – the crowd soon began to boo, louder and louder, until the song stopped midway through, inevitably accompanied by the rather brutal and unimaginative message informing me that I had 'failed'. As the failures piled up, I was brought back to fourth grade – year five – when I had tried to learn to play the recorder (a sort of poor man's flute that was popular in the Baroque era) and was so musically naive I couldn't get past

TUNING UP

‘Mary Had a Little Lamb’. *Guitar Hero* might be a poor substitute for real guitar, but for a musical dunce like me even *Guitar Hero* seemed out of reach; I soon packed the game away and returned to my ordinary life.

But then a funny thing happened. My wife, Athena, returned home from a trip to see friends and raved about how much fun she’d had playing a counterpart to *Guitar Hero* called *Rock Band*.



Our copy of *Guitar Hero* came out of the closet, and thus my new life began. Trying again, but this time with the benefit of Athena’s feedback (telling me when I was pressing the buttons too early versus when I was pressing too late), I finally managed to play ‘Slow Ride’ all the way through, with nary a boo. I was so excited I could barely speak. My first taste, ever, of quasi-musical success – it was nothing short of intoxicating.

For weeks, I kept practising, and soon I started getting better and better. I never made it to expert mode, but I eventually got through medium and became obsessed with a different question. I didn’t want to while away my later years playing a video game, but if I could make progress with a plastic controller, could I learn to play a real guitar? I began to wonder: Could persistence and a lifelong love of music overcome age and a lack of talent? And, for that matter, how did anyone of any age become musical?

It was time to find out.



To an alien scientist, music – and the desire to create it – might be one of the most puzzling aspects of humanity. Any species, for instance, would presumably have a metabolism, and any reasonably intelligent species would likely also have a system of communication; eventually we would expect it to develop systems of government and law, too. But

would such creatures also revere patterns of sound that vary over time? I wonder, would they have any desire to make their own music?

Someday, maybe we will find out, but for now, one thing was clear: my own desire to make music was undeniable. I had reached the point where it felt like it was now or never. I began to read up on the scientific literature. How did children learn music? Were there any lessons for adults?

To my surprise, although children had been well studied, there was hardly any systematic research on people my age. Nobody seemed to know much about whether adults could pick up an instrument late in life, and it wasn't just music that we knew little about; the literature on the capacity of adults to learn new skills in general was far sparser than I had imagined. We know something about gradual declines in memory, but the only truly firm result I could find with respect to the late learning of music in particular concerned perfect pitch (the ability to identify a single note in isolation). For that, one must indeed start early, but lucky for me and anyone else starting late, it is also quite clear that perfect pitch is more luxury than necessity. Duke Ellington didn't have it, and neither did Igor Stravinsky (nor, for that matter, did Joey Ramone).

Several other studies show some kind of advantage for music learners who began earlier in life over adults who began later, but most of those don't control for total amount of practice. When it came to other aspects of music, such as the ability to improvise or compose, or even to learn a simple melody, there was almost no compelling literature. Although any number of studies have shown that the more you practise the better you get, startlingly few have compared what happens when people of *different* ages get the same amount of practice.

How could such a basic scientific question remain so unanswered? I wondered about this for months, until Caroline Palmer, a soft-spoken but exceptionally clear-thinking professor of psychology at McGill University in Montreal, finally explained the answer to me. The problem

TUNING UP

wasn't a lack of scientific interest; it was a lack of subjects. To learn a musical instrument, you need to put in a lot of work – ten thousand hours is an oft-mentioned (if somewhat oversold) number – and to do a proper study, you'd need a reasonably large sample of participants, which is to say a big group of adult novices with sufficient commitment. Nobody has studied the outcomes of adults who put in ten thousand hours of practice starting at age forty-two because most people of that age have lives and responsibilities. Your average forty-two-year-old might go to lessons once or twice a week, but eventually the burdens of a child, a job, or an ageing parent often take over; few adult learners of music are prepared to invest the kind of time that a teenager has. No subjects, no science.

At that point, I decided to become a guinea pig. I couldn't ethically force other adults to practise for ten thousand hours, but I could experiment on myself. As it happened, I had a sabbatical coming up, which would give me more free time than usual, and I decided to see what would happen if I devoted myself to music full-time, for a month or two – or as long as I could stand. If someone as tuneless as I could make progress, perhaps there was hope for anyone.



At the outset of my journey, one study in particular gave a glimmer of hope.

For years, the strongest scientific evidence for critical periods came not from humans but from animals. To properly establish the existence of a critical period, one needs to do an experiment in which young animals are raised in a carefully controlled environment.

In the literature on critical periods, one of the most influential experiments came from raising barn owls. Barn owls, as it happens, are a little like bats: they rely heavily on sound to navigate. At the same time, however, they can see better than bats typically do, and one of the

first things they do after hatching is to calibrate their eyes with their ears, lining up what they hear with what they see. This allows them to use sound cues to help them navigate in their dark nocturnal world. But exact mapping between eyes and ears cannot be hardwired at birth, because the navigational function of the auditory information depends on the exact distance between the two ears, and that distance changes as an animal grows.

How do owls manage to calibrate the visual world with the auditory world? The Stanford biologist Eric Knudsen explored this question by raising owls in a kind of virtual reality world, in which prisms shifted everything by twenty-three degrees. This disrupted the owl's normal capacity to see and forced the owl to adjust its internal map of the visual world. The earlier the prisms were installed, the better the owls were able to cope with the altered world. Young owls could easily learn to compensate for the distortion, whereas old owls could not.

If that were the only paper I had read, I would have given up on the guitar right there. But I soon stumbled on a more recent study, less widely known, in which Knudsen discovered that older owls weren't entirely hopeless after all. Although Knudsen's original results still stand – adults definitely aren't as flexible as baby owls – adult owls can often get to the same place, so long as their job is broken down into smaller bite-size steps. Adult owls couldn't master twenty-three degrees of distortion all in one go, but they could succeed if the job was broken down into smaller chunks: a few weeks at six degrees, another few weeks at eleven degrees, and so on.

Maybe I didn't have talent, and maybe I was old (or at least no longer young), but I was willing to take it slow. Could adults like me acquire new skills if we approached them bit by bit, owl-style?

This book is about how I began to distinguish my musical derriere from



TUNING UP

my musical elbow, but it's not just about me: it's also about the psychology and brain science of how *anybody*, of any age – toddler, teenager, or adult – can learn something as complicated as a musical instrument.

What does it take to learn to play an instrument? What makes learning new skills so labour-intensive, when learning to talk seems so easy and so natural? Do children really have an advantage? Can adults make up for any disparity with directed practice?

Along the way, I marvel at the wonder that is music and the human desire to create and enjoy it. I take a look at the nature of music itself and how it evolved culturally and biologically. I explore what separates true experts from mere amateurs and debunk the myth of a 'music instinct' yet show that talent really does exist.

At the same time, I ask whether learning music makes people smarter and investigate what it takes to be a good teacher. Should parents encourage their children to play real musical instruments, or should they relax and let their kids play *Guitar Hero* instead?

With a guitar in one hand and a laptop in the other, I set out to understand the limits of human reinvention and how humans, young and old, talented or otherwise, become musical.