

MUSIC

Riffs on Numerical Themes

On a recent frigid evening in New York City, I went downtown to hear some jazz. In most respects it was a perfectly normal concert: a quartet led by the saxophonist Rudresh Mahanthappa promoting a new CD in the sort of high-end jazz bar that seats about 100 people, all of them squinting in disbelief at the price of drinks. But there was also a tantalizing secret for those in the know. Mahanthappa composed the music for his latest album, *Codebook*, using number theory—the branch of mathematics that has born such fruits as the Fibonacci sequence (the inspiration for centuries of art and mysticism, including the best-selling if often reviled *Da Vinci Code*) and the tools of cryptography.

One could say that mixing math and music is nothing new. As the German philosopher Gottfried Leibniz put it, “Music is the pleasure the human mind experiences from counting without being aware that it is counting.” But whereas all music is built to some extent on mathematical structures, Mahanthappa takes the relationship to the next level: Math isn’t just the medium of his art, it is also his subject.

Take for example his tune “Further and In Between.” The melodies batted between sax, bass, and piano are permutations of a scale built on the semitone intervals (1,4,2,8,5,7). It happens that 142,857 is one of the so-called cyclical numbers, which have long fascinated number theorists and numerologists alike (not to conflate the two). Cyclical numbers with n digits have the interesting property that multiplying one of them by a whole number between 1 and n generates a new number having the same digits rearranged (e.g., $142857 \times 3 = 428571$). Mahanthappa uses this arithmetical curiosity as a constraint for improvisation: play anything as long as it generates a cyclical number.

But what does the audience get out of such mathematical mischief? The pessimist in me says that they get nothing at all, that it’s just a gimmick. Let’s call that the null hypothesis. If you’ve been to modern art museums, you’ll know

immediately what I mean. (Leaning forward to read the artist’s explanation of the pile of tin cans covered in panty hose and melted bubble gum, you learn that it represents spacetime, evolution, artificial intelligence, etc.)

To test the null hypothesis, I gave Mahanthappa the best chance possible to prove it wrong by assembling an ideal audience. Sitting around the table with me were two musicians with no formal mathematical training, a mathematician with no musical training, a couple of mathematicians who are also accomplished musicians, and, as a control group, a lawyer and a social worker. I passed around a cheat sheet so that everyone knew what to listen for. (The day before the concert, I met with Mahanthappa and wrote down the order of the pieces to be played and the mathematical basis of each.) The lights dimmed, the band mounted the stage, and the experiment began.



M a h a n t h a p p a launched us into the deep end right away, both musically and mathematically. Before the rest of the instruments joined, he broke the silence with a sequence of notes so fast and jittery it was like a spider dancing on his sax. The manic melodies of the tune, “The Decider,” are a mapping of the Fibonacci sequence (2) onto the 12-tone musical scale. From that initial shock, the band carried the piece aloft in what felt like a series of booster rockets before reaching the seemingly free-floating (but actually quite structured) space of improvisational jazz.

Using the Fibonacci sequence seems like an arbitrary choice, perhaps verging on a gimmick. Wouldn’t a random sequence do just as well? According to Mahanthappa, the choice rises above gimmickry for two reasons. For one, he says, taking the sequence as his inspiration and constraint generates music he could not have produced otherwise. For another, he claims, the mapped sequence has unique

musical behaviors. “It sounds right no matter what key the others are comping (3) in,” he told me. “I tried alternative sequences and they didn’t have that property.”

Fair enough. However, such subtleties didn’t immediately come across to my test audience. “The mathematical themes are difficult to hear,” remarked Michael Thaddeus (an algebraic geometer at Columbia University) with furrowed brow. “Well, it is called *Code-*

book after all,” he quipped. And for some of the pieces—such as “Frontburner,” in which a Coltrane melody has been run through several layers of encryption—no human ear, no matter how prepared, would be able to detect Mahanthappa’s invention.

Far more apparent than any of the individual mathematical tropes was an overall sense of lush complexity. “The drummer in particular was using rhythmic elements from Indian classical music in a way that was clearly far beyond that of an amateur,” observed Manjul Bhargava, a number theorist (and tabla performer) at Princeton University. (Indeed, the drummer, Dan Weiss, is a student of the renowned Calcutta tabla player Samir Chatterjee.)

But as the show went on, mathematical neurons did begin to fire. Thaddeus deduced that the melodies in “Further and In Between” get their jumpy quality from the lack of consecutive digits in the cyclical numbers. He and Bhargava were also wise to the math within another tune, “Enhanced Performance,” which is built on a nested set of accelerating polyrhythms. (Mahanthappa dedicated the piece to steroid use among Olympic athletes, and knowing this contributed an extra squirt of adrenaline.) Nor did you have to be a mathematician (or a musician) to observe many of the tricks. Caroline Trowbridge, a recent graduate of Yale Law School, easily detected that layered within several of the tunes—but especially “Play It Again Sam,” dedicated to Samuel Morse—were the performers’ names in Morse code, like signatures on sound paintings.

So on this basis, I can already rule out the null hypothesis. The math is definitely more than just a gimmick, even to the untrained ear. But what then does the audience get out of the experience? This is where the experiment got interesting. The band played two sets, and the breather between them, like a coffee break between lectures at a good scientific conference, brimmed with heated, cross-disciplinary conversation. Topics ranged from how constraints act as dynamos for creativity (for example, the sonnet form in poetry) and the

Codebook

Rudresh Mahanthappa
Quartet (1)

Pi Recordings, New York,
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biological constraints that produce Fibonacci numbers in nature to the independent discovery (far earlier than in Europe) and use of Fibonacci numbers in ancient Indian poetry. With our brains fizzing from such cross-talk, the second set was all the more enjoyable.

And that supports my alternative hypothesis for what an audience can get out of a Mahanthappa performance: a unique, jazz-fueled occasion to explore ideas. Trowbridge called it “the secret knowledge effect”—that heightening of the senses from an awareness of hidden layers of meaning—and I agree. In addition, the quartet’s virtuosity makes their playing a pleasure to behold, no matter how one feels about jazz. But before taking my word for it, I recommend replicating the experiment for yourself—with the CD if you can’t catch a performance.

—John Bohannon

Notes

1. The quartet comprises Rudresh Mahanthappa, Vijay Iyer, François Moutin, and Dan Weiss.
2. The sum of each pair of consecutive numbers in the Fibonacci sequence [0, 1, 1, 2, 3, 5, 8, 13, 21, ...] generates the next. The ratios of consecutive Fibonacci numbers [1/2, 2/3, 5/8, 8/13, ...] converge on the irrational number Φ (0.618033989...), known as the golden mean.
3. That’s jazz-speak for “accompanying.”

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SCIENCE AND RELIGION

Arguing for Atheism

Michael Shermer

There is no position on which people are so immovable as their religious beliefs. There is no more powerful ally one can claim in a debate than Jesus Christ, or God, or Allah, or whatever one calls this supreme being. The religious factions that are growing throughout our land are not using their religious clout with wisdom. They are trying to force government leaders into following their position 100 percent. If you disagree with these religious groups on a particular moral issue, they complain, they threaten you with a loss of money or votes or both. I’m frankly sick and tired of the political preachers across this country telling me ... that if I want to be a moral person, I must believe in A, B, C, and D. Just who do they think they are?

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Such stirring words, spoken with such moral conviction, must surely come from an outraged liberal exasperated with the conservative climate of America today, and one can be forgiven for thinking that in a review of *The God Delusion* these are the words of Richard Dawkins himself, who is well known for not suffering religious fools gladly. But no. They were entered into the *Congressional Record* on 16 September 1981, by none other than Senator Barry Goldwater, the fountainhead of the modern conservative movement, the man whose failed 1964 run for the presidency was said to have been fulfilled in 1980 by Ronald Reagan, and the candidate whose campaign slogan was “In Your Heart You Know He’s Right.”

If Goldwater had been president for the past six years, I doubt that Dawkins would have penned such a powerful polemic against the infusion of religion into nearly every nook and cranny of public life. But here we are, and like Goldwater, Dawkins is sick and tired of being told that atheists are immoral, second-class, back-of-the-bus citizens. *The God Delusion* is his way of, like the Howard Beale character in the 1976 film *Network*, sticking his head out the window and shouting, “I’m as mad as hell, and I’m not going to take this anymore.”

But *The God Delusion* is so much more than a polemic. It is an exercise to “raise consciousness to the fact that to be an atheist is a realistic aspiration, and a brave and splendid one. You can be an atheist who is happy, balanced, moral, and intellectually fulfilled.” Dawkins wants atheists to quit apologizing for their religious skepticism. “On the contrary, it is something to be proud of, standing tall to face the far horizon, for atheism nearly always indicates a healthy independence of mind and, indeed, a healthy mind.”

Dawkins also wants to raise consciousness about the power of Darwin’s dangerous idea of natural selection. He believes that most people—even many scientists—do not fully understand just how powerful an idea it is. He attributes that failure to the need to be steeped and immersed in natural selection before you can truly recognize its power. In this context, natural selection “shatters the illusion of design within the domain of biology, and teaches us to be suspicious of any kind of design hypothesis in physics and cosmology as well.”

Out of obligation, of course, Dawkins

reviews and offers rebuttals to all the standard arguments for God’s existence. He concentrates on dissecting the anthropic principle and dismantling intelligent design creationism. (As part of the latter efforts, he redirects the creationists’ argument from complexity to show that God must have been designed by a superintelligent designer.) He

then builds a case for “why there almost certainly is no God.” The remainder of the book outlines possible evolutionary origins of morality and religious belief, a justification for being hard on religion, childhood religious indoctrination as child abuse, and an elegant commentary on the progressively changing moral zeitgeist.

Dawkins closes with a tribute to the power and beauty of science, which no living writer does better.

When I received the bound galleys for *The God Delusion*, I cringed at the title, wishing it were more neutral (why not, say, *The God Question?*). As I read the book, I found myself wincing at Dawkins’s references to religious people as “faith-heads,” as being less intelligent, poor at reasoning, or even deluded, and to religious moderates as enablers of terrorism. I shudder because I have religious friends and colleagues who do not fit these descriptors, and I empathize at the pain such pejorative appellations cause them. In addition, I am not convinced by Dawkins’s argument that without religion there would be “no suicide bombers, no 9/11, no 7/7, no Crusades, no witch-hunts, no Gunpowder Plot, no Indian partition, no Israeli/Palestinian wars, no Serb/Croat/Muslim massacres, no persecution of Jews as ‘Christ-killers,’ no Northern Ireland ‘troubles’ ...” In my opinion, many of these events—and others often attributed solely to religion by atheists—were less religiously motivated than politically driven, or at the very least involved religion in the service of political hegemony.

I also never imagined a book with this title would ever land on bestseller lists in the United States. But I was wrong. The data have spoken. *The God Delusion* is a runaway bestseller, a market testimony to the hunger many people—far more, I now think, than polls reveal—have for someone in a position of prestige and power to speak for them in such an eloquent voice. Dawkins’s latest book deserves multiple readings, not just as an important work of science, but as a great work of literature.

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The God Delusion

by Richard Dawkins

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