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Strength in numbers: How Fibonacci taught us how to swing

The Parthenon, Mona Lisa, Billie Jean … they share a secret formula. And the influence of the Fibonacci sequence doesn't stop there

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Brought to you by the same formula responsible for Billie Jean ... the Parthenon. Photograph: Taxi/Getty Images

Playing music sharpens the brain. It's proven. I'm a musician, but I've also spent a number of years studying mathematics and physics. That is unlikely to have made me a better musician or composer, but playing music from an early age has, quite possibly, made me better at maths. Today, I like to let both disciplines talk to each other, and use mathematical ideas in my composing. They help me find sounds and rhythms that I might never have made otherwise. I want to make music that hits me viscerally, but in surprising, unobvious ways.

I want to show you one example involving Fibonacci numbers. Fibonacci was a 13th-century Italian mathematician who brought the Indian-Arabic number system to Europe. He also wrote about this set of numbers that now bears his name. I became intrigued by these numbers some years ago, and have used them to structure much of my work ever since.

The Fibonacci sequence begins: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 and continues from there. Each number in the sequence is the sum of the previous two numbers, and it continues ad infinitum. If you look at the ratios of two successive Fibonacci numbers, and keep going up the sequence, you get: 1, 2, 1.5, 1.667, 1.6, 1.625, 1.615, 1.619, 1.618

... As you go up the sequence, this ratio gets closer and closer to a famous irrational number called the "golden ratio": 1.6180339887.

That ratio has been observed frequently in dimensional proportions across many different contexts – in architecture from the Pyramids of Giza and the Parthenon, to constructions by Le Corbusier and Mies van der Rohe; images by artists from Da Vinci and Albrecht Dürer to Juan Gris, Mondrian and Dalí; and rhythmic durations and pitch ratios in works by composers from Bartók and Debussy to John Coltrane and Steve Coleman. (Coleman introduced me to this whole idea.)

What interests me about Fibonacci numbers is their scaling property. Because the ratios get successively closer to the golden ratio, the ratio 5:3 is not the same as, but "similar" to the ratio 8:5, which is "similar" to the ratio 13:8, or 144:89, or 6,765:4,181. But what do I mean by as vague a term as "similar"? This is a question I explore musically with my trio's version of Mystic Brew, a 70s soul-jazz classic by Ronnie Foster. The harmonic rhythm in Foster's original is asymmetric in a Fibonacci way: a short chord and then a long chord, three beats plus five beats, totalling eight beats. It's standard four-four time, with one added feature: if you were to step to the beat, you'd hear a chord when you take your first step, and then another chord while your knee is aloft between the second and third steps. This is a rhythm that you hear in all kinds of places – think of the opening chords of Michael Jackson's Billie Jean.

In our version of Mystic Brew, we work with that asymmetry and move it through Fibonacci-like transformations. We perform an asymmetric "stretch" that maintains the same "golden" balance over the entire measure. But we don't transform simply by multiplying, as you might when shifting from duple to triple metre, or when doubling the quantities of a recipe, say. Rather, we try to preserve an "impression" of the original – the short-and-long-ness of it – to see if we can this way achieve that feeling of similarity.

Suppose you had a round pie and eight guests; you know how to divide that pie into eight equal pieces, and you know exactly what that pie would look like with three pieces missing. Now, suppose five more friends unexpectedly show up. You have the same pie and 13 guests. How do you divide a circle into 13 by eye? A decent short cut would be to imagine it divided into eight with three pieces missing, and cut that shape. Then, divide the smaller section you've just cut into five equal pieces, and the larger section into eight. Your result would be close enough.

This is something like the technique we use here, only instead of a pie, we divide a length of time. The three beats and five beats of the original are transformed to a faster five beats and eight beats (totalling 13), which then becomes a still-faster eight beats and 13 beats (totalling 21). Each transformed measure is roughly the same length and, importantly, the second chord lands at roughly the same time, about 3/8 of the way through (or 5/13, or 8/21).

The goal is that you perceive the "short-long" division of the cycle the same way in each case. Thankfully the ear is forgiving: because we expect and even crave continuity in our perception, our listening brains help smooth things out. Like the guests eating your slices of pie, the ear doesn't complain about small differences. In this case, the overall motion proceeds seemingly undeterred – including a sense of regular pulse –

while the music's inner mechanism seems to quicken.

And a bonus finding is that, through accenting these changes just right, you can make these "irregular" or "artificial" rhythms sound simple and natural – like a buoyant, composite version of the original's asymmetric 4/4. I never would have guessed that an irregular 21-beat cycle could feel as powerful or joyous as it does in this treatment. Does that reveal anything about the golden ratio? I can't be certain, but perhaps because that proportion is so familiar to us, it may even help us hear the continuity through the transformations. Your ear is tricked into hearing the familiar amid the unfamiliar.

As abstruse as some of this may seem, there are specific cultural origins for these techniques. As the American-born son of immigrants from India, I'm very inspired by Karnatak music – the "classical" music of south India. It is a tradition of religious song, very intricately organised: melodically nuanced and rhythmically dazzling, full of systematic permutations. I'm also interested in the African roots of African-American music, which have a profound and widespread influence on nearly every vernacular music we have in the west.

These non-western musical traditions are just as deeply ordered with rhythm as western music is with harmony. But there's a qualitative difference between rhythm and harmony: when you organise rhythms, you structure a listener's experience in time. Rhythm is the first thing we perceive about music. It hits us viscerally. Why? Perhaps it's because the rhythms of music are not so different from the inherent timescales of human bodies. Think of the rapid clip of our speech, the bounce of our walk, the slow ebbing of our breath. And then think of Charlie Parker's conversational saxophone solos, Ray Brown's loping basslines, or Billie Holiday's cries and sighs. Musical rhythm resembles human bodies in motion because music is the sound of bodies in motion.

So when you impose rigorous order on musical rhythm, you are organising human motion. You create a dialogue between the physical and the ideal: embodied human action in a structured environment. The process gives us something to strive for, to work through, to achieve with virtuosity and grace. This is the case with music, sport, dance, ritual, games, art. The dialectic between soul and science, freedom and discipline, self and non-self – dare I say it? That's culture in a nutshell.

It is this very dialogue – this sustained interaction between ourselves and the world around us – that I wish to make audible through music. That's true whether it's my own compositions, arrangements of familiar songs, ensemble projects, or perhaps most revealingly, solo concerts like the one I'll be playing at the London jazz festival. That will be a sustained interaction between my body, the piano, history, memory, numbers, acoustics, and you. I look forward to connecting with you then.