Podcast interview: Bob MacCallum

PNAS: I’m Nicholette Zeliadt, and welcome to Science Sessions. Like the incredible diversity found in the natural world, musical diversity can evolve through a process of descent with modification as music is passed from one musician to another and is copied and modified. In a recent study published in PNAS, Bob MacCallum of Imperial College London and colleagues investigated whether listener preferences exert a kind of natural selection, influencing the reproduction, spread, and persistence of particular musical sounds. MacCallum, a bioinformaticist by day, develops computer programs that evolve solutions to computational problems, engineering problems, and scientific problems such as protein structure and function prediction. By night, he developed DarwinTunes, a program that generates random sounds and gradually evolves music based on listeners’ preferences. MacCallum, who joined us by phone, begins by explaining the basic idea behind how DarwinTunes works:

MacCallum: Basically you have a population of short pieces of music, which are made completely at random to start with. And you play those to your audience, and they say if they like them or if they don’t like them. They’re short pieces of music which were called loops, for simplicity.

PNAS: The loops that are more highly rated by listeners get to reproduce, in a process that resembles sexual reproduction.

MacCallum: Two parent loops get together, and they can swap bits of their genetic material to make the offspring. And then, when that’s done, then the offspring are mutated, which means small changes are introduced at random. These processes mirror the genetic mechanisms in nature.

PNAS: The researchers then had a different set of people rate the loops, who didn’t know whether the loops they were listening to were from earlier, less evolved generations, like this one (audio clip 1), or later, more evolved generations, like this one (audio clip 2).

MacCallum: They rated some loops from the 2500 generations of evolution, and then we saw that their ratings increased, were higher for the later loops than for the earlier loops. It seemed that more musically appealing loops were evolving. And then we wanted to know how and why, so we looked at the musical qualities, and two in particular: one, the rhythmical complexity and the other was how much harmony was in the loops, was it well-developed chord structures in the loops. Both of those two traits or features that we measured increased during evolution also.

PNAS: However, these musical traits stopped increasing after about 500 generations.
**MacCallum**: We analyzed the evolutionary dynamics in great detail and found that it’s the transmission of the musical traits that was the limiting factor. So there were highly musical individuals in the population, but their offspring were not successfully receiving those beneficial musical traits. For example, because the recombination process was mixing them up too much, or perhaps the mutation rate was too high. So we changed the recombination algorithm, the mechanism to be more like biological evolution, to do homologous recombination, switching like with like rather than randomly switching things around. And that really, that seemed to make a difference—there’s a sudden change in the complexity of the music that evolves. So you get more high-level musical structures—you have two or melodies playing at the same time, they fit together nicely, and you start to get more structured music.

**PNAS**: MacCallum talks about what he’d like to do next.

**MacCallum**: While all these are great experiments that we can do, it’s a real struggle to get enough people to do the rating, to do the audience selection for us. And so we can’t really do another experiment until we have a self-sustaining community of people who enjoy evolving music in this way, and who want to do it. And to get that self-sustaining community we have to radically redesign the whole thing, maybe stop thinking about loops, start thinking about longer pieces of music, make it work on people’s phones—all these little things added together, if we can make it a more attractive experience, then we can do some interesting science again.

**PNAS**: For their work, MacCallum and colleagues were awarded the 2012 Cozzarelli Prize in behavioral and social sciences. The prize is awarded annually by PNAS to acknowledge recently published papers that reflect scientific excellence and originality.