# Playing and Being Played by the Drums

Matthew D. Egbert
[1] School of Computer Science, University of Auckland, Auckland, New Zealand
[2] Te Ao Mārama, University of Auckland, New Zealand
m.egbert@auckland.ac.nz

## Abstract

The metaphors that we choose to describe living and cognitive systems influence how we study them. Similarly, the behaviours that we choose as examples of intelligence or adaptivity influence the models we build and the ways we conceive of and study cognition. Over the course of history, humanity has embraced a variety of metaphors for minds and how they work. The dominant metaphor at the moment compares minds to computers. I would like to consider an alternative metaphor. Instead of thinking about brains as computers, and instead of thinking about cognition as problem-solving, what emerges when we compare mind (and life) to improvisational performance? This abstract uses improvisational drumming as a specific example to elaborate upon key aspects of enactivist and A-Life related perspectives of cognition. I suggest that (i) by recognising how improvised performances define their own norms as they develop, we can come to better understand how living and thinking systems might also define their own dynamic norms; (ii) by understanding what is lost when an acoustic drumset is replaced by one that is electronic, we can derive insight into what is missed when the body and the environment are left out of our descriptions of intelligent adaptive behaviour; and (iii) by recognising the diverse factors that determine the form of an improvised collaborative performance, we can better recognise the similarly diverse factors that sculpt the norms, behaviours and other features of an individual.

In artificial life research, the target of study is life and its salient properties—evolution, reproduction, autopoiesis, cognition, etc. To study these, we use computer simulations, mathematical models, philosophical arguments and we employ diverse methods of analysis. Each choice of methodology influences the kinds of phenomena we can uncover. For example, information theoretical anaylsis and dynamical systems analysis each reveal and emphasize different features of a dynamical neural network (Beer and Williams, 2014).

The metaphors that we use also shape our research. If we consider cognition to be a form of computation, we end up studying problems that are readily presented to a computer, like chess (Risi and Preuss, 2020). If, on the other hand, we consider cognition to be the result of dynamical interplay between coupled brain, body and world, then we find ourselves considering cognitive tasks that can be readily formalized as fitness functions—e. g. investigating categorical perception in an embodied robot that can use whisker-like sensors to distinguish between circle and diamond shaped objects (Beer, 2003).

What we choose as an exemplar of the target of study also biases our research. If human cognition is the target, which of its many remarkable abilities should we focus on to understand it? Our ability to solve mazes or puzzles? Our ability learn a new sporting ability? Our ability to detect liars? Many examples of human cognition focus on our ability to solve problems that have well defined and pregiven criteria of success. Human problem solving ability in these contexts can indeed be remarkable, but so too are some of our abilities where success is not so easily defined or pre-given. Particularly interesting examples of this include expressions of creativity and improvisation.

These abilities—creativity and improvisation—are key parts of human playfulness, and musical creativity is a place where play persists a bit longer than those other forms of play that we associate with children. What can we learn about human cognition by studying musical improvisation?

For about 30 years I have played the drums. Recently, after a long break, I have returned to practicing and performing at regular 'jam nights' hosted at our local bar. This is the first time that I have been regularly practicing and performing since becoming a scientist and I find that I think about music differently now thanks to ideas that I've been exposed to thanks to my exposure to ideas from science and phillosophy. For example, when I might have taken it for granted before, I now find it quite amazing, from an adaptive systems perspective, that strangers can come together, and spontaneously perform an unplanned creative musical performance that coheres—a performance that did not exist in anyone's 'head' before the performance and that cannot be reduced to any individual, nor even to the entire band, as the band is not just responding to itself, but also to dancers, audience members, perhaps the political events of the day and other factors.

In a way, this kind of performance, creates *itself*, and while it lasts it adapts and maintains itself, despite perturbations—when a guitarist's string breaks, the music carries on. As the performance develops, so to develop norms for what kinds of musical expressions would fit, and which would be errors. Even some mistakes can be transformed into key themes in improvised performances.

These observations about music are inspired by concepts I have learned about via the A-Life and enactivist communities. In particular I am inspired by the enactivist ideas concerning the self-construction, self-maintainance, and self-defining nature of living autopoietic systems (Maturana and Varela, 1980; Varela et al., 1974; Beer, 2004; Barandiaran, 2017) as well related ideas, such as the dynamical hypothesis in cognitive science (van Gelder, 1998), sensorimotor feedback (Braitenberg, 1986); sensorimotor contingency theory (O'Regan and Noë, 2001); etc.

These papers and authors have inspired my observations about music, but also, conversely, I have found that thinking about improvised musical performance helpful in my efforts to understand these enactivist ways of thinking. And this paper represents the start of my efforts to bring these ideas to bear on improvisation and on drumming—inspired, in part by the efforts of Torrance and Schumann (2019) to relate jazz improvisation to embodied and enactive cognitive science.

In my talk, I will present a collection of thoughts that have emerged while thinking about the interface between drumming and these different A-Life or A-Life related concepts. A central theme in what I will explore will be taking a cyclical or symmetric perspective, rather than one that is linear or asymmetric (Pickering, 2010). In other words: instead of the linear view where drumming is something that is done by a drummer, I am interested in what comes to light when we instead see drumming as an interaction between drummer and drums, where yes, the drummer plays the drums, but also, in a sense, the drummer is played by the drums.

In the first section of my talk, I will explain how skillful drumming is situated, embodied and dynamical (Beer, 2000). In other words how it depends not just upon the drummer's brain making smart decisions about when to move which muscles, but also bodily and environmental dynamics. To support this point, I'll describe the difference between a novice's stiff performance of a two-stroke roll, and an expert's performance of the same rudiment, which takes advantages of the dynamical properties of the drumstick, drum head and mechanical properties of the drummer's hands and arms.

I'll also speak about ways that technological advancements in electronic drums have actually failed to fully recognise the roles played by the drums in drumming. Instead of given the full dynamical complexity that is possible in an acoustic drum, electronic drums often work by using a trigger to either start the playback for a short recorded sound (a 'sample') or to excite some simulated model that is used to generate the drum sound. This excessive simplification of an acoustic drum's complexity is apparent to any intermediate drummer who has had the experience of digital vs. acoustic drums—and it is noteworthy that it is rare to see electronic drums being used in place of acoustic drums by professional musicians. Generally speaking, the variety of tones one can get using just a stick and an acoustic snare drum is surprisingly diverse. Electronic snare drums by comparison is capable of much less sonic diversity. I find it interesting that the electronic drums fail to compete successfully with acoustic drums. I'll relate this dismissal of acoustic drum complexity to GOFAI's (Good Old-Fashioned AI)'s dismissal of the important roles played by the body the environment, and time.

In the third section of my talk, I will raise and discuss the question: *What determines the next note that a musician plays?* The answer to this question is arguably relatively straight-forward when the music is composed in advance. In that case, the next note is largely determined by the composer and what they wrote down when the composed the song. When performance is improvised, the answer is much more complicated, and messy. By messy, I mean that the answer involves many non-linear and interconnected factors that opeate at diverse timescales and yet all influence what the next performed note will be. In essence, the answer is largely irreducible. An incomplete list of such factors includes: the constraints agreed upon before the song starts—"Let's jam a blues shuffle in E."; the technical ability of the musician; the motifs or scales or rudiments that they have practiced; the music they have listened to; the other musicians (e. g. how the drummer is comping the solo); the audience and how they are dancing (or not!) in response to the performance; and perhaps most interestingly: the performer's own recent performance in the few seconds leading up to that note. I'll spend some time elaborating on this last point, and the reflexive idea that what counts as a good in a performance is a product of the performance itself. I'll relate this 'self-defining' structure to that proposed in the enactivist ideas of autopoiesis (the self-constructing nature of living systems (Varela et al., 1974)), where what is good for an autopoietic system is defined by (i. e. emerges from) the way that that system is organized (Barandiaran and Egbert, 2013). In both cases, the system's norms (what is good or bad) are defined by (the result of) how it produces itself.

If time allows, I will close by providing an overview of a project we have started at The University of Auckland, where we are exploring ways to augment acoustic drums electronically. This work relates to that of Lupone and Seno (2006), Eldridge and Kiefer (2017), Morreale et al. (2019), and others, who avoid reducing acoustic instruments to triggers and samples, but instead work to augment instruments, using rich and continuous feedback to enrichen the kinds of sounds that acoustic instruments can produce.

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