Representation: Emulation and anticipation

Georgi Stojanov[a] and Mark H. Bickhard[b]

[a]*Computer Science Department, Electrical Engineering Faculty, Saints Cyril and Methodius University, 1000 Skopje, Macedonia;* [b]*Cognitive Science, Lehigh University, Bethlehem, PA 18015.* **geos@etf.ukim.edu.mk**
mark@bickhard.name **http://bickhard.ws/**

Abstract: We address the issue of the normativity of representation and how Grush might address it for emulations as constituting representations. We then proceed to several more detailed issues concerning the learning of emulations, a possible empirical counterexample to Grush's model, and the choice of Kalman filters as the form of model-based control.

We are quite sympathetic with much of the general orientation involved here – in particular, the emphasis on anticipation – and we would like to explore a few important issues that are embedded in Grush's discussion.

Grush begins his discussion with an engineering perspective on motor control, but later makes use of such notions as "expectation" and "representation." This shift crosses a major divide, that between fact and norm. The normativity in this case is that of the truth value of representation, of the capability of being true or false. In general, when one discusses phenomena such as representation, there are issues that cannot be avoided, such as normativity and learning. In our commentary we will focus on these broader issues.

Is there any concern here for "emulations as representational" being able to model the possibility of being true or false? If there is no such concern, then in what sense is representation involved at all? The shift into this language engages these issues and makes use of the special normative properties of representation in the discussions of more cognitive phenomena. Without any representational normativity, much of the last part of the target article makes no sense, so there would seem to be an embedded necessity for ultimately addressing these issues.

If there is a concern regarding representational truth value, then is the issue one of being true or false from the perspective of the organism, or just in terms of the usefulness of an external observer making representational attributions to the organism? If there is such a concern and it is from the perspective of an observer (e.g., Clark 1997; Dretske 1988), then how does one account for the representations of the observer – isn't the observer just one more homunculus, even if an external one? An attempt to render representation as strictly constituted in the ascriptions of external observers seems to derive all of its representational normativity from those observers themselves, and, therefore, does not accomplish any sort of naturalistic model of that normativity.

If representational truth value is to be modeled from the perspective of the organism, then how does one make good on the normativities involved in "true" or "false"? How does one cross Hume's divide? One way to begin to address such normativities would be in terms of the anticipations involved in the emulations: Such anticipations can be true or false, and can, in principle, be detected to be true or false by the organism itself. In such a model, the normativity of representation is derived from the functional normativity of anticipation, which then must itself be accounted for. A model of representation and cognition based on such functional anticipations has been under development for some decades (e.g., Bickhard 1980; 1993; 2004; Bickhard & Terveen 1995). So, a question for Grush: Do you have an approach for addressing these issues, and, if so, could you outline it a bit?

A cautionary note: One powerful way to attempt to model the normativities of function, including, potentially, the function of anticipation, is in terms of the etiology (generally the evolutionary etiology) of the part of the organism that has the function at issue (Millikan 1984; 1993). The kidney, in such an approach, has the function of filtering blood because the evolutionary ancestors of the kidney were selected for having that effect. Unfortunately, this does not work as a naturalized model of function. Here is one reason: Millikan points out that, if a lion were to magically pop into existence via the coming together of molecules from the air, that lion is, by assumption, molecule by molecule identical to a lion in the zoo; nevertheless, the organs of the lion in the zoo would have functions, whereas those of the science fiction lion would not because it does not have the right evolutionary history (Millikan 1984; 1993). What this example points out, however, is that etiological function cannot be defined in terms of the current state of the organism, but only current state, according to our best physics, can have proximate causal power. Here we have two lions with identical dynamic properties, but only one has functions. Etiological function, therefore, cannot make any dynamic difference – any causal difference – in the world, and therefore, does not constitute a successful naturalization of function (Bickhard 1993; 2004; Christensen & Bickhard 2002). In consequence, then, the etiological approach to the normativities of representation is similarly blocked.

We turn now from issues of normativity to some more detailed and empirical considerations. First, we note that Grush does not discuss the issue of learning "emulations as representations." If we pursue the control theory framework, we might, for example, look for system-identification tools for obtaining the relevant Kalman filter (KF) parameters. What are their biological counterparts? Further, the computations in KF can be seen as manipulations of multivariate normal probability distributions – what guarantees that those conditions are fulfilled? Can it be shown that the approximations involved are good enough?

In the context of situated robotics, Grush mentions the MetaToto architecture of Stein as being able to engage in off- and online use of the map it builds of the environment in order to solve navigation problems. MetaToto is built on the basis of Mataric's Toto architecture (Mataric 1992). Is there any essential difference with respect to emulation versus simulation between these two architectures?

When it comes to empirical (counter) evidence, we would like to mention O'Regan's change-blindness experiments (e.g., O'Regan & Noë 2001). The setup is quite simple: A subject is shown a photo in which suddenly some mud splashes (or flickering) appear, and in the meantime a drastic change (up to one third of the size of the overall picture) is introduced. The majority of the subjects do not notice the change. According to Grush's KF framework, because the estimate does not match the stimuli, the Kalman gain should increase, which would lead to an accurate representation and perception of the changed photo. Apparently some crucial elements dealing with attention are missing from the proposed framework.

Finally, we have a question concerning the role of emulation in general, and KFs in particular, in the overall model. Concerning KFs, it would seem that any model-based control theory could do what Grush needs here – is there a more specific reason to choose KFs? In this respect, see some of our works and papers cited here (Stojanov 1997; Stojanov et al. 1995; 1996; 1997a; 1997b). Concerning emulation more broadly, the initial motivation for the model is in terms of motor-control emulators. These depend on, among other things, explicit efferent and afferent transmissions with respect to an emulator process. But the later uses made of the notion seem to depend on more general notions of modeling and anticipations generated from such modeling. The question, then, is whether other forms of generating anticipations – such as, for example, the set-up (microgenesis) of an interactive system to be prepared to handle some classes of interactions but not others, thus anticipating that the interaction will proceed within that anticipated realm (Bickhard 2000; Bickhard & Campbell 1996) – might not do as well for broader forms of cognition?

In sum, we are quite enthusiastic about the modeling orientation that Grush has discussed, but we would contend that some of the important issues have yet to be addressed – at least in this paper.