GIVING NATURALISM A CHANCE: INTERACTIVISM, EMERGENCE, AND NONLINEARITY

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Abstract: This paper offers a defense of naturalism, which might improve its chance of being adopted as a direction, both for theory and for empirical research. This defense responds in particular to three themes:: the **emergence** of mind (as opposed to nonemergence or reductionism), the pervasiveness of **nonlinearity** in biology and psychology, and the need for **levels and degrees of self** (as opposed to a human self that is self-evidently unitary, or a self that turns out to be illusory, or a concealment of what is truly there).

Keywords: Naturalism; Interactivism; Emergence; Reductionism; Nonlinearity; Degrees of Self

Naturalism has taken more than a few hits at Foundations of Mind. Some contributors (e.g., Needleman (forthcoming); Spitzer (forthcoming)) have directly opposed it from a religious perspective. Other participants have treated mind or cognition or consciousness as nonemergent. Either because everything already always has both mental and material properties (panpsychism; considered a possibility by Freeman, 'Consciousness Began with a Hunter's Plan', and others). Or because the material and biological worlds are actually, or have actually been, produced by a mind or minds (e.g., Haisch, 'Is the Universe a Vast, Consciousness-Created Virtual Reality Simulation?'; Larson, 'Evidence of Macroscopic Quantum Phenomena and Conscious Reality Selection').

It is not our aim here to review anything like the full range of conceptions that were under discussion at Foundations of Mind. This cannot sensibly be done in a short contribution. Besides, several presentations (e.g., Larson, 'Evidence of Macroscopic Quantum Phenomena and Conscious Reality Selection'; Stapp, 'Mind, Brain, and Neuroscience'; Laskey, 'Information, Physics and the Representing Mind'; Baer, 'Force of Consciousness in Mass Charge Interactions') have drawn heavily on quantum mechanics and its various interpretations, where the present author lacks the technical competence necessary to offer a critique.

What we can offer is a qualified defense of naturalism, which might improve its chance of being adopted as a direction, both for theory and for empirical research. This defense will respond in particular to three subthemes of the conference: the **emergence** of mind (as opposed to nonemergence or reductionism), the pervasiveness of **nonlinearity** in biology and psychology, and the need for **levels and degrees of self** (as opposed to a human self that is self-evidently unitary, or a self that turns out to be illusory, or a concealment of what is truly there).

NATURALISM IN PSYCHOLOGY AND NEUROSCIENCE

Most research psychologists in the world today subscribe to a form of naturalism. By this we mean that they avoid any references to a supernatural dimension (gods, bodiless spirits, supernormative beings that create norms, superconsciousnesses that bring matter and consciousness into existence) in their efforts to account for mind, cognition, and consciousness. We further mean that they do not take the psychological phenomena that they study today to have existed back when Planet Earth clumped together out of dust and gas within the solar nebula—let alone when the Big Bang took place.

Though most researchers in psychology and neuroscience subscribe to it (and most of them, in turn, would feel obliged to shun any other approach as unscientific), naturalism as typically practiced in psychology and the allied sciences has not been a roaring success. It has been taken to be unproblematically consistent with a near-exclusive search for linear relationships (e.g., Vul, Harris, Winkielman, & Pashler, 2009; Ó Nualláin, forthcoming). It has led to widespread epiphenomenalism: conscious processes may be real, but only as byproducts of neurophysiological or more deeply physical processes, which alone are able to cause anything or make anything happen. Or on to harder forms of reductionism, for which conscious processes cannot be real, and only neurophysiological or maybe just microphysical processes can explain anything at all. It cannot accept mind or consciousness having always been around, certainly not as ultimately productive of matter and energy and life, yet it seems illequipped to explain how mind or cognition evolved, how reflective consciousness or language could have emerged, how individual human beings develop, how the human self does its unfolding.

INTERACTIVISM

There is, however, a program of theory and research in psychology and the other sciences of mind that is committed both to naturalism and to emergence. It has been under development for more than 40 years, which means that wherever it still needs elaboration and application, it has gotten far enough along that many of its implications for the issues under discussion should be clear. (If they were not, after all this time, investment in a different program would be overdue.)

The overall program is called *interactivism*, because it takes *knowing* (a more basic notion, in this framework, than cognition or consciousness) to be a process of *interaction* between a system, or an organism, and its environment. Though several collaborators, including the present author, have lent a hand at one time or another, the founder of interactivism, as well as its chief developer, is Mark Bickhard, a psychologist and philosopher at Lehigh University.

Some of the aspects of interactivism that we emphasize are more recent in origin (for instance, the attention drawn to the actions of astrocytes in the human brain, or the broader lean toward biological organisms and away from artificial systems; Bickhard & Terveen, 1995; Bickhard & R. L Campbell, 1996; Christensen & Bickhard, 2002; Bickhard, 2009). Others, such as the basic conception of interactive representation, or the model of levels and degrees of self, go back to the beginning, or nearly so (Bickhard 1973/1980; R. L Campbell & Bickhard, 1986). We will present them here in logical rather than developmental order.

EMERGENCE

Interactivism takes it as a crucial feature that various cognitive functions (knowing, then learning, then emotions, then reflective consciousness) have emerged over time, in the course of biological evolution. A bacterium may be capable of interactive knowing; a chunk of granite is not. A flatworm may be capable of learning; a bacterium is not. Human beings are capable of reflective consciousness; organisms of nearly every other species are not. All of these capacities had to come into being, after their preconditions, in their turn, had to come into being (Bickhard, 1973/1980; R. L Campbell & Bickhard, 1986, 1987; Bickhard, 1991, 1993; Bickhard & R. L. Campbell, 1996a, 1996b; Bickhard, 1998).

Emergence is itself impossible unless processes (not particles, not old-fashioned substances), and organizations of processes, are what is subject to emergence—though we will not mount the case here for a full-out process ontology (for more about that, see Christensen & Bickhard, 2002; Bickhard, 2003, 2009, 2011; R. J. Campbell & Bickhard, 2011; Bickhard, 2013). Our aim is rather to sketch out several relevant levels of emergence (drawing, in what follows, on Bickhard, 1993; Christensen & Bickhard, 2002; Bickhard, 2003, 2009, 2013).

A classic simple example of emergence is the formation of Bénard cells as water is heated in a pan. A regular pattern of convection, consisting of hexagonal cells of approximately the same size, forms on the surface of the water. Previously there was nothing like this pattern, so the Bénard cells are an *emergent* phenomenon; they are also in a far-from-equilibrium condition. However, the cells cannot maintain themselves; they arise when an external heat source produces a heat differential in the water, and disappear after the heat source is taken away.

A candle flame is a more advanced emergent phenomenon, because, within some limits, it is *self-maintaining*. The heat of the flame melts and then vaporizes additional wax, which in turn serves as fuel, while convection brings in more fuel and more oxygen as it moves carbon dioxide and other waste products away. Because the flame is self-maintaining, heat generation and convection actually serve functions for the flame. But the self-maintenance is within limits. No more candle wax, and the flame goes out. If the air around the flame is replaced with krypton, again the flame extinguishes. A flame can't forage for wax, or run away to an oxygen-rich environment.

If the flame could forage or could run away, it would be able to maintain the conditions of its own self-maintenance; it would be *recursively self-maintaining*. A simple living organism, say an *Escherichia coli*, is recursively self-maintaining. If the *E. coli* is in a solution that has a sugar gradient, it will expend energy by swimming up the gradient, toward greater concentrations. If, contrariwise, it is moving down a sugar gradient, it will use less energy, and tumble rather than swim. Swimming and tumbling actually serve functions for the bacterium. What's more, the bacterium is making an interactive distinction between two sorts of environment: an environment that affords swimming (expending energy to get more food) and an environment better suited to tumbling. This is (already) the simplest case of *interactive knowing*.

Taking a step further, our *E. coli* can be *wrong* about something. If saccharine is dissolved in the solution, instead of sugar, the bacterium may swim up the saccharine gradient, expending energy to obtain something non-nutritive. On the one hand, it has formed an *interactive representation* of (an aspect of) its environment; on the other, it has made an *error*, not merely from a researcher or an observer's point of view, but from its own. The goal that it ought to be able to satisfy, in this type of environment, cannot in fact be met. (Our conceptions of interactive representation and system-detectable error are ultimately out of the Peircean tradition in philosophy, and consequently bear a family resemblance to Feldman's [forthcoming] idea of *actionability*. Our account of truth appears to be different from his, however, as do some other aspects of the interactive framework.)

An *E. coli* cannot, so far as we know, change its representation to differentiate a saccharine gradient from a sugar gradient, and avoid wasting energy swimming up the saccharine gradient. If it could, it would be capable of *interactive learning*. But we will not try to work through the next steps in the evolutionary sequence here (see Bickhard, 1973/1980; R. L Campbell & Bickhard, 1986; Bickhard & Terveen, 1995; Bickhard & R. L. Campbell, 1996a, 1996b; Bickhard, 1998, 2001, 2003, 2009, 2013). Our main point is that knowing is an emergent phenomenon, and not just any kind. It is a type of emergent phenomenon that pertains to recursively self-maintaining systems.

NONLINEARITY

If all relationships among the relevant variables were linear, we would not see either thermodynamic emergence (as with Bénard cells and candle flames) or biological emergence (as with *E. coli*). There is no reason to suppose that emergence of the sort that concerns psychology or the allied disciplines would be possible either, and in recent years there has been a welcome incursion of dynamic systems theory and other forms of modeling in which the relevant relationships are presumed to be nonlinear.

Yet the standard operating procedure for nearly all empirical research in psychology remains the search for linear relationships. Aside from a few well-worn examples (such as the attention- or arousal-performance curve), the hypotheses tested and the statistical techniques generally applied presuppose that relationships are linear.

The already celebrated article by Vul, Harris, Winkielman, and Pashler (2009) reveals how spuriously or even impossibly high correlations have been obtained in studies that sought to relate fMRI measures and measurements of personality or other dimensions (most often from self-report surveys). But of course this is merely where the trouble begins. fMRI techniques typically use scalar numbers to measure activity levels in units of brain volume ("voxels"). But there is absolutely no reason to suppose that the relevant activity in a voxel would vary along one dimension, instead of two or three or four—if not more (Ó Nualláin, forthcoming). And the sought-after relationships between activity levels in voxels and overt actions or survey responses are linear, as assessed with Pearson product-moment correlations and linear regression.

If the human brain were merely made up of nearly 10^{11} tiny switches (in the form of neurons) wired together with synapses, its functioning would already be far too complex to yield to data analyses that look for linear relationships between scalar measures, whether these be of activity in voxels or of something else. But despite the talk of "circuits" and "wiring" that researchers can't stop indulging in, the brain is evidently not composed of switches wired together. Beyond the paradigmatic synapse with transmitter molecules diffusing across a narrow cleft between cell membranes are purely electrical gap junctions, volume transmission of hormones that diffuse through larger chunks of the brain, and astrocytes (a type of glial cell) sticking their "feet" into synaptic clefts and altering their shape or closing them off from neighboring intercellular spaces. Beyond the standard-model neurons that produce action potentials, there are others that never fire. And these are merely the phenomena that have already been discovered.

In light of all this, some conception of brain functioning in terms of oscillatory systems modulating each other might merit further investigation (Bickhard, 1993; Bickhard & Terveen, 1995; Bickhard, 2003, 2009).

Meanwhile, there is not much more reason to suppose that relevant dimensions at a more strictly psychological level will necessarily be related in a linear fashion.

To take a case that is not terribly important in itself, but has the merit of being ready to hand, suppose we are interested in the relationship between overall or global self-esteem and tendencies toward narcissism. Some existing views of self-esteem (e.g., Baumeister, Smart, & Boden, 1996) virtually equate it with narcissism. The linear correlations typically obtained in studies using the Rosenberg Self-Esteem Scale (a widely used 10-item global self-esteem questionnaire) and the Narcissistic Personality Inventory (a fairly widely used 37-item questionnaire with items pertaining to different aspects of assumed superiority over others and obsession with personal appearance) are in the vicinity of +.35. Not really strong enough to support the kind of theory that equates self-esteem with narcissism, but strong enough to pose some difficulty for conceptions (e.g., Branden, 1994; Mruk, 2006) that sharply differentiate between the two.

Building on a preliminary study that merely sought to tease some aspects of self-esteem that correlate positively with narcissism apart from others that correlate negatively with it (R. L Campbell, Eisner, & Riggs, 2010), one of my students conducted a follow-up on the relationship between components of self-esteem, attributional style, narcissism, and paranoia (McCain, 2008).

Somewhere along the way, it occurred to us that global self-esteem might be related to narcissism in a nonlinear manner. It might be, for instance, that as long as global self-esteem is below average, global self-esteem increases as narcissism increases, but when global self-esteem is above average, the relationship flattens out or even inflects and changes direction. Analyzing data that McCain obtained from 80 Clemson undergraduate students, with the aim of relating scores on the Rosenberg Self-Esteem Scale when participants first took it (before any of the other questionnaires featured in the study) to their scores on the Narcissistic Personality Inventory, we naïvely expected a quadratic relationship (i.e., between Rosenberg score squared and NPI score). We didn't get a statistically significant quadratic relationship, and we didn't get a statistically significant cubic relationship either. But we got a nice quartic relationship (a relationship between Rosenberg score *to the fourth power* and NPI score) that turned out significant. See Figure 1 below.

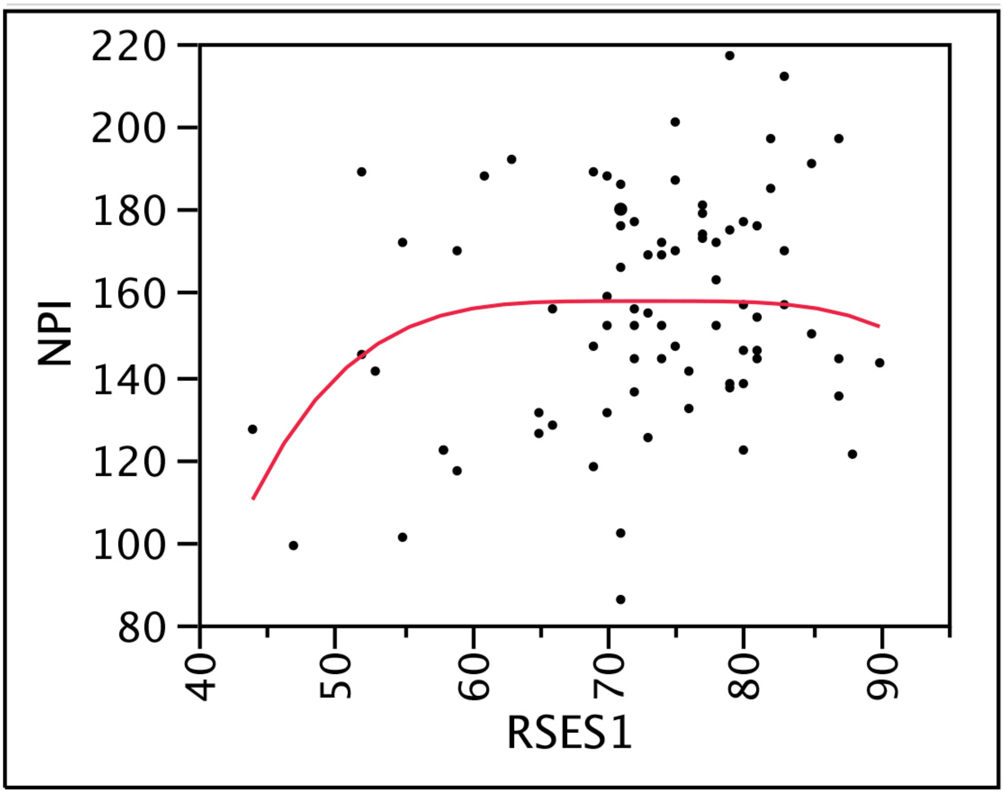

Figure 1. A statistically significant quartic relationship between scores on the first presentation of the Rosenberg Self-Esteem scale (RSES1, minimum score 10 and maximum score 90) and scores on the Narcissistic Personality Inventory (NPI, minimum score 37, maximum 259). Data from 80 university undergraduates (McCain, 2008).

We won't make a whole lot out of this particular result. Neither the Rosenberg Scale nor the Narcissistic Personality Inventory is, to say the least, a high-precision instrument. The Rosenberg Scale is almost certainly not the best way to assess self-esteem when used alone, and the jury is still out on the job it does when used as part of a much larger package of self-esteem assessments. And our result is obviously exploratory. Next time around, we could look specifically for a quartic relationship between Rosenberg and NPI scores. But where is the personality theory that yields any fourth-power equations? And these are just the most obvious concerns, in an ongoing dialectic of measurement and theory we find so often in psychology (R. L Campbell, Eisner, & Riggs, 2010).

Precisely because there is essentially no theory or research program in most areas of present-day psychology that would encourage anyone to go out looking for significant quartic relationships, maybe, at this stage in the development of the field, we could use one. At a minimum, interactivism encourages researchers to expect they will turn up such relationships.

LEVELS AND DEGREES OF SELF

Let us return for a moment to the theme of emergence. One of the best developed parts to date within the interactivist framework has been the account of reflective consciousness and the resultant unfolding, in human beings as they grow, of goals, values, and the self. This was a focus in the earlier years of interactivism (Bickhard, 1973/1980; R. L Campbell & Bickhard, 1986) and it continues to be one today (Bickhard, 2013, in preparation).

At Foundations of Mind, Spitzer (forthcoming) made what he took to be an argument against naturalism in psychology; namely, that human beings can know things about themselves, but a Turing Machine (an abstract machine that plays a foundational role in modern computational theory) cannot know anything about itself. It so happens that we agree with Spitzer, both about human beings being able to know themselves, and Turing Machines not being able. But we do not therefore reject naturalism.

Rather, we point to a key requirement for the emergence of higher cognitive functions. Interactive knowing is indeed irreflexive: a system or organism may be able to know aspects of its environment, but is not therefore empowered to know itself. Interactive learning and emotions significantly enhance the powers of the system or the organism, but they still do not make knowing reflexive (Bickhard, 1973/1980; R. L Campbell & Bickhard, 1986; Bickhard & Terveen, 1995).

Now suppose, however, that we have *two* Turing Machines, one piggybacked on top of the other. Under these conditions, the Level 2 machine is able to know aspects of the functioning of the Level 1 machine, just as the Level 1 machine, in turn, is able to know aspects of its environment. (Our appeal to abstract machines is doing some simplifying here, where it does not appear to affect the outcome of the argument; for instance, we are not worrying, as we would have to in some other contexts, about the lack of rhythm or timing in the operation of an unenhanced single-level Turing Machine. For more about this, see Bickhard and Terveen, 1995.)

A key result for interactivism is that, in a system that has evolved and can develop a second physical machine level, an unbounded series of even higher levels will be functionally attainable. That is, once the Level 2 machine has come to know enough about the Level 1 machine, a virtual Level 3 machine can come to know properties of the Level 2 machine, a virtual Level 4 can come to know properties of Level 3 … and so on up the ladder.

We propose that the emergence of a specialized Level 2 subsystem has, in fact, been part of human evolution, with a wide array of consequences, including for the evolution of human languages (Bickhard, 1980; Bickhard & R. L. Campbell, 1992; R. L. Campbell & Bickhard, 1992). More to the point that Spitzer (forthcoming) raised, the emergence of a specialized Level 2 subsystem in normal human beings supports stepping up from being a self, to having a self, to knowing that self, to knowing about knowing that self, and so on. It gives equal support to the upward emergence of goals, values (i.e., goals about goals), metavalues (values about values), principles (metavalues about metavalues), and so on. It keeps leaving properties of the highest level yet attained, which cannot themselves be known without ascending to a higher level still. Whether the resulting account of the self will meet all of Ó Nualláin's (forthcoming) requirements, we are not entirely sure, but there are plenty of levels and degrees in it. We have brought this portion of the interactive framework to bear on issues of value conflict, self and personhood, and moral development (R. L. Campbell, Christopher, & Bickhard, 2002; R. L. Campbell, 2002; Christopher & R. L. Campbell, 2008). We have also employed it in a reanalysis of Jean Piaget's major stages of development, along with his conception of "reflecting abstraction" as the process that leads from functioning at Stage N to functioning at the next higher stage, N+1 (R. L Campbell & Bickhard, 1986; R. L Campbell, 2001).

CONCLUSION

In this commentary, we have hit some high points of interactivism. We hope they may be enough to indicate how psychologists and neuroscientists might profit from looking further into it. We should acknowledge that even after following some particular thread of interactive argumentation through its ramifications, in far greater detail than we have gone into here, psychologists and neuroscientists are apt to find that such questions as have gotten answered are generalized and programmatic. We further acknowledge that generalized, programmatic answers would be of little interest if most of the problems of psychology were solved. Emphatically, however, they are not. We are confident that psychologists will continue to seek theoretical frameworks and programs of empirical research that will point them in the direction of solutions to all of these problems. Interactivism, if the arguments we have sketched here have something going for them, may here and there be pointing in such a direction.

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