

Sean Ó Nualláin, *The Search for Mind: A New Foundation for Cognitive Science*, Ablex Series in Computational Science, Norwood, NJ: Ablex Publishing Corporation, 1995, xxi + 360 pp., \$24.50 (paper), ISBN 1-56750-139-7.

Ó Nualláin provides a polemical romp through the multiple areas that contribute to cognitive science, and a suggestion for a reconceptualization of the field. The book is organized into two sections: “The Constituent Disciplines of Cognitive Science” and “A New Foundation for Cognitive Science”. In the first section, he discusses “Philosophical Epistemology”, “Psychology”, “Linguistics”, “Neuroscience”, “Artificial Intelligence”, and “Ethology and Ethnoscience”; in the second section,

“Symbol Systems”, “Consciousness and Selfhood”, and “Cognitive Science and the Search for Mind”.

The Search for Mind ranges widely across contributors to our understanding of mind. The broad scope of discussions extends beyond what is usually considered to be core cognitive science, enabling Ó Nualláin to develop interrelationships that would otherwise be missed. An example important to my own orientation is the common focus on mind as emergent in embodied systems that interact with real environments that is to be found among Maurice Merleau-Ponty, Jean Piaget, James Gibson, and Rodney Brooks.

This is a fast-paced book. It assumes too much and moves too fast to be an introductory text, but, as a focus in higher-level courses, it is sure to intrigue and outrage more than enough to stimulate lots of discussion. It also has wonderful drawings – I particularly like the illustration of the computational hierarchy of abstract machines (p. 248).

Ó Nualláin weaves several strands of argument throughout his discussions. Setting the stage is the point that, although cognitive science commonly makes claims to be the science of mind, in practice it ignores such phenomena as motivation, emotions, and consciousness. Rather clearly, either cognitive science ignores much of its subject matter, or else its subject matter is something more restricted than all of mind. In any case, the issue is open as to just what the subject of study of cognitive science is and ought to be, and how that relates to the study of mind in general. That issue is the basic theme of Ó Nualláin’s book.

Ó Nualláin endorses a conception of cognitive science as having information processes as its subject matter, but he arrives at several unusual conclusions from this starting point.

First, he argues that information processes need to be conceptualized broadly enough that they include not only classical symbol-manipulation systems, but also connectionist nets and modern robotics.

Second, information processes, so conceived, encompass not only the classical backbone of perception, cognition, and language, but also aspects of motivation, emotion, and consciousness. In fact, if Ó Nualláin is correct, cognition cannot be severed from such phenomena without fatal loss – the restriction in subject matter that we have observed to date in cognitive science is theoretically untenable. Cognitive science should be addressing far more of its announced subject matter of Mind than it has.

Third, information processes capture important aspects of consciousness, but this approach cannot capture *all* critical aspects of consciousness. Phenomenal aspects and higher forms of consciousness, in particular, are beyond the explanatory power of information models; something more is needed. If this third point is correct, then the study of mind divides into two sciences: the science of information processes, or cognitive science, and the science of consciousness.

These are extremely provocative and important theses. They address the foundations of the field, and, therefore, they address the presuppositional framework

that is ubiquitously simply taken for granted in cognitive science – and in its related disciplines. If Ó Nualláin is correct, then much work in cognitive science is simply misconceived in its presuppositions. This would not be the first time this has occurred: The field of verbal learning and verbal behavior, once the center of psychology, no longer even exists. Its presuppositions were fundamentally false. His claims, then, merit careful attention.

I have agreements and disagreements with various aspects of Ó Nualláin's theses, so I will discuss them in sequence.

Ó Nualláin's identification of cognitive science with the science of information processes, I would argue, is both right and wrong. Certainly, connectionism and robotics must be included in whatever conception of cognitive science we arrive at. Symbol manipulation is not adequate. I would also agree that information can be conceptualized with a generality that allows those incorporations.

But I nevertheless have some reservations. First, information in the mathematical or covariational sense is ubiquitous throughout the universe. Every instance of every physical law provides an instance of something carrying information in this sense about something else - e.g., neutrino fluxes carry information about processes in the interior of the sun, the temperature internal to a rock carries information about the ambient air temperature and incident sunlight, and so on. Almost all of these instances of information, and the processes that they might be involved in, are not representational or cognitive in nature. The science of information processes, then, seems too broad for cognitive science.

On the other hand, I have argued that representation *can* be understood in informational terms if information is taken to be not about previous states or events or objects, but instead as about future potentialities for action (Bickhard 1993, Bickhard & Terveen 1995). I don't know to what extent Ó Nualláin would endorse the critiques and the model that I am alluding to here, but it does provide one possible restriction on "information" as delimiting cognitive science.

A second question addresses the second part of the conception of information processes: What is process? Does process have to be modeled in terms of the material instantiations? Can only neurons yield mind? Most would hold that a more general conception of process is appropriate; neurons, silicon, or any other material medium would suffice so long as critical functional characteristics are satisfied. This is the intuition of functionalism, but the notion of function is itself highly problematic (Bickhard 1993, Godfrey-Smith 1994). What is "function" and how does it relate to "information"?

My third point is not a question, but an enthusiastic agreement. Cognition is commonly conceptualized as being autonomous from action systems that might make use of cognition and from the motivational processes that guide such action systems. But that assumption of the autonomy of cognition is itself a presupposition that might be false. Ó Nualláin argues, and I agree, that motivation, for example, cannot be dirempted from cognition without destroying the ability to understand either one. If representation is emergent in systems of action, to illustrate with

my own model, then representation, thus cognition, cannot be modeled without attending to the dynamics of such action systems, including the processes of action selection – motivation. I would similarly agree with Ó Nualláin that emotions and consciousness are addressable within a broad informational and functional perspective and that human cognition will not be understood so long as these are ignored.

This brings me to Ó Nualláin's last point – that phenomenal consciousness and higher forms of consciousness are *not* modelable within an information-processes framework and, therefore, that they form a second division in the sciences of the mind. I have mixed reactions to this claim. Clearly it's a logical possibility, so the issue is its plausibility. (For an interesting salvo in this battle, see Churchland 1996.) Considering information in its usual cognitive-science sense of carrying information about the event, state, object, or whatever that is being represented, I am in strong agreement with Ó Nualláin. This aspect of information cannot make good on the homunculus that must interpret those informational correspondences, nor on the phenomenal aspects of that homunculus's functioning, and has nothing whatsoever to say about higher forms of consciousness.

I have already suggested, however, that this standard conception of information needs to be broadened to include *future*-oriented information and strong models of functional interactive processes. I go on to conclude that those functional interactive processes must be of real, situated, embodied agents (Bickhard 1993, Bickhard & Terveen 1995). It is not so clear to me that consciousness – even in its phenomenal aspects, and with respect to its higher forms – is outside the purview of a science of “informational processes” with information and process so conceived. (For a model of the structure of potential higher forms, see Campbell & Bickhard 1986.)

Ó Nualláin addresses the fundamental issues of what form the study of mind must take. I do not agree with all of the positions he advocates, and I doubt that you will either. But you ignore the issues he raises at your own peril. Besides, the book can be lots of fun.

References

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