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Methodical Support for Informational Analysis of Mind: A Review of Igor Aleksander's and Helen Morton's "*Aristotle's Laptop: The Discovery of Our Informational Mind*"

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Aleksander and Morton take pains to build a case for the information theoretic mind. In the process, they provide an extensive review of the history of modern neuroscience, psychology, and artificial intelligence research. The authors make a distinction between the state structure of the mind and the physical structure of the brain, where the latter includes such things as the modification of synapses between neurons. This is a recognition of the fact that the dynamic nature of brain activity is supported by processes of change acting at different time scales: From the gradual alteration of physical connections between neurons [Abbott and Nelson, 2000], and the chemical strengthening and weakening of synapses [Anwyl, 1994], to the fleeting hold of short-term memory processes [Atkinson and Shiffrin, 1971].

The approach taken in the book is to deliver a step-by-step construction of their case for the information theoretic production of mind. In the process, the authors support each step with a generous helping of historical references, descriptions of discoveries made, and the most influential researchers in the field, including Claude Shannon, Santiago Ramon y Cajal, Donald Hebb, McCulloch and Pitts, Hubel and Wiesel, and many others.

The authors discuss mental states as being unique and indivisible. They point out that this is achieved, even though processes such as visual perception cause activity in disparate and separate processing areas. Two important concepts that arise from their analysis are the notion of a state structure and of iconic learning. Iconic learning is proposed to bring about the ability to recognize and to resolve during subsequent tasks. A mind is then thought to be a state structure of the various neural parts of the brain, as created through the iconic learning.

The interconnections between brain areas lead to information integration, so that the states of the state structure generate information by being unique and are capable

of representing causal relationships by being indivisible. According to the authors, iconic learning integrated with muscular control information creates a "self" that senses its embedding in the "out-there-world".

The authors go on to point out that much of the objection to the informational mind approach comes from its being masked by the problematic "computer processing" metaphor. They valiantly take on the difficult task of removing confusion surrounding the use of the term "information", which has so often led to expressions that mind cannot be informational.

Much of the confusion is of course about the word itself. By exploring the meaning of "information", the authors manage to address the concerns expressed by thinkers such as Raymond Tallis in "*Why the Mind is Not a Computer*", They emphasize that the informational mind includes the description of more than information processing and point out that informational analysis is more than Shannon's theory of communication.

Of course, in the end much of the debate comes down to agreement about what it means to "explain" or to "understand" something. Even if we can draw a correlate between a brain mechanism and some mental function (even consciousness), doing so does not necessarily satisfy our sense of understanding that function. In my own work, I have often stressed that proclaiming understanding or explanation often means a comprehension at many levels of abstraction, as well as a comprehension of the transformations between those levels.

Somewhat troubling was the ease with which the authors dismissed theories in the study of brain states during sleep and dreaming that postulate a function for the consolidation of memories acquired during awake experience. The authors stated that they chose not to entertain those theories, because those theories appear to clash with their informational theories. This is unfortunate, because it is unwise to ignore experimental evidence in order to make a case for one's theories. It would be better to use the evidence to improve a theory. In the case of recent work in the area of sleep activity in the brain, mounting evidence suggests that regions of the brain do indeed replay sequences of neural activity in batches that correlate strongly with sequences observed during awake experience [Buzsaki and Solt, 1999; Karni *et al.*, 1994; Wilson and McNaughton, 1994; Pennartz *et al.*, 2004]. Theories proposed in connection with the experimental evidence consider at least two possible functions:

(1) Moving memory from a less durable form to a more permanent form by strengthening synapses in consecutively activated neural patterns.
(2) Associating old and new knowledge through a process of elicited discovery.

Aside from the side-step in the ninth chapter, commendable and satisfying features of "Aristotle's Laptop are: The authors' strong emphasis of careful consideration of the meaning of an informational analysis of mind; their methodical build-up of the central arguments; and subsequent comparison of their arguments with other theorier, beginning with Aristotle. In the closing chapter, an imaginary tale of a

conversation with Aristotle about a laptop computer does not lead to any surprising final insight, but it manages to wrap up the arguments and reiterate the cautionary constraints within which the authors propose their theory.

Overall, the book is methodical and its tenets fall within the core of the canon of present-day neuroscience. My comment about its place within the canon is intended as a point of praise! These days, it is all too common to see pop-neuroscience authors selling their writings by appealing to the sensationalism of outrageous, controversial or even fantastical claims and notions concerning the workings of the brain. That state of affairs is unfortunate, because the brain's mechanisms are beautiful and complex in their nature. They are replete with astounding tricks that should amaze and fascinate anyone who learns about them, even when the material is treated seriously and with rational constraint. Igor Aleksander and Helen Morton do this very well!

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