

Pattern Theory as a Refutation of Fodor's Representational Theory of the Mind
by Michael Currie

Since the 1970s, philosophers of mind have generally accepted *functionalism* as the best way of relating mental activity to the brains that support that activity. This theory considers the mind as functions (“the software”) executed by neurons in the brain (“the hardware”). Precisely how the brain’s states (or neurons) functionally implement higher-order processes (like thinking) is still an open question; this is the *scientific problem of representation*, and it has two popular solutions. The first, *symbolic representation*, claims that mental states represent thoughts as sets of symbols. This solution is most fiercely defended by Jerry Fodor, who advocates it for the Representational Theory of the Mind (RTM). The second solution, *distributed representation*, claims that “meaning is not captured by a single symbol, but rather arises from the interaction of a set of symbols”¹.

The key to deciding which of the two solutions is correct is the observation that computers and brains should be able to implement each other’s functions – the correct solution should work in both computers and minds. One important mental function is pattern recognition; one abstraction of this function is called *Pattern Theory* – defined by David Mumford as “the analysis of the patterns generated by the world with the goal of reconstruction [of] the objects that produced them”². The fact that researchers cannot make computers perform passable pattern recognition symbolically implies the same inability in the mind. Thus, my thesis is that RTM is now untenable as a complete

¹ Eliasmith, Chris. *The Dictionary of Philosophy of Mind*.
<http://artsci.wustl.edu/~philos/MindDict/distributedrepresentation.html>

² Mumford, page 25.

solution to the scientific problem of representation, because developments in Pattern Theory show that some mental states are not in fact represented symbolically.

RTM

Before discussing RTM's difficulties, let us define it precisely. Fodor takes the *syntactically driven causal processes of a computer* and uses the logic-inspired parallelism between *semantics* and *syntax* to conclude that a reasonable story of the mind involves mental representations that are in a 'language of thought' whose syntactic properties explain the causal powers of mental states. RTM's construction begins with the basic idea in cognitive science that computers "connect the causal properties of a *symbol* with its semantic properties, via its syntax"³. Since Fodor wants to reify common sense belief/desire psychology, he assumes that having a propositional attitude involves tokening a symbol as a mental state. Thus, it is also possible to connect semantic properties with causal ones for *propositional attitudes* (i.e. thoughts) via syntax.

Moreover, RTM makes a claim about the structure of mental states. Syntax, in natural languages, has a constituent structure and is processed according to rules that are truth preserving. As well, propositional objects, like those used in languages, have a constituent structure that mental states functionally represent. So, if one takes the position that brains operate on the syntax of symbols (as computers operate), one arrives at Fodor's conclusion: that mental states have a language-like constituent structure.

So, RTM is one story of how the mind could use symbolic representations. It is popular not least because it vindicates intentional psychology. Also, and more relevant to this discussion, RTM satisfies our intuitions of how the mind should work – intuitions which are seeded by our experience with the ubiquitous Von Neumann (or sequential)

³ Fodor, page 43.

computer. As is elucidated in the following discussion of pattern recognition, however, RTM is not an adequate explanation of how the mind understands patterns.

Pattern Theory

Pattern theory seeks to quantify a function that human brains do effortlessly: detect patterns from the ambiguous, complex input signals of the real world. The history of image recognition in particular, is, according to David Mumford, a “long one of ambitious projects which attained their goals [only] with carefully tailored artificial input.”⁴ Mumford continues, “Many of the early algorithms in pattern recognition ... computed a vector of ‘features’, and then compared these feature vectors with those expected for signals in various categories... the problem that these algorithms encountered was that they had no way of dealing with anything unexpected.”⁵ These *bottom-up* algorithms – that extract constituent symbols into a world model without prior knowledge – were foiled by simple imperfections such as a smudge on a paper partially obscuring a character. Progress on a robust solution has only recently taken place, thanks in part to Ulf Grenander’s precise mathematical definition of the problem: Generally, Pattern Theory tries to infer the state of the world given a signal (for example, a visual signal). Grenander’s definition is probabilistic, that is, it allows for iterative recognition algorithms that avoid the rigidity of immediate symbolic extraction. Neurologists have concluded that the brain operates with similar (distributive) algorithms; as Chris Eliasmith contends, “the fundamental unit of signal processing in the nervous system [is] the simplest neural population ... rather than the single neuron.”⁶ Motivated by this rigorous approach to pattern theory, a second class of algorithms has been developed.

⁴ Mumford, page 49.

⁵ Mumford, page 36.

⁶ Eliasmith, page 10.

Occurring simultaneously with the bottom-up stage, there is a *top-down* stage wherein the partly constructed world model is compared with the input to verify that it is within normal tolerances (i.e. that no feature has been missed or overly emphasized). These new algorithms have given insight into how *humans* process visual signals as well; Mumford concludes, “Pattern Theory contains the germs of a universal theory of thought, one which stands in opposition to the accepted analysis of thought in terms of logic [or symbolism].”⁷

The Brittleness of RTM

The problems with symbolic pattern recognition are subsumed in a popular reply to RTM: that symbolism leads to *brittle* cognitive states. According to Fodor, the neurological properties of the brain are irrelevant to its cognitive properties. Ironically, his strong functional stance invalidates his own theory: since it is not possible to implement the function of pattern recognition symbolically in computers, that same function must not be possible under any other implementation (i.e. minds). Closing the case for RTM is the more direct criticism that pattern recognition uses no ‘language of thought’ forms whatsoever. Indeed, symbolism in general and RTM’s linguistic nature in particular is not useful for doing pattern recognition.

RTM’s difficulties are not marginalized to sense-data pattern recognition. As M. Savini notes, “Vision ... [is] strictly integrated with the capabilities of an intelligent system.”⁸ Mental processes like “tip-of-the-brain” recall⁹, partial retrieval of

⁷ Mumford, page 59.

⁸ Savini, page 62.

⁹ For a remarkably prophetic discussion of this phenomenon, see James’ 1892 paper, *Stream of Consciousness*.

representations, and prosopagnosia (loss of face recognition), indicate that the “all-or-none” symbolic nature of RTM cannot explain whole classes of mental processes.

Functionalism is committed to the metaphor of the brain as a computer, since the theory implies that brains and computers can indeed represent the same mental processes. The mental software posited by RTM is outdated and quite defunct, because advances in Pattern Theory have demonstrated that image recognition is not a symbolic process. Thus, RTM is not the solution to the scientific problem of representation, since it contradicts the principles of functionalism.

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