Mechanism, Computational Structure and Representation in Cognitive Science

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The notion of computation has been playing an essential role in the sciences of the mind at least since the foundation and consolidation of cognitive science as a research field from the 1950s on. The idea that the workings of the mind/brain can be explained by unveiling the computations that it performs is still very popular among researchers and lies at the basis of many scientific projects. Importantly, talk of computation in cognitive science is normally supposed to play more than a heuristic or purely epistemological role. Computing systems are relevant not just for modelling cognitive processes – a stronger, ontological commitment, is often at work: the mind/brain is a computing system. The notion of concrete computation becomes then the most relevant. However, there is as yet no consensus on what the best account of concrete computation is.

The most prominent understanding of concrete computation in cognitive science, sometimes called 'the received view', is the semantic account, which takes computation essentially to involve representation [3, 8, 10, 11]. It follows from such a picture that a satisfying account of concrete computation will ultimately depend on a satisfying theory of (cognitive) representation. However, despite the considerable philosophical efforts dedicated to the issue of mental representation in the past 40 years, no satisfactory theory has as yet been provided. Representation seems thus a bad route to take in trying to provide an explanation of computation and computing systems, at least for what regards cognitive science. Hence, if we are to take seriously the proposal that the mind/brain is a computing system, it might be worthwhile to investigate alternative theoretical paths.

Luckily, the semantic view of concrete computation is not the only one on offer. There are at least two other candidate theories that make no recourse to representation in order to account for computation: the syntactic view [13], and the functional–mechanistic view [9, 7, 4].

In this talk, I claim that the mechanistic view of concrete computation can be useful in solving some of the philosophical problems at the foundation of cognitive science, especially that of representation. My aim will be to explore the fruitfulness of taking a non–traditional explanatory route, namely to use computation as a way to clarify representation, rather than the other way around. In particular, I will enquire on whether the mechanistic view of concrete computation can help provide a satisfying theory of representation.

I argue that at least for one important kind of theory of representation in cognitive science, *i.e.* structural representation [1, 5, 14, 2], the mechanistic view of computation may help solve, or dissolve, traditional metaphysical problems. Structural representation is based on the idea that representations represent what they do by virtue of instantiat–

ing the same relational structure, *i.e.* by being structurally resemblant to what they represent. One natural way to cash out the relevant relational structure of representational vehicles is in terms of computational structure. A representation would thus represent all the entities in the world that share its (computational) structure.

Opponents of structural representation have pointed out that this account leads to wild non-uniqueness of representational content. Any representation will represent many different entities in the world, since structural resemblance, when left unconstrained, can be found between any two structures [6, 11]. Such non-uniqueness undermines the explanatory role that appeal to representation plays in the explanation of cognitively complex behaviour.

I want to propose that uniting the mechanistic view of concrete computation with a structural account of representation helps to give both notions – computation and representation – a respectable philosophical standing in cognitive science. In particular, I argue that combining these views allows 'deflating' representational content in a way that nonetheless preserves the explanatory purchase the notion of representation is supposed to have in the sciences of the mind.

Structural representation seems naturally to lead to a position according to which it is computational structure that carries much of the explanatory burden in an account of cognition. The computational structure of internal states and processes lies at the basis of ascriptions of representational content. In other words, content can be seen as what explains the successful use of an internal state in the context of certain task-domains, namely its mechanistically individuated computational structure. On this account, representation becomes a matter of "having the structure of the world at one's computational fingertips" [2]. There is nothing mysterious or in need of metaphysical vindication in this picture, and wild non-uniqueness of content does not pose a threat.

Brains/minds are computing mechanisms, and representations are those computational structures that, by instantiating the same relational structure of entities in the world, play a guiding role in complex behaviour. Once a mechanistic view of concrete computation is coupled with structural representation and a deflated understanding of representational content, I argue, traditional metaphysical worries concerning computation and representation in cognitive science lose much of their bite.

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