

# On Facing up to the “Semantic Challenge”

Otto Lappi

Cognitive Science, Dept. of Psychology  
University of Helsinki, Finland  
[otto.lappi@helsinki.fi](mailto:otto.lappi@helsinki.fi)

## Abstract

Computational neuroscience is founded on the *computational hypothesis* of the mind/brain: that neural systems are automata that compute information by their state transitions, and that understanding this property is useful for accounting for much of the intelligence we observe in the behavior of organisms (Sejnowski et al. [1988]).

In a recent paper (Grush [2001]) Rick Grush presents computational neuroscience with a ‘semantic challenge’: how to distinguish between computation – “genuine information processing” - and any other complex causal process merely governed by a computable rule.

Grush himself frames this problem in terms of a distinction between a-semantics and e-semantics: conformity of the neural process to a mathematical algorithm, and isomorphism of a neural structure to something that it is used to “stand in for” in the brain.

In this paper, Grush’s a-semantics and e-semantics are reframed in terms of a more general distinction between “horizontal” semantics (based on the notion of causality and isomorphism) and “vertical” semantics (based on the idea of information coding in formal systems). It is put forward that the semantics that computational neuroscience needs in order to address “the semantic challenge” must be vertical.

a-semantics is “bottom up” vertical semantics, and indeed inadequate. This inadequacy, however, is explained as stemming from the fact that what you really need is “top down” vertical assignment of semantics: “c-semantics”.

Finally, it is argued that Grush’s own solution, e-semantics, is a case of horizontal content-assignment, which is not what one should be looking for. Based on considerations of intensionality and “poverty of the stimulus”, it is maintained that the c-semantic, not an e-semantic nor an a-semantic, definition of content is the genuinely mentalistic notion of information that would be needed as a coherent philosophical foundation.