C

Carruthers on Massive Modularity

Ian D. Stephen[1,2,3], Darren Burke[4] and Danielle Sulikowski[5]
[1]Department of Psychology, Macquarie University, North Ryde, NSW, Australia
[2]ARC Centre of Excellence in Cognition and its Disorders, Macquarie University, North Ryde, NSW, Australia
[3]Perception in Action Research Centre, Macquarie University, North Ryde, NSW, Australia
[4]School of Psychology, University of Newcastle, Ourimbah, NSW, Australia
[5]School of Psychology, Charles Sturt University, Bathurst, NSW, Australia

Synonyms

Adaptive specialisations; Domain specificity

Definition

Carruthers defines mental modules more loosely than does Fodor and provides three arguments in defense of the concept of massive modularity of mind.

Introduction

In *The Architecture of the Mind: Massive Modularity and the Flexibility of Thought*, Carruthers (2006) defends the concept of massive modularity of the human mind. He first distinguishes massive modularity (that the brain is composed entirely of modules) from Fodorian modularity (which postulated peripheral modules feeding into a domain-general central processor/s). He then provides a series of three formal arguments for the massive modularity of mind: an argument based on the architecture of complex biological systems; an argument appealing to task specificity, which is supported largely by comparative evidence; and an argument from computational tractability. The current entry summarizes Carruthers' position and notes some key challenges that his arguments have received.

The Nature of Modularity

Carruthers (2006) argues that Fodorian modules (Fodor 1983) are not consistent with a massively modular concept of mind that is "even remotely plausible" (Carruthers 2006, p. 6). Fodorian modules are conceived as domain specific (responding to information of a single class or domain, such as spatial information or visual information), have their own transducers (such as cone and rod cells serving a visual module), and are fast and automatic. Fodor (1983) conceptualized such

T.K. Shackelford, V.A. Weekes-Shackelford (eds.), *Encyclopedia of Evolutionary Psychological Science*,
DOI 10.1007/978-3-319-16999-6_3095-1

modules as peripheral to a central processor, which he credited as responsible for reasoned thoughts, ideas, and beliefs (outputs which Fodor's modules could not achieve). Carruthers (2006), on the other hand, argues that a massively modular concept of mind stipulates that the mind is constructed *only* of hierarchically organized modules. As such, modules must be capable of any and all mental processes and outputs, including the most complex and sophisticated thoughts. Carruthers (2005) argues that mental modules are: dissociable (in that they can be changed without affecting the working of other mechanisms); functionally specific (serving a single function, such as navigation, but using inputs from across Fodorian domains, such as both spatial and visual information); and localized within specific neural structures. In common with Fodor, though, Carruthers also requires a module's internal workings to be inaccessible to other modules, and to be mandatory, in that their processing cannot be voluntarily suppressed. Carruthers rejects Fodor's central claim that modules are encapsulated (i.e., that they cannot draw on information from elsewhere in the mind during the course of processing) in favor of a form of weak encapsulation, in which information from elsewhere in the mind is accessible but cannot be drawn upon all at once.

Wilson (2008) and Cowie (2008) charge that Carruthers' ideas, and in particular that the loss of the strong version of encapsulation, represent a weakened conception of modules. While this may be true, Carruthers (2008) argues that the goal of his book is not to extend the concept of Fodor modules to central processing functions of the mind but rather to identify the conception of modules that can most defensibly be extended to these central functions.

The Argument from Biology

The first of Carruthers' (2006) three arguments for massive modularity is the argument from biology. Quoting foundational work on the evolution of complex biological systems (for example, Simon 1962, see more recently Simon 2003) Carruthers observes that some level of modularity is a requisite for evolution by natural selection to produce incremental improvements in the functioning of a complex system. This is because random mutations must affect a reasonably small, and preferably related, collection of traits, such that when a random mutation produces an improvement to some (dissociable) component of the system (a rare enough event in itself), that improvement is not completely offset by deleterious effects on other components (the more common impact of a random mutation). He argues that the human mind is an evolved, complex, biological system, and as such must exhibit a level of modularity.

In biological systems, this modularity is inherently hierarchical, with cells organized into tissues, tissues into organs, and organs collectively forming functional systems (such as the digestive system). Carruthers extends this feature to his description of massive modularity as well. Though he concedes that the hierarchy of mental modules could potentially be quite shallow, amounting to no more than a handful of dissociable modules, Carruthers argues that the complexity of the human mind reflects a massive proliferation of function (2005). In combination with Carruthers' assertion that modules map cognitive functions one-to-one, this implies a massively modular mind made up of a "*very great many*" modules (2005, p. 11).

This argument hinges on the proposition that modular systems provide more efficient and rapid solutions to cognitive problems than domain-general systems, which has been challenged by theorists in the past (Fodor 2000). However, Carruthers asserts that a domain-general central processor of the mind would quickly become overwhelmed and that weakly encapsulated, dissociable, and isolated modules are therefore a more efficient way of solving specific, recurring cognitive problems.

The Argument from Task Specificity

Carruthers' (2006) second argument proposes that the specificity of cognitive tasks with which a hypothetical animal must contend (using the azimuth of the sun to determine the time of day compared with the computations associated with dead-reckoning, for example) necessitates the existence of computationally specialized modules within animal minds. Carruthers invokes Gallistel's (2000) arguments to assert that no *general* learning mechanisms likely exist at all within nonhuman animals, with each distinct challenge an animal must solve, and skill it must acquire, supported by a specialized computational process. He refutes Samuels' (1998) proposition of an "informational modularity." This is where a nonspecialized central learning mechanism exhibits a proliferation of algorithms in response to different types of information. Carruthers argues that such a mechanism would become irretrievably overwhelmed and is in any case not consistent with the notion of parallel processing that predominates in modern theories of cognitive neuroscience. Although many of the arguments relating to task specificity are centered on comparative examples, they are tied to the human mind by an argument of common descent. It is curious that, unlike massive modularity of the human mind, Carruthers presents massive modularity of the animal mind as sufficiently uncontroversial and self-evident that it counts as prima facie evidence for the massive modularity of the human mind. If one accepts that massive modularity of mind, whether in humans or nonhuman animals, is a position that requires independent verification, this argument distils into a case of begging the question.

This argument also makes the assumption that the assumed modularity of animal minds has been maintained in the evolution of human minds (Wilson 2008). Carruthers accepts this point, arguing that since humans retain all of the animal mental capacities with some incremental additions, it may be assumed that these additions are also modular. However, it is possible that, even if the additions to animal minds are modular, a series of such additions could lead to the loss of modularity.

The Argument from Computational Tractability

Carruthers' third argument is the argument from computational tractability. In this, he argues that cognitive processes are computational (i.e., the mind is the result of the computational properties of the brain). These computational processes must be sufficiently tractable that they are soluble within the human brain within a finite timescale. They must also, therefore, be frugal in the amount of information they utilize and in the complexity of algorithms they employ. Such tractability, Carruthers argues, is only possible if the computational processes (and, by extension, the mental modules that house them) are at least weakly encapsulated (insulated from other modules), permitting them to draw only upon a predetermined set of relevant information from the rest of the mind. In making this argument, Carruthers acknowledges that the notion of a computational mind is a central premise of his version of massive modularity (and indeed a central premise of much of modern cognitive psychology). While he concedes that this is not an uncontroversial claim, Carruthers argues that computational processes offer the only feasible mode by which mental processes can be realized into physical ones – one of the few allusions he makes to the fact that theories of massive modularity of mind imply a level of mind/brain dualism that is not completely resolved.

Conclusion

In conclusion, then, Carruthers (2006) suggests a definition of modularity that is less tightly defined than that of Fodor (1983) but which allows for the central processes of the mind to be modular in addition to the more peripheral tasks proposed by Fodor (1983). Carruthers offers three arguments in defense of this conception of the mind as massively modular. Critiques of Carruthers' position comprise claims that Carruthers modules are insufficiently tightly defined to represent a true massive modularity (Wilson 2008) and empirical disputes over the accuracy of the assumptions about animal minds and processing efficiency.

Cross-References

- ▶ Evidence for Modularity
- ▶ Evidence of Brain Modularity
- ▶ Massive Modularity in Evolutionary Psychology
- ▶ Modularity
- ▶ Modularity in Computer Programming
- ▶ Modularity of Mind
- ▶ Theory of Mind and Evidence of Brain Modularity

References

Carruthers, P. (2005). The case for massively modular models of mind. In R. J. Stainton (Ed.), *Contemporary debates in cognitive science* (pp. 3–21). Malden: Wiley-Blackwell.

Carruthers, P. (2006). *The architecture of the mind: Massive modularity and the flexibility of thought*. Oxford: Oxford University Press.

Carruthers, P. (2008). On Fodor-fixation, flexibility and human uniqueness: A reply to Cowie, Machery and Wilson. *Mind and Language, 23*, 293–303.

Cowie, F. (2008). Us, them and it: Modules, genes, environments and evolution. *Mind and Language, 23*, 284–292.

Fodor, J. A. (1983). *The modularity of mind*. Cambridge: MIT Press.

Fodor, J. (2000). *The mind doesn't work that way: The scope and limits of computational psychology*. Cambridge, MA: MIT Press.

Gallistel, C. (2000). The replacement of general-purpose learning models with adaptively specialized learning modules. In M. Gazzaniga (Ed.), *The new cognitive neurosciences* (2nd ed.). Cambridge, MA: MIT Press.

Samuels, R. (1998). Evolutionary psychology and the massive modularity hypothesis. *British Journal for the Philosophy of Science, 49*, 575–602.

Simon, H. (1962). The architecture of complexity. *Proceedings of the American Philosophical Society, 106*, 467–482.

Simon, H. A. (2003). The architecture of complexity. In R. Garud, N. Kumaraswamy, & R. N. Langlois (Eds.), *Managing in the modular age* (pp. 15–37). Oxford: Blackwell.

Wilson, R. A. (2008). The drink you have when you're not having a drink. *Mind and Language, 23*, 273–283.