Cognition and Neurophysiology: Mechanism, Reduction, and Pluralism

The present collection of papers brings together some of the most recent developments in the philosophical understanding of the relation of cognition to neuroscience. Earlier versions of most papers have been presented at a workshop held in Paris on 19 June 2006, which was organized by Institut Jean Nicod and supported by
RESCIF (Réseau des sciences cognitives en Ile-de-France).

The common starting point of all papers is the conviction that the concept of reduction is insufficient to account for the ongoing process of integration of the different sciences that study human cognition and the human brain. It is controversial whether psychology and biology discover and make use of specific biological or psychological laws, over and above chemical and physical laws. However, even if there are such laws and if they play an important role in explanations, it does not seem possible or fruitful to characterise the interaction of research at different levels as tending toward a reduction of higher-level laws and theories to lower-level laws and theories. Analysis of contemporary cognitive neuroscience yields few if any examples where something like the logical deduction of higher level-laws from lower-level facts and theories is possible (Nagel 1961). Careful observation does not seem to license the view that all apparently higher-level phenomena are sooner or later completely explained at a lower-level, so that higher-level concepts and explanations turn out to be merely provisional and heuristic (Bickle 2003).

Rather, what cognitive neuroscience shows is that the understanding of cognition requires the integration of research conducted at various levels: psychological, neurophysiological, chemical and physical. The concept of mechanism and of mechanistic explanation has proven a promising tool for analysing the way in which the collaboration of different sciences focussing on different levels of organisation can yield understanding of complex phenomena such as animal vision that would be inaccessible to any single science alone.

The papers collected in this volume explore some of the powers and limitations of the concept of mechanism for the scientific understanding of cognitive systems.

Bechtel shows that mechanistic analysis of cognitive systems must take into account three dimensions: it must “look down” to decompose a system into its functional and structural parts, it must “look around” to understand how the interaction between these parts leads to the realization of a given cognitive phenomenon or capacity in the cognitive system as a whole, and it must finally “look up” into the environment of the cognitive system or animal under investigation, which turns out to be indispensable for understanding what the system does.

In his comment on Bechtel, Forest argues first that mechanistic explanation is not so much incompatible with reduction; it would be wrong to think that the mechanistic strategy yields a weaker form of integration of the sciences studying a cognitive phenomenon at different levels, compared to traditional reduction. Rather, mechanistic explanations are richer and provide deeper insights than simple reductions. Second, he argues that understanding how the parts of a system interact to produce a given capacity and understanding the system’s interaction with its environment often go hand in hand, so that “looking around” and “up” are practically inseparable.

It has been suggested that mechanisms might provide objective grounding for the existence of natural kinds, in particular in the framework of the conception of kinds as "homeostatic property clusters". Mechanisms are supposed to justify the intuition that not all kinds are conventional: property clusters are natural insofar as they are bound together by a mechanism. However, Craver shows that there is no straightforward way to identify mechanisms themselves in any absolute way: what we take to be a mechanism depends on what we are trying to explain, predict or control. Pragmatic factors determine in particular which level of abstraction we judge relevant for what counts as a kind of mechanism and how we delimit the boundaries of a mechanism.

In his contribution, Kistler argues that the analysis of the experimental study of mechanisms provides new grounds for thinking that there are causal relations crossing levels of composition in complex systems. In bottom-up causation, changes at the level of parts of a system cause changes at the level of the system; in downward causation, changes at system level cause changes at the level of the parts. Taking up Craver and Bechtel's suggestion that interlevel causation can be analyzed into a causal and a non-causal part, he makes two proposals concerning the non-causal part: the first is that constitution, which is required to account for bottom-up causation, must be distinguished from identity; second, he argues that the notion of partial constraint is required to account for downward causation.

McCauley's paper adds a new argument against the New Wave model of reduction and for explanatory pluralism. During scientific research on long term processes such as those happening at the time scale of biological evolution, hypotheses elaborated at one level may have fruitful implications at other levels. He elaborates the example of an hypothesis offered by evolutionary psychology, which has inspired research in cognitive neuroscience on patients with specific impairments due to localised brain lesions. McCauley also offers two new criteria to ground a general notion of levels: objects at higher levels are not always composed of parts belonging to lower levels, but sciences studying lower levels have wider scope; and their objects are older in terms of natural history.

In his comment, Eronen challenges first McCauley's new criteria for analytical levels, arguing that they wrongly put thermodynamics and particle physics at the same basic level. According to Eronen, McCauley is right that the New Wave model of reduction is inadequate but he argues that this would only constitute an argument for explanatory pluralism if there were no alternative forms of reductionism. Eronen suggests that McCauley's cases do not refute a form of reductionism that concentrates on the claim that more and more important discoveries are made at lower levels, leaving a merely heuristic role for higher level theories and sciences.

References

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Word count 10 June 2009

Bechtel 9769

Craver 9099

McCauley 10632

Kistler 7255

Eronen 4278

Forest 3969

Total 45002