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What is a cognitive ontology, anyway?

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This special issue brings together philosophical perspectives on the debate over cognitive ontology. We contextualize the papers in this issue by considering several different senses of the term "cognitive ontology" and linking those debates to traditional debates in philosophy of mind.

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Traditional debates in philosophy of mind about the mind–body relationship, mental realism and eliminativism are starting to take on radically different shapes as a result of the advance of the neurosciences. Reflection on cognitive categories, their metaphysical commitments and their interrelations – that is reflection on what has come to be known as "cognitive ontologies" – is one of the fields of inquiry where scientific influence on the philosophy of mind is most visible. The cognitive ontologies debate brings together philosophers, neuroscientists, psychologists and information scientists in an attempt to shed light on issues such as whether explanatory and clinical taxonomies map onto each other, how different types of cognitive category interact, whether we should look only at the brain to carve up the mental or whether the body and the environment play a role as well, and whether or not we should give up on psychological or psychiatric categories in favor of neural categories.

In order to sketch this field of inquiry, let us first clarify the term "cognitive ontologies', as it has different meanings that all play a different part in the debate. We will then sketch three themes that structure the debate. A first set of issues concerns the scope of the explanandum and the levels at which it can be analysed. Taxonomizing the cognitive domain depends on what we count as belonging to it and at what level it can best be analysed. Secondly, we should decide whether to be realists or instrumentalists with respect to the categories of a given ontology, and specify what either position entails. Thirdly, there is the crucial question of whether psychological, folk-psychological and psychiatric categories are going to survive the advance of neuroscience or whether they should be eliminated in favor of a neural ontology. There is an obvious connection between the latter two questions, as resistance to eliminativism usually goes hand in hand with the defence of some kind of mental realism. But in general all three questions are connected. The papers in this issue all address one or more of these queries, as we shall indicate in the course of this introduction.

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One phrase, three meanings

The term "cognitive ontology" was introduced to contemporary debate by Price and Friston (2005). Multiple disciplines have since contributed to the debate, and this has led, ironically, to the term being used in several different ways. We thus introduce the debate by distinguishing three senses of "cognitive ontology".

First, a cognitive ontology could be a *nomenclature*: that is, a set of standardized terms which researchers intend to use in a systematic way in order to promote mutual understanding. Price and Friston are encouraged by work on gene ontologies (Ashburner et al. 2000), the point of which was to make sure that different researchers use the same names for genes, avoiding inefficient duplication. More broadly, "ontology" in this sense stems from work in informatics (Gruber 1995), where it is important to use a consistent set of terms and relations, set out in a formal language, in order to make possible information retrieval and manipulation in large databases. Similarly, projects like the Cognitive Atlas (Poldrack et al. 2011) attempt to capture the current state of cognitive neuropsychology into a standardized framework.

Second, a cognitive ontology could refer to a *domain*, not a set of terms but a set of entities to which a cognitive theory refers. This is "ontology" in the sense familiar to philosophers of science (though widened beyond the traditional Quinean sense to include properties and taxonomic groupings). Debates about whether working memory is unified or modality-specific, or whether schizophrenia is really an appropriate taxonomic category, or whether spelling-to-sound conversion goes by a single route or a dual route, belong in this category. Although Price and Friston mention the informatics sense of "ontology", their concern is primarily with the domain sense. They argue that positing new terms (and securing their standardized use) is not enough to make sense of findings of overlap across distinct functional magnetic resonance imaging studies. Rather than new terminology for existing processes, what is required is the posit of new psychological processes, new ways of carving up or structuring cognitive systems.

Third, a cognitive ontology could be a set of basic metaphysical *categories*: when we carve up or structure cognitive systems, what kind of entities make up that structure? What kinds of entities make up the cognitive domain? This is the sense of "ontology" primarily used by metaphysicians. So for example, we might debate whether a good cognitive theory should refer to mechanisms, dynamic processes (Chemero and Silberstein 2008), or clinical concepts. Furthermore, the cognitive domain is usually stratified in levels. A cognitive ontology in this third sense should indicate whether the relationship between levels is one of composition, constitution, or something else. These questions in turn affect how you think cognitive theories ought to be developed and verified. For example, if you think cognition proper might span multiple timescales, you may draw very different conclusions from neuroimaging studies than if you think cognitive science only studies processes on the millisecond level (Klein 2014).

These three senses of cognitive ontology are not independent. For starters, a consistent nomenclature is probably only possible if you have consensus about the referents of the terms – that is, what the domain of inquiry ought to be. This is a marked contrast between gene ontology and cognitive ontologies. In the case of gene ontologies there are procedures for delineating genes and their products, and this occurs against a background of rough agreement about how genetics works. Some debates like this do occur in cognitive neuroscience – for example about which brain atlas to use or how to delineate cytoarchitectural areas. However, most debates in cognitive neuroscience run deeper. Theoretical disputes are often not just about what particular neural areas do, but about what the domain of the theory is in the first place.

This tension is most obvious in the case of philosophy of psychiatry. The Diagnostic and Statistical Manual of Mental Disorders (DSM) was developed in order to provide a consistent nomenclature for mental health professionals. As the categories of the DSM terminology turn out not to match with identifiable neural substrates, the question arises whether we should abandon DSM categories in favor of ones that are tractable at the neural level. Opinions differ considerably here. In this issue, **Murphy** argues that elimination of existing psychiatric categories in favor of tractable neural categories is the most defensible option. **Bluhm**, on the other hand, argues that we should not conflate the clinical and the explanatory use of a system of categories; neuroscience might be preferred for explanation, but this does not rule out the possibility that the DSM is indispensable for clinical use. The idea that different taxonomies can and should co-exist resonates with **Sullivan**'s contribution. She discusses several collaborative initiatives for knowledge-building that address conceptual and methodological obstacles for progress in taxonomizing and explaining psychological functions. She argues that only a "coordinated pluralism" will have the potential for success.

There are also important relationships between theoretical domains and metaphysical categories. Indeed, it may be more useful to view these more as two poles of a spectrum. Traditional debates about what representations are, or about whether the mind is modular, for example, can be viewed either as comparatively abstract domain questions or more concrete categorical ones. Which categories actually exist is controversial, as the philosopher often senses broader issues lurking in the background. Let us elaborate on some of these broader issues that appear in multiple papers in this issue.

Scope and levels of analysis

One important categorical question concerns how we draw the line between the cognitive (or the mental) and the non-cognitive. What is the right unit of analysis when reflecting on questions of cognitive ontology?

Traditional debates about the extended mind obviously fall into this category. These have long turned on questions of how to demarcate the mental (Rupert 2009; Menary 2010). But whereas previous debates were relatively abstract, neuroimaging work gives concrete examples. **Hutto et al.**, for example, argue that the real lesson to be drawn from neuroimaging work is that brains are "protean". That is, various neural regions change their function on the fly to fit circumstances (see Anderson 2014 for a similar view). As such, brains alone are not the right unit of analysis; we should also include the world that co-determines the brain's functionality.

Khalidi's paper seems to back this claim up. He argues for what he calls "environmental-etiological contextualism". Like Hutto et al. he argues that the psychological functions carried out by neural regions can only be identified against an environmental context. The same neural structures can subserve different psychological functions in different contexts. There are two major differences between Hutto et al. and Khalidi, though. First, unlike Khalidi, Hutto et al. think cognition is not confined to the brain and extends into the environment. Secondly, while Khalidi's contextualism is meant to enhance the search for stable neural functions, Hutto et al. think that there is good reason to give up on that search.

De Brigard also turns a critical eye to demarcation criteria, re-evaluating Rupert's defence of internalism. Rupert's criterion for what counts as belonging to a cognitive mechanism for a certain task fails, according to him, because it cannot take into account the diachronic dynamicity of cognitive processes. Such dynamicity is a real feature of aging

human brains. Building on recent neuroscientific developments De Brigard proceeds to suggests an internalist alternative that accommodates diachronic dynamicity without losing functional stability.

Apart from scope, there are serious issues connected with *levels* of scientific analysis. Traditional nonreductive physicalism pushed hard for the autonomy of the special sciences (Fodor 1974). This implied in part that neuroscience and cognitive science operate at different levels and should thus have little to say to one another. Much of this spirit lives on, though the debate has been revived by scientists who want to import increased neuroscientific knowledge into cognitive domains. **Weiskopf** considers the appropriate boundary conditions for delineating autism, advocating a way in which different levels can be integrated (see below). The papers by **Sullivan**, **Bluhm** and **Murphy** mentioned above, consider the Research Domain Criteria (RDoC) proposal from the National Institute of Mental Health, which embodies a controversial proposal about the appropriate level of investigation for psychiatric research. RDoC focusses on psychosocial functions such as responses to acute threat, reward learning, attention, and affiliation and attachment, precisely because these functions can be mapped onto neural substrates.

It is not obvious that there is a single *cognitive* level. There has been a growing move towards "local" conceptions of levels, on which compositional relationships are determined on a problem-by-problem basis (Craver 2007; Potochnik and McGill 2012). **Burnston** considers another interesting problem, on which processes putatively at the *same* cognitive level may not have cognitively well-defined means of interaction. Starting from the assumption that cognitive states are propositional in nature, he wonders how they can (and be influenced by) non-propositional states from the sensori-motor system. Burnston argues against the existing idea that states determine motor processes. Instead, he argues that cognitive states can at best bias us towards specific kinds of action.

Realism and interest-relativity

A second broad theme concerns realism about the mental. Ought we be realist about the posits of our best psychological theories, or treat them instrumentally? Can we accept more than one ontology for the mental? If so, how many? And if so, can we still accept some kind of mental realism?

Both **Bluhm** and **Sullivan** consider the possibility that the differing demands of the clinic and the lab might demand different ontologies (see above); if so, the one-size-fits-all assumption of the RDoC would be misguided. This would fit with recent trends. Cognitive neuroscientists have become increasingly sensitive to the differing demands of prediction and explanation (Yarkoni and Westfall, in press), while the mechanist project in philosophy of neuroscience is happy with a kind of interest-relativity (Craver 2007).

However, this pluralism is not without its challenges. Are multiple interest-relative ontologies still real enough? Few want complete nominalism: the world pushes back in some ways. But few authors are likely to think that all sets of interests are equally valid. The challenge for the pluralist is to tell a principled story about which interests are valid enough, even if there are no general solutions (Woodward 2016). **Weiskopf**'s network-based models offer one possible way forward. A "network category" is defined by a set of idealized exemplars linked by multiple levels of theoretically significant properties. While this kind of category is certainly not what traditional mental realists have in mind (Francken and Slors 2014), Weiskopf nevertheless argues that a realist interpretation of these is possible.

Revision and elimination

Psychological or psychiatric categories as network categories are used by **Weiskopf** to settle an issue that falls within a third theme. How are we to consider the relationship between scientific ontologies and the ontologies of folk-psychology, psychology, psychiatry or even of pre-neuroscientific cognitive science? To what extent should the latter four be revised or even eliminated on the basis of scientific findings? Price and Friston's (2005) original concern was that traditional ontologies do not do justice to findings of neuroscience, and as such should be replaced.

For the monist who thinks that there should be only one best cognitive ontology, revision or elimination seems like a likely move. At the extremes, this can resemble the old eliminative materialism of Churchland (1981), but now with a scientific bite. And indeed, recent proposals from cognitive neuroscientists (Anderson 2014; Poldrack and Yarkoni 2016) often toy with this kind of hard line. In line with these moves, **Murphy** argues that eliminativism, albeit of a moderate variety, is indeed a viable possibility. **Khalidi** similarly considers the possibility and consequences of full-scale reduction, and notes that it interacts in non-obvious and interesting ways with categorical questions about the fundamental relationships between mind and brain.

For pluralists, on the other hand, the pressure to eliminate or revise categories is less pressing. Thus, **Weiskopf**'s proposal of network categories (see above) is used as an argument against eliminativism. Eliminativism hinges on the supposition that a psychiatric category such as autism should be identified in terms of an identifiable underlying neural substrate. Accordingly, the neural, genetic and behavioral heterogeneity of the condition would call for elimination of the category. However, understanding autism as a network category would be a viable antidote for this move, as it is able to acknowledge the heterogeneity of the category without considering it less real.

Conclusion

The papers in this issue all testify to the fact that the influx of scientific and clinical knowledge in philosophy of mind intensifies and enriches traditional debates over the nature of human cognition, folk-psychology, eliminativism and extent to which we should view our mentalistic categories as natural or as human kinds. Moreover, philosophical theories and insights are now being put forward as contributions to possible solutions of complex scientific and clinical issues. Even though – as will be clear from the papers – there is serious disagreement between researchers in the field of cognitive ontologies, we believe this makes the field an important addition to traditional philosophy of mind.

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