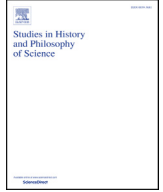




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Giving up on convergence and autonomy: Why the theories of psychology and neuroscience are codependent as well as irreconcilable

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ABSTRACT

There is a long-standing debate in the philosophy of mind and philosophy of science regarding how best to interpret the relationship between neuroscience and psychology. It has traditionally been argued that either the two domains will evolve and change over time until they converge on a single unified account of human behaviour, or else that they will continue to work in isolation given that they identify properties and states that exist autonomously from one another (due to the multiple-realizability of psychological states). In this paper, I argue that progress in psychology and neuroscience is contingent on the fact that both of these positions are false. Contra the convergence position, I argue that the theories of psychology and the theories of neuroscience are scientifically valuable as representational tools precisely because they cannot be integrated into a single account. However, contra the autonomy position, I propose that the theories of psychology and neuroscience are deeply dependent on one another for further refinement and improvement. In this respect, there is an irreconcilable codependence between psychology and neuroscience that is necessary for both domains to improve and progress. The two domains are forever linked while simultaneously being unable to integrate.

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There is a long-standing debate in the philosophy of mind and the philosophy of science regarding how best to interpret the relationship between the theories and models of neuroscience, and those of psychology. Both domains are dedicated to the scientific study and explanation of cognitive behaviour, yet each domain appears to explain and predict this behaviour by appealing to distinct sets of theories and models, and by employing different kinds of concepts and categories. How then can we make sense of the relationship between these different domains, and move forward in our scientific understanding of such behaviour? Traditionally, philosophers of science have proposed one of two possible options for how this relationship might ultimately be understood, and their seemingly conflicting accounts resolved:

1. As neuroscience and psychology improve and change over time, the theories and models of both domains will slowly co-evolve together, each undergoing alterations and changes until they converge on a single unified theory of cognitive behaviour (e.g. Bickle, 1998, 2003, 2006; Boone & Piccinini, 2015; Churchland, 1989; Craver, 2007; Piccinini & Craver, 2011).
2. Neuroscience and psychology will not converge because the two domains characterize systems at different levels of organization. The theories of psychology characterize functional states of systems that can be realized in different ways by different mechanisms, while the theories of neuroscience only characterize the physical implementation of neurological mechanisms. Given that the functional properties and regularities of psychology exist autonomously from any one system that realizes them, the theories of psychology are therefore irreducible to those of neuroscience. As a result, psychology and neuroscience will proceed largely in isolation from one

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another (e.g. Aizawa & Gillett, 2011; Burge, 2010; Crane, 2001, pp. 62–66; Cummins, 1983; Fodor, 1974, 1998; Johnson-Laird, 1983; Menzies & List, 2010).

In this paper, I argue that progress in neuroscience and psychology has been made possible by the very fact that both of these positions are false. More specifically, I propose that scientific progress in both domains is contingent on their theories being irreconcilable with one another in various respects (making convergence impossible), but also on the fact that the different theories and models do *not* identify states and properties that exist autonomously from one another. The theories and models of psychology and neuroscience are deeply dependent on one another for further refinement and improvement, yet this dependence does not imply the eventual convergence of the two disciplines.

Human behaviour is the product of a vast number of causal influences, from historical, to biological, to environmental. The sheer complexity of the causal influences at work means that we often must employ distinct scientific theories with radically different idealizing and simplifying assumptions depending on which of these influences we wish to study, and which we do not. Different idealizations will be used as the foundation for different types of scientific theories depending on which representational goals we seek to satisfy.

When it comes to understanding the relationship between psychology and neuroscience, the relevant question therefore becomes: what are the representational goals of neuroscience, and how do they differ from those of psychology? I propose that in virtue of representing different aspects of cognitive systems, the two domains must adopt different idealizing assumptions about the target system, resulting in vastly different and incompatible sets of theories useful for their own representational purposes, but not the other's. Convergence between these domains would therefore require that they give up the very idealizing assumptions that allow them to effectively represent the different aspects of the cognitive system we use them to study.

The fact that the models and theories employed by psychology are not useful for the same representational tasks as those employed in neuroscience (and vice versa) has led a number of philosophers to mistakenly infer that the two domains operate autonomously from one another, with the theories and findings of one domain being largely unhelpful to the theories and findings of the other. I will demonstrate that such a view is false, and is not supported by empirical research. There is strong empirical evidence that as we develop more detailed psychological theories and models, it puts essential constraints on what the neural mechanisms of the system are, and how they operate. Likewise, the more we know about the underlying neurological architecture of a system, the more it constrains the sorts of psychological generalizations we can make about it. As such, while psychology and neuroscience will not converge towards a single unifying account, neither can they stand apart from each other. This is not a problem that must be overcome, however, but is in fact a virtue that makes scientific understanding possible. It is the very tension between the irreconcilability of these different theories, and their required codependence, that drives scientific practice forward.

In order to make this argument, I begin in Section 1 by discussing how the relationship between psychology and neuroscience has been traditionally conceived. In Section 2, I demonstrate why these options are inappropriate for understanding the relationship that exists between the two domains. Lastly, in Section 3, I argue for an alternative account that justifies both the irreconcilability of psychology with neuroscience, as well as their necessary

codependence. I end by demonstrating why this irreconcilable codependence is essential for scientific progress.

1. Traditional characterizations of the psychological/neuroscientific divide

1.1. Convergence

The motivating assumption that underlies the argument for the convergence of neuroscience and psychology is that both domains share the same general goal of developing an ideally correct theory of cognitive behaviour, but differ in their approaches for achieving it. Psychology is an attempt to understand cognitive behaviour by employing a largely “top down” approach, while neuroscience is an attempt to understand this same behaviour from a “bottom up” perspective. In other words, psychology attempts to understand cognitive behaviour by identifying and characterizing the high-level cognitive capabilities and deficits of the system, the behavioural patterns displayed by the system, and the environmental contexts in which certain behaviours appear. They then use this information to draw conclusions about what the underlying neurological mechanisms of the system must be like. Neuroscience, meanwhile, starts by studying the neurological mechanisms themselves, and then uses this information to draw conclusions about what the overall cognitive behaviour of the system is likely to be in various situations. Both domains therefore directly inform and constrain one another. Knowing more about the underlying mechanisms of the system informs our understanding of how the system will behave. This allows us to change and improve our psychological models to better account for this information. Likewise, the more detailed our psychological theories become regarding the overall behaviour of the system, the more it informs our understanding of what the neurological mechanisms are doing, and thus puts constraints on what their underlying architecture is. As Patricia Churchland notes:

Crudely, neuroscience needs psychology because it needs to know what the system does; that is, it needs high-level specifications of the input-output properties of the system. Psychology needs neuroscience for the same reason: it needs to know what the system does. That is, it needs to know whether lower-level specifications bear out the initial input-output theory, where and how to revise the input-output theory, and how to characterize processes at levels below the top. (Churchland, 1989, p. 373)

A similar claim is made by Boone and Piccinini (2015), who argue that:

The upshot is that cognition cannot be explained without accounting for the ways in which structures constrain functions and vice versa. In the long run, the mutual constraints between structures and functions lead cognitive psychologists and neuroscientists to look to each other's work to inform their analyses. [...] The best strategy is to investigate both structures and functions simultaneously. [...] This is the main driving force between the merging of neuroscience and cognitive psychology into cognitive neuroscience. (pp. 14–15)

Under these accounts, the concepts, categories, and theories of both domains will be constantly changing as they are continuously altered to better fit with the emerging findings of the other domain. This process of mutual refinement continues until a single unified account of the system is developed.

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