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The molecules of social recognition memory: Implications for social cognition, extended mind, and neuroethics

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ABSTRACT

Social cognition, cognitive neuroscience, and neuroethics have reached a synthesis of late, but some troubling features are present. The neuroscience that currently dominates the study of social cognition is exclusively *cognitive* neuroscience, as contrasted with the cellular and increasingly molecular emphasis that has gripped mainstream neuroscience over the past three decades. Furthermore, the recent field of molecular and cellular cognition has begun to unravel some molecular mechanisms involved in social cognition, especially pertaining to the consolidation of memories of particular conspecific organisms. Some new experimental techniques for *positive interventions* into these hypothesized mechanisms offer opportunities for establishing direct causal linkages between intra-neuronal molecular events and the behaviors used to measure social cognitive phenomena. Predicted results from an experiment described below also cast doubt on the application of the "extended mind" approach from recent cognitive science to ground the neuroscience of social cognition. Since neuroethics relies heavily on our best neuroscience of social cognition, that field may soon need to extend its attention beyond cognitive neuroscience, and into neuroscience's cellular and molecular mainstream.

1. The new synthesis of social cognition, cognitive neuroscience, and neuroethics... and a troubling observation

"Naturalizing" programs have been prominent throughout the philosophy of mind, epistemology, and value theory for decades. Philosophical concepts ranging from 'representation' to 'the good' have received numerous characterizations via concepts ostensively limited to those of the natural world. Since most ethical concerns involve social interactions between multiple agents, appeals to results from scientific studies of social cognition have been popular in "naturalized" ethics. Such projects have incorporated results from studies of the perception, memory, and judgment of social stimuli, the effects of social, culture, and affective factors influencing how humans process information, and the interpersonal consequences of behavior and cognition.

Not surprisingly, naturalized ethicists first looked to social psychology and sociology to find resources to re-characterize ethical concerns naturalistically. But over the past decade, neuroscience has grown increasingly influential. On the one hand, this shift shows that philosophers are attending to larger scientific trends. Neuroscience is now among the hottest of all sciences in terms of external grant money to fund research, publications in the top scientific journals, and coverage in popular media. On the other hand, philosophers have grown increasingly myopic in their neuroscientific dabbling, concentrating exclusively on only small branches of the discipline—namely, on cognitive neuroscience, and clinical neurology and neuropsychology. Results from functional neuroimaging studies, neuropsychological and neurological assessments,

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neurocomputational modeling and computer simulation, and large-scale lesion studies using experimental animals dominate current neurophilosophical attention, to the nearly complete exclusion of the rest of neuroscience.[1] Thus naturalistic philosophers have not kept up with mainstream neuroscience's recent developments. They have missed entirely the "molecular wave" that washed across neuroscience over the past two decades.

To verify this cellular/molecular trend to non-neuroscientists, I once performed some amateur sociology. As reported in chapter 1 of my (2003) book, *Philosophy and Neuroscience: A Ruthlessly Reductive Account*, I turned to the then-current searchable database on the Society for Neuroscience's web site (www.sfn.org) of titles and abstracts of the 13,000+ posters and slide presentations at the 2001 annual meeting (November 4–11, in San Diego, CA). When one searched the database for the two themes mostly dominated by cell physiology and molecular biology, namely "Development" and "Synaptic Transmission and Excitability" (searching for "Any subtheme"), 4698 titles and abstracts were returned (respectively, 1818 and 2880). When one searched for the theme dominated by cognitive neuroscience, namely "Cognition and Behavior," 1873 entries were returned. But when one refined this second search by limiting subthemes to "Human cognition and behavior," the number of entries returned dropped to 476; and many of these were purely behavioral correlational studies that didn't purport to offer "cognitive" explanations for the data presented. At bottom this was anecdotal evidence—I do not purport to any serious sociological skills!—but it did reveal that when it comes to basic scientific, not-purely-clinical investigations, the search for cellular and molecular mechanisms had already come to dominate neuroscientific research by the turn of the 21st century.

This molecular focus is now prominent even in neuroscience's most popular textbooks. For example, Eric Kandel, James Schwartz, and Thomas Jessell opened the introductory section of the 3rd Edition of their monumental textbook, *Principles of Neural Science*, back in 1991, with the following remark:

> The goal of neural science is to understand the mind, how we perceive, move, think, and remember. In the previous editions of this book, we stressed that important aspects of behavior could be explained at the level of individual nerve cells. . .Now it is possible to address these questions directly on the molecular level (1991, p. xii).

Ten years later, and only a few years ago, with the publication of the 4th Edition of their text, they were ready to announce accomplished mind-to-molecular pathways "linkages":

> This book. . .describes how neural science is attempting to link molecules to mind—how proteins responsible for the activities of individual nerve cells are related to the complexity of neural processes. Today it is possible to link the molecular dynamics of individual nerve cells to representations of perceptual and motor acts in the brain and to relate these internal mechanisms to observable behavior (2001, pp. 3–4).

It is important to realize that these quotes come from a central textbook in the field—one of the most common resources used to train students and inform researchers new to a topic.

This emphasis on molecular mechanisms is also not limited to "basic" neuroscience. It has now reached the study of cognitive phenomena. Beginning in earnest in the early 1990s with the initial uses of genetically engineered mammals, the field of Molecular and Cellular Cognition now boasts a professional society with a membership of over 1000 scientists, at least one hundred labs actively pursuing research around the world, and regular publications in the most prestigious science and neuroscience journals. Its web site (www.molcellcog,org) states one of its key goals "is to promote the study of the cellular and molecular basis of cognitive function." And it sets its experimental approaches squarely in contrast with cognitive neuroscience:

> Unlike Cognitive Neuroscience, which historically has focused on the connection between human brain systems and behavior, the field of Molecular and Cellular Cognition studies how molecular (ie. receptor, kinase activation), intra-cellular (i.e. dendritic processes), and inter-cellular processes (i.e. synaptic plasticity; network representations such as place fields) modulate animal models of cognitive function.

Most of this young field's successes to date have come from the study of learning and memory, but work is underway to uncover the molecular mechanisms of many of the phenomena that collectively characterize cognitive science.

So neurophilosophers and neuroethicists have not kept up with the *latest* trends in mainstream neuroscience. But is there anything more to this observation than the familiar chide that even "scientifically-minded" philosophers typically do not keep up with the cutting edges of real science? Might not someone respond to my observation by pointing out that no one has argued for the *relevance* of mainstream cellular and molecular work for philosophical naturalizing projects—especially those in neuroethics? Until that bridge is made, cannot naturalistic philosophers adopt a pragmatic attitude toward current neuroscience—use what works for their projects, even if what works comes from only a small subfield of a vastly larger discipline?

[1] Attention to "mirror neurons" is an exception to my point. Yet despite fairly extensive philosophical attention to these cell-physiological findings, the scientific study of mirror neurons has pretty much fallen off the scientific radar. One rarely sees publication of new results, or even recent review papers, in major scientific and neuroscientific journals (like *Neuron*, *Journal of Neuroscience*, *Nature Neuroscience*, and *Journal of Neurophysiology*), much less in *Science*, *Nature*, or *Proceedings of the National Academy of Sciences, USA*.