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History and Philosophy of Science
Dissertation proposal:
"Proxy Representation: A Non-semantic Bridge between Brain and World"

Objectives and Plan

The goal of this dissertation is to introduce the notion of *proxy representation*, a form of

mental representation that functions *transactionally* rather than semantically; to explain why

most mental representation is best characterized this way; to outline some implications for the

philosophy of science (including areas such as biological function, the nature of scientific

knowledge, and the nature of scientific theory) and for other specialties in philosophy; and to

suggest new perspectives on, and directions for research in, biology, psychology, cognitive sci-

ence, cognitive ethology, and related disciplines.

I will begin by exploring a distinction between semantic and non-semantic representation,

for my primary challenge is to explain convincingly that neural activity *can* represent non-

semantically. I will look at two types of non-semantic representation, natural and transactional.

Natural representations are already accepted as non-semantic; intrinsically, they are just causes

or effects, but *causal import* invites us to say effects *represent* their causes (or vice versa), one

being interpretable as a *sign* of the other. Natural representation, then, is only representation in

the eyes of a beholder. A transactional representation has the *intrinsic function* of representing

non-semantically. This form of representation is familiar from many business, legal, and other

social contexts, but its potential for internal, mental representation has been neglected, as has its

general application to biology.

Given these three kinds of representation, it is important for science that none of them is

arbitrarily excluded as a potential explanation for representational relationships in nature. To

that end, it will help to look at how each satisfies the most fundamental requirement for representation in biology: the exploitation by an organism of the causal structure of its world.

Semantic interpretation exploits such things as the structural resemblance between a photograph and its subject, the causal relations whereby a weathervane indicates wind direction, the social conventions whereby symbols are adopted and used – all cases in which signs have the function of representing. Except for symbols, analogous cases represent naturally rather than functionally (e.g., footprints, thunder) – but their exploitation *as signs* is semantic.

Causal structure can be exploited by organisms in several ways in addition to the semantic ones just mentioned. First, causes of the right type can trigger specific reflex-like behaviors – but I'll argue that operation is at a non-representational level. Second, causal structure can be used in transactional representation, which I will ultimately argue is the dominant use in biology.

This project must explain why, for most mental use, proxy representation is explanatorily superior both to semantic alternatives and to natural representation, given what we know about evolution, brain architecture, neural function, the training of neural networks, and more. It will also show how proxy representation can enable outwardly directed intentional states (that an ideal scientist, say, might have), giving back the outward semantics that it first takes away.

What follows is the planned organization of my project by chapter.

Introduction

I have four main objectives for this introduction. The first is to provide some historical and philosophical motivation for my project. There has been much debate in philosophy regarding knowledge of external things – from Plato's cave to the dispute between realists and anti-realists. The philosophy of science has endured its own unresolved debates over the relation between internal experience and external things (e.g., "What is observable?" "How theory-laden is

observation?"), yet most of science has been conducted under the working assumption (deliberate or not) of direct realism – roughly, the view that our perceptions, thoughts, intentions, and actions are directed toward external things that are their immediate objects. If a new theory of mental representation can resolve those debates (as I claim mine can), that would be of some benefit even if practitioners of science typically have been little concerned. But if mental representation is *not* usually intentional with respect to its external counterparts, as I will argue, then a new perspective on how science and philosophy should relate representations to externalities is urgently called for – perhaps more for the sake of science than for philosophy. Proxy representation is the foundation for that new perspective.

My second objective is an introductory discussion of semantic and non-semantic representation, including a first look at transactional and proxy representation.

My third objective is to offer some general philosophical considerations that should inform investigations into how mental representation might develop and function in a biological context – standards whereby my view can be compared with others. Among those considerations: (1) mental representation should not be prejudicially construed to be semantical in nature, since at least one other option is on hand; (2) we need criteria whereby one can judge whether a representation functions semantically or not; (3) if a mental representation's function can be explained adequately by treating it as non-semantic, there is a special onus on those who would characterize it semantically; and (4) we must avoid the confusion of shifting between the level of the organism and the level of its cognitive components when analyzing what the objects of outward actions and internal cognitive operations are.

Fourth, I will preview the main arguments to be advanced later: (1) that proxy representation is adequate to explain the success of most organisms (and most success for all organisms) to which we attribute mental representation; (2) that proxy representation is the most likely form of

mental representation to arise in evolution; (3) that proxy representation best comports with what we know about brain organization and function; (4) that most mental representations don't function as *signs* of externalities, either on traditional conceptions of signs or on the modified theory known as 'teleosemantics'; (5) that the mechanisms usually characterized as manipulating symbols syntactically are better viewed as implementing the non-semantic representations I posit; (6) that proxy representation provides a foundation for the outward semantics philosophers and scientists have been trying to establish; (7) that proxy representation readily solves key puzzles about mental representation and explains many quirks of psychological function; and (8) that proxy representation shares the advantages touted by theories in the "mental models" tradition (discussed momentarily) that regard at least some mental representation as a matter of modeling the world in some way, but – by abandoning the notion that such models typically *refer* to externalities – it provides a more satisfactory and explanatory alternative.

Chapter One

This chapter will discuss two kinds of semantic theories of mental representation. First, it will take a quick look at two popular teleosemantic attempts to naturalize proposition-like representation, advanced by Millikan (her *intentional icons*) and Dretske (his *indicators*). Next it will give a more thorough look at the "mental models" tradition from Craik (1949) through contemporary descendants. Most (if not all) of the reasons these views seem promising are due to factors that also support proxy representation. Thus, this family of views will be not only my primary foil, but a source of important arguments in favor of proxy representation.

I will focus on work by Barsalou, Grush, and Prinz, and touch on support from Johnson-Laird, Cummins, Swoyer, Metzinger, and others. Giving due credit to and explanation for these views will occupy some space. The dominant motivation for these "mental models" approaches

is pragmatic: how to deal with complex challenges in one's environment without employing im-probably difficult computational, linguistic, and/or rational cognitive operations.

A key theme is how the modeling approach answers many worries advanced by anti-representationalists, anti-computationalists, dynamical systems theorists, and others – especially those concerned with how slow neural systems are fundamentally incapable of producing ob-served behavior if they are *computing* systems rather than modeling systems. In a nutshell, struc-tural analogues such as models offer an attractive alternative to proposition-like representation because they better represent the actual, *biological* requirements and capabilities of organisms.

Each of the theorists on whom I focus approaches mental representation from a different direction. What they have in common is (1) treating at least some representations as internal *structural analogues* of externalities, and (2) treating those structural analogues as tools for deal-ing semantically with the world. While I subscribe to the notion of representations as structural analogues, I dispute the idea that they are normally used semantically.

Chapter Two

This chapter will deal with the problems facing competing views. Reviewing the quest for a semantic connection to the external world discussed in the introduction, I will consider why it has relentlessly faltered, despite centuries of brilliant work.

Teleosemantic accounts rely on the causal histories of representing mechanisms to un-derwrite outward semantics, and that is also perhaps the best defense of semantics for structural analogue theories (though the issue tends to be ignored in that camp). Those causal histories play two important roles in this philosophical debate. Most importantly, they explain the biological function of representational mechanisms and how they developed. They also serve admirably as a *ground* for outside interpreters to treat mental representations as signs, comparable to the caus-

al grounds available for natural representations; that is, causal histories have *causal import* for outside interpreters, just as natural representations do.

I will show how the standard evolutionary story for mental representation never properly accounts for representational semantics. Biological mechanisms in typical circumstances produce typical responses, and appealing to this fact in the case of representational mechanisms justifies teleological claims of representational function – but it's another thing to claim such representation is semantic. Deploying objections by Fodor, Godfrey-Smith, Akins, and Cummins, I will argue that claims of outward semantics for mental representation have been unjustified.

Finally, I will present a negative case against mental representations typically functioning as *signs* of externalities ... rebutting traditional views, teleosemantic ones, and current structural analogue proposals alike.

Chapter Three

Here I provide a more detailed account of transactional representation in general and proxy representation in particular.

Transactional representation allows an organism to exploit analogues that are structurally similar (physically or causally; usually both) to things in the world, in a way that bears on its success in interactions important to its fitness. It is helpful to focus on the term "representative" rather than "representation", for the representational relation is one of replacement, substitution, surrogacy, etc. As far as a legal adversary or a potential employer is concerned, an attorney or business agent bears this kind of relation to his or her client. At a simpler level, biological mimicry provides helpful exemplars: a walking stick insect exploits the structural analogy between its body's appearance and common twiggy components of its environment; and an angler fish exploits the structural analogy (including some behavioral elements) between its lure and certain

characteristic food for its own prey. In general, the "owner" of the representative benefits in transactions with an external entity when a sub-system uses the analogue in its representative role. In these examples, the using sub-system belongs to the external entity.

Proxy representation is the mental variety of transactional representation, and differs from the previous examples in that the using sub-system is internal to the owner of the representative. "Proxy" could just as easily apply to non-mental surrogates such as my attorney, but I will treat it as a technical psychological term. A proxy representation corresponds to some kind of external thing because of *non-semantic* causal relations determining the evolution and training of representational mechanisms and their activation by sensory inputs.

I will explain how the two basic forms of mental representation, signs and proxies, fulfill entirely different roles within a cognitive economy. Signs enable a cognitive system to entertain thoughts, beliefs, intentions, etc. about external things, and ultimately to direct behaviors, intentionally, toward those things. Proxies serve to *bypass the need* for such outwardly directed mental states and intentionality, functioning as internal "useful imposters" that are themselves the objects of thoughts, beliefs, intentions, etc. Though it may seem strange to claim that intentions are "displaced" from external entities (having real biological significance) to internal "imposters", I will offer examples of this, ranging from biological states such as hunger and libido to the familiar movement of the cursor on a computer screen and less familiar complex virtual realities.

I will propose a rough model of how proxy representation might be implemented in brains like ours, characterizing the process as maintaining activity within a complex associational network of neuronal populations, each one trained to be a proxy for some object, type, property, relation, schema, etc. – these both serving as inputs for some kind(s) of control module (especially attentional ones) and priming certain behavior-generating module(s). This network has the

general structure (but not the semantics) of the semantic networks proposed by psychologists Collins and Loftus and others.

Overall, activity within the network looks like a complex damped oscillator, driven by either sensory inputs or attentional ones (typically both), with shifting emphasis among currently active components (leaving available components representing factors not relevant to the immediate situation "idling" at or near base firing rates). The overall architecture of the system provides something like a construction kit from which all experience (and all behavior) is generated on the fly, driven by sensory inputs and/or attentional ones. That architecture is determined first by inherited constraints, then by unsupervised training during development under ordinary sensory stimuli. All this is part of a larger dynamical system comprising not only proxy representations but the cognitive modules using them to generate behavior, motor systems producing behaviors directly, affective mechanisms, and others – perhaps even sensory inputs.

I will discuss recent research on the capabilities of neural networks and on the architecture and development of the brain, which points away from notions of semantic representation and toward the training and dynamic use of internal structural analogues of externalities. It appears that the function of neural systems in representational and associational cortex (and other brain areas) is not likely computational; instead, activity there is *itself* the functional role, constituting at any given moment the components of "content" for other subsystems responsible for attention, consciousness, and propositional attitudes – a "virtual reality" (as Metzinger describes it) for those systems, constituting an immediate world of experience.

Last, I will explain how proxy representation can naturally emerge evolutionarily from simpler systems serving as triggers for reflex-like behaviors, and how it may develop and function using primarily the well established low-level mechanism of modified Hebbian association.

Chapter Four

The purpose here is threefold: (1) to answer anticipated objections; (2) to catalog the many explanatory advantages of proxy representation with respect to traditional philosophical puzzles and well established psychological phenomena, and (3) to show proxy representation's salutary implications for many fields within science and philosophy.

I will explain in particular why common objections (especially anti-Cartesian ones) against pictorial theories of mental representation simply don't apply to proxy representation.

The puzzles discussed will include a number catalogued by Block, Prinz, and others. Among the well established psychological phenomena, it is worth taking special note that on this view psychological priming is more than an interesting phenomenon. It is a fundamental organizational strategy for proxy representation.

Among the implications for science and philosophy are answers to key questions or problems mentioned in the introduction ... for example, that all we ever observe is in the inner world of proxy representations and derivative counterfactual imagery and memories, so philosophically scrupulous talk of scientific investigation should eschew claims of outward observation and rely instead on inferences based on a theoretical understanding of (and trust in) proxy representation. Also, conundrums in the philosophy of language and of mind (e.g. "Twin Earth" problems of mental content and "Norma Jean" problems of reference) are readily dispelled.

I will discuss some benefits my view offers to biology, psychology, medicine, cognitive science, artificial intelligence, and robotics. Either the notion of proxy representation itself or the functional architecture and organization I suggest might implement it will offer new perspectives on the nature of consciousness; the content of dreams; the status of folk psychology (and elimi-

nativism); the perplexing and often infuriating vagaries of real human inference (and the difficulty people have with formal logic); the late acquisition of concepts such as color; streams of consciousness, and more.

Conclusion

In addition to recapitulating conclusions already drawn, I will place them in perspective in several ways. First, I will review why the mental models tradition should be reconceptualized, treating models as transactional rather than semantic.

Second, I will examine how mental representations are often treated unconsciously as *metaphors* for what they represent, when the proper thing is to treat them as *analogues* instead. The difference is that metaphors are treated in a way as *being* the represented, while analogues are simply structurally similar to their counterparts, and may be exploited without anything like knowledge of that fact. When ordinary people talk and act as though they are dealing *cognitively* with external things rather than with internal representations of them, they are engaging in metaphor. That won't do for science or philosophy.

Third, I will explain why the notions of *sensory information* and *perception* (specifically and most commonly, *exteroception*) are mistaken.

Fourth, I will show how proxy representation makes sense of the attractiveness of phenomenalism, idealism, realism, and constructivism.

Finally, I will offer both a strong conclusion (that proxy representation is the only viable theory of mental representation) and a weaker one (that proxy representation is an eminently plausible account of mental representation, even better than the "mental models" approaches, and that it deserves serious consideration and exploration).

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