Levels and the Relationship between Psychology and Neurobiology

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Abstract

In this paper I offer a framework for understanding the relationship between psychology and neurobiology. I begin by considering Lycan's account of this relationship: the psychological occupies a higher level than the neurobiological in a hierarchy of levels of nature. On this account, the move from the psychological to the neurobiological is made via a process of decomposing higher level entities into lower level ones. I discuss one problem with Lycan's account, and then outline an alternative model. In the account that I offer, levels of organization and levels of explanation are used to create a two-dimensional framework. The result of employing this framework is that the psychological turns out to be a particular way of describing the activities that occur at the cellular and molecular levels of organization.

Lycan's Account

A psychological capacity can be decomposed into component parts and each of these components can themselves be similarly decomposed. Reiterating this process a number of times we are left with neurobiological and neurochemical entities—and if we continue, to lower level entities (Lycan 1987, see also 1981, 1991).

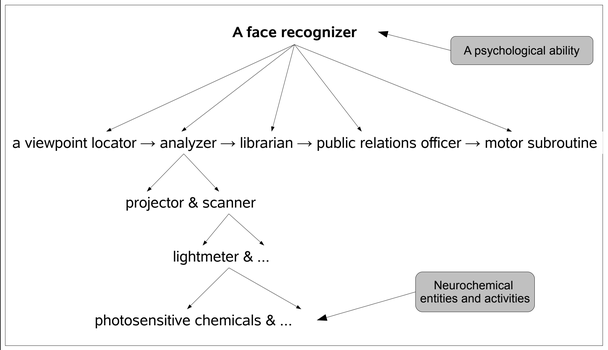


Figure: Lycan's example of the decomposition of a face recognizer. These (hypothetical) levels are set within the larger hierarchy of the levels of nature.

Three foundational commitments of Lycan's account

(1) Teleology: The function of a psychological capacity is the purpose of that capacity with the understanding that this purpose has been selected by natural selection.

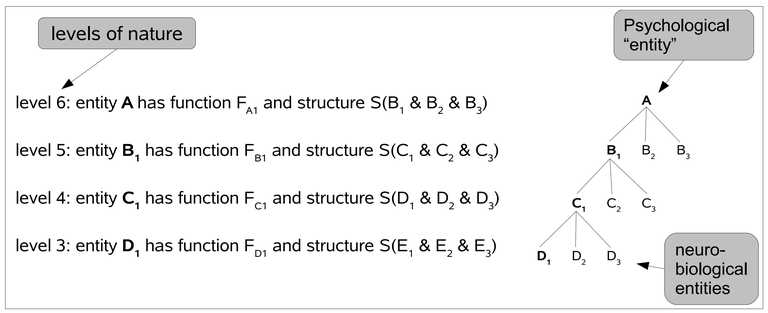
(2) Homuncular functionalism: Psychological capacities can be decomposed into simpler components, i.e., a set of homunculi that together perform the psychological function. Each of these homunculi can then be decomposed into another set of homunculi and so on.

(1) and (2) combined: At higher levels the entities have clear teleological characterizations. As the decomposition proceeds downward, the characterizations become less teleological until they are just mechanical (i.e., relatively non-teleological).

(3) Levels of nature: Organisms are composed of cells, cells are composed of molecules, molecules are composed of atoms, etc. At any particular level the constituents of that level can be explained functionally, by referring to their purpose, or structurally, by referring to their constitutive parts, which occupy a lower levels of nature.

Lycan's model

Lycan's claim is that homuncular functionalism and levels of nature fit together; "for single organisms, degrees of teleologicalness of characterization correspond rather nicely to levels of nature" (1987, p. 45).



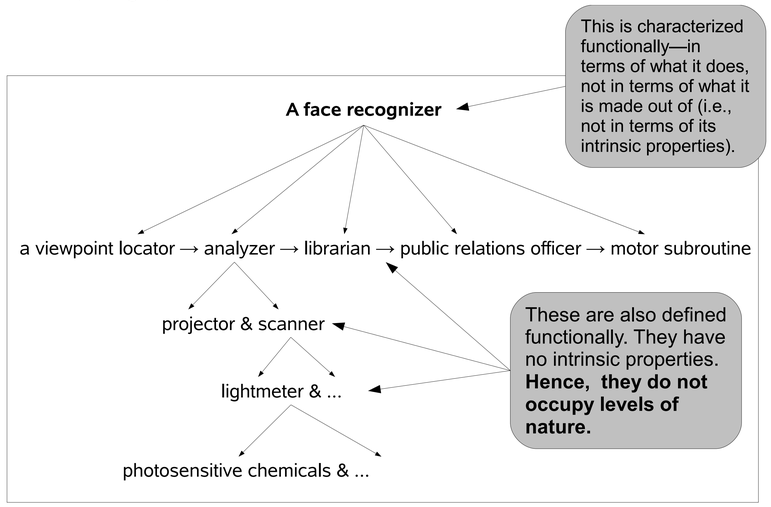
The psychological, which are "highly teleological characterizations" at the top of the homuncular functionalism hierarchy, occupy a higher level of nature.

As characterizations are offered that are less teleological—that is, as we decompose mental capacities via homuncular functionalism—we move to lower levels of nature, eventually reaching a level occupied by neurobiological entities.

Problem

Homuncular functionalism cannot be mapped onto the hierarchy of levels of nature.

Lycan justifies this move by understanding psychological capacities (and, at least for a few levels, the components that they can be decomposed into) as teleological. For Lycan, *being teleological* means that every component, including psychological capacities, must have functional as well as intrinsic (i.e., non-relational) properties—*what the component does* as well as *what stuff it is made out of*. But this does not accurately represent the situation (see figure).



Because the "entities" at each level do not have both functional and intrinsic properties—most do not have intrinsic properties—the decomposition fails. Thus, we do not have an explanation of the relationship between the psychological and the neurobiological.

A Two-Dimensional Model

My account uses levels of organization and levels of explanation to understand the psychological and its relationship to the neurobiological.

Employing levels of organization and levels of explanation gives us the ability to keep separate:

(1) the levels that we use to order things and activities that are found in nature, and

(2) the various ways that we have of describing those things that are found in nature.

Ordering the entities and activities that are found in nature is done using **levels of organization**.

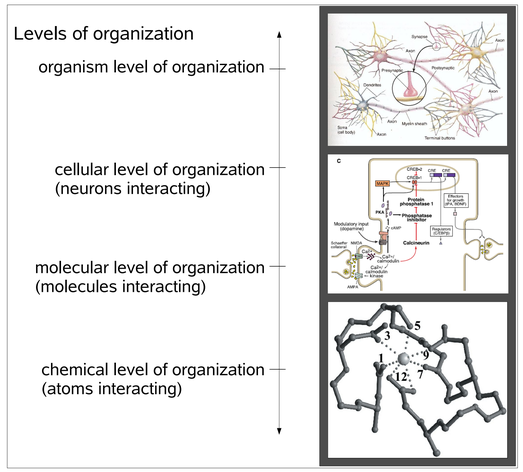
Displaying the different ways we have of describing the things that are found in nature is done using **levels of explanation**.

Levels of organization

Two features of levels of organization are:

(1) Composition orders the levels in the hierarchy: the entities at one level are composed of the entities found at lower levels.

(2) Interaction among entities—in particular, stable and regular interactions—identifies the levels.



Wimsatt: Nature is, at least to an extent, organized in terms of levels that are "local maxima of regularity and predictability [of interactions] in the phase space of alternative modes of the organization of matter (2007, p. 209).

Figure: the levels of organization that fall within the scope of the brain.

Levels of explanation

Marr (1982): there are at least a few different ways of explaining a single process. Each of his levels of explanation is occupied by a different type of description of the same process.

The highest of Marr's levels is the **level of the computational theory:** the description of what the process does (or what kind of process it is). E.g., face recognition is an ability that humans have, and a theory of this ability would explain what this ability is exactly.

The middle level of explanation is the **level of the representation and algorithm:** the procedures or operations that carry out the computational task.

The lowest level of explanation is the **level of hardware implementation:** a description of the physical mechanism that carries out the capacity.

For mental capacities, the levels of explanation are:

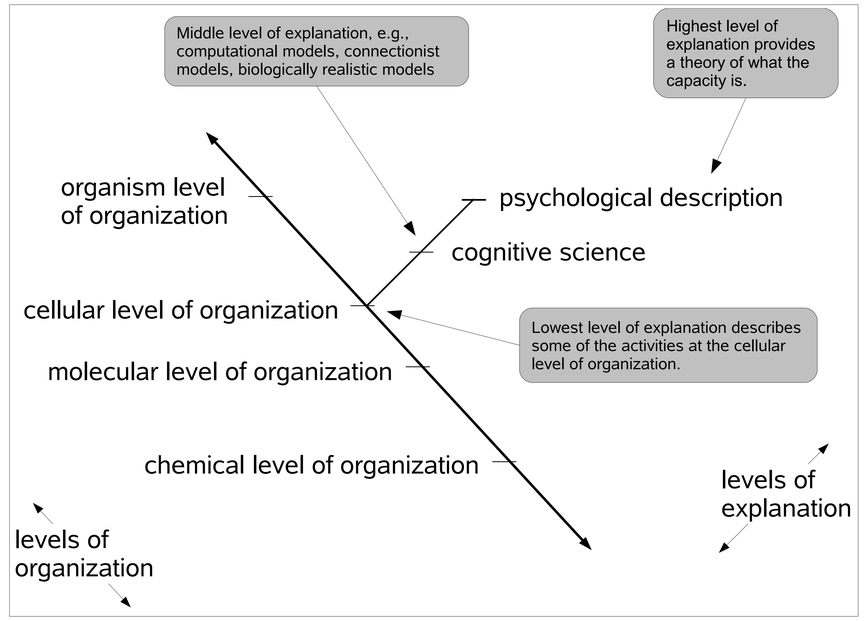
— Psychological description of a capacity, i.e., a theory of the capacity (Level of the computational theory)

— Cognitive modeling: Classical computational models, connectionist models, or biologically realistic models (Level of the representation and algorithm)

— Neurons interacting (Level of the hardware implementation)

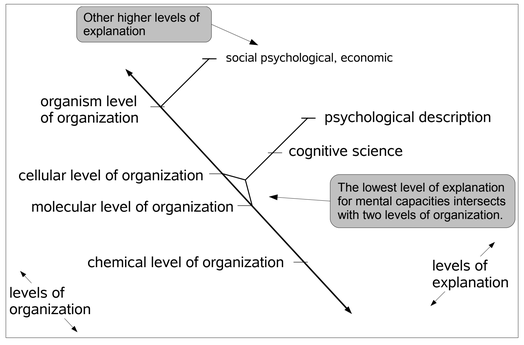
The two-dimensional model

Combining the hierarchies of levels of organization and levels of explanation we get the framework shown in the figure below.



Psychological descriptions do not occupy a level of organization—besides the levels of organization for neurons. Rather, the psychological is a type of description, which although it may appear distinct from the activities found at the cellular level of organization is not, and moreover, cannot be. This, then, is the relationship between psychological descriptions of capacities and neurobiology that this model generates.

Higher levels of explanation, in particular psychological descriptions, are just a different way of describing what is occurring at the cellular level of organization. Psychological descriptions draw on a particular set of resources and, hence, generate a particular kind of description, but are, nevertheless, just descriptions of those activities that occur at the cellular level of organization.



Although there are good reasons to think that psychological capacities are carried out by the activities at the cellular level, there are also important aspects of psychological processes that are carried out by the entities at the molecular level of organization, in particular the processes that allow for plasticity at the cellular level. The more detailed model is shown in this figure (left).