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Integrating mechanistic explanations through epistemic perspectives

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ABSTRACT

Talk of *levels* is ubiquitous in philosophy, especially in the context of mechanistic explanations spanning multiple levels. The mechanistic conception of levels, however, does not allow for the kind of integration needed to construct such multi-level mechanistic explanations integrating observations from different scientific domains. To address the issues arising in this context, I build on a certain *perspectival aspect* inherent in the mechanistic view. Rather than focusing on compositionally related levels of mechanisms, I suggest analyzing the situation in terms of *epistemic perspectives* researchers take when making scientific observations. Characterizing epistemic perspectives along five dimensions allows for a systematic analysis of the relations the scientific observations made from these different epistemic perspectives. This, in turn, provides a solid foundation for integrating the mechanistic explanations that are based on the scientific observations in question.

1. Introduction

Talk of "levels" is ubiquitous in philosophy, especially in the context of mechanistic explanations. The basic idea behind mechanistic explanations is that complex phenomena such as action potentials, memory, attention, delusions, or language processing are explained by the mechanisms that underlie, produce, or maintain them (Bechtel & Abrahamsen, 2008; Bechtel, 2008; Craver, 2007a; Craver & Darden, 2013; Craver & Tabery, 2015). [1] This is true for both causal and constitutive readings of mechanisms (see Illari & Williamson, 2012; Kaiser & Krickel, 2017). According to the causal reading (e.g., Glennan, 1996), mechanistic explanations are essentially causal in nature. According to the constitutive reading, on which I will focus in the current paper, mechanistic explanations are an inherently interlevel affair. They describe the temporally organized activities of spatially organized components within a (lower-level) mechanism that jointly constitute the (higher-level) phenomenon to be explained (e.g., Bechtel, 2008; Craver, 2007a; Craver & Darden, 2013). This view is specifically tailored to the neurosciences and life sciences where mechanistic explanations often span multiple different levels: from the behavior of whole organisms to the nervous system all the way down to cellular and molecular processes.

Constitutive mechanisms capture an important feature of how scientists describe and investigate the world, namely that observations from different scientific domains can be combined into a coherent multi-level picture. For instance, cognitive scientists try to account for cognitive phenomena (such as memory) in terms of neural processes in the brain (such as long-term potentiation). Likewise, psychiatrists may refer to genetic factors to explain patient behavior, and medical doctors may refer to cellular processes to explain the systemic effects of drugs. In all of these cases, phenomena occurring in one domain (usually referred to as "at a higher-level") are accounted for in terms of processes occurring in another (usually referred to as "at a lower-level").

While this sounds intuitive, it is important to note that the conception of levels mechanists use is quite different from scientific fields or domains. The basic idea behind *levels of mechanisms* is that complex wholes are located at higher levels than the component parts that make up the whole. Still, most mechanists will readily agree that insights from various domains feed into coherent "multi-level" explanations—or, to use Craver's (2007a) phrase, a *mechanism mosaic*. However, there is no single absolute hierarchy, no layer-cake of mechanistic levels. Rather, levels of mechanisms are a strictly *local* affair (e.g., Craver, 2007a, ch.5; 2015). We can only determine whether something is at a higher or lower level with respect to any given mechanism. There is no way of saying, for instance, that NMDA receptors in the hippocampus, say in regions CA1 and CA3, are at the same mechanistic level just because they

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[1] I will here work with a non-technical notion of phenomenon. But much can be said on what "phenomena" are and different kinds of phenomena mechanisms explain. For discussions see Feest (2017) and Kästner (2016b).

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are alike things that are components in similar mechanisms. This seems not only inadequate against the background of scientific practice; the strict locality of levels of mechanisms also gets into the way of constructing multi-level mechanistic explanations (e.g., Fazekas & Kertész, 2011; Eronen, 2013). Put in a nutshell, the reason is this: if things can only be said to be on the same mechanistic level when they are components in *the same* mechanism, and at different levels when they are related as mechanism and component, we cannot say anything about how different mechanisms or components in different mechanisms are related (see Section 2). However, relating different mechanisms and integrating them with one another is essential to building complex multi-level explanations.

The challenge for mechanistic explanations thus is to avoid problems with interlevel integration raised by levels of mechanisms as they are currently conceived while preserving the plausible multi-level character of constitutive mechanistic explanations. To achieve this, a better understanding of how we might integrate various scientific observations into multi-level mechanistic explanations is needed. Since levels of mechanisms are not up to the task, I suggest analyzing the situation in terms of the *perspectives* scientific observers take instead.

Thinking about perspectives in the context of scientific observations is not new. They feature in traditional discussions in the philosophy of mind as well as in recent philosophy of science. In fact, there is even a certain perspectival aspect inherent in the mechanistic view (see Section 3). Fleshing this out in more detail, I provide an empirically adequate account of perspective that can (i) help us gain a deeper understanding of the explanatory practices we encounter in science and (ii) be fruitfully applied to construct multi-level mechanistic explanations. Rather than talking about hierarchically or compositionally related levels of mechanisms while emphasizing the downward-looking character of mechanistic explanations, I argue, we should analyze mechanistic explanations spanning multiple domains of investigation in terms of *epistemic perspectives*.

Put briefly, epistemic perspectives can be considered as filters offering different ways of accessing and describing things in the world. The tools and paradigms a researcher uses, her skills, the background theories she assumes, as well as her explanatory concerns jointly determine her epistemic perspective. I will propose characterizing epistemic perspectives with respect to five dimensions: (i) the temporal and/or spatial *resolution*, scale, or grain of observations they permit, (ii) their *specificity*, i.e., which kinds of things can be detected, (iii) the overall *point of view* from which observations are made (given the background theories and taxonomies assumed), (iv) which *variables* can be measured directly and which *proxies* are used for indirect *measurements*, and (v) which portion or aspect of a phenomenon can be studied, i.e., the observation's *scope* (see Section 4).

Describing epistemic perspectives along dimensions (i)-(v) enables us to relate scientific observations without tapping into the problems mechanists currently face in the context of interlevel integration. Besides, it allows us to consider how observations from different epistemic perspectives work together in mechanism discovery. Finally, allowing for various possible relations between epistemic perspectives, rather than focusing on composition only, accommodates for the methodological variety we find in the sciences. Epistemic perspectives thus help to provide an empirically realistic understanding of how mechanistic explanations spanning multiple domains are reached; and this understanding is grounded in the empirical reality of scientific practice while it avoids the problems associated with levels of mechanisms.

I proceed as follows: Section 2 briefly reiterates how "levels of mechanisms" are defined in the literature and the resulting problems for multi-level mechanistic explanations. Since these problems bear structural similarities to level-problems in other branches of philosophy, specifically in the philosophy of mind, I believe epistemic perspectives may also be fruitfully applied elsewhere; for current purposes, however, the focus shall be on mechanisms. Section 3 motivates thinking about perspectives rather than levels to capture different ways of accessing and describing things in the world. Section 4 introduces the notion of *epistemic perspectives* and explains how it supports the integration of mechanistic explanations into a mechanism mosaic. Section 5 replies to some worries, and Section 6 concludes.

2. Levels of mechanisms: the notion and its challenges

A variety of ideas find shelter under the notion of "levels". According to the perhaps most common conception, levels sort nature into a general hierarchy based on the size or scale of things, classic mereology, or composition. The gist of these views is that entities get bigger as we move up the level hierarchy while small things get tied together to make up bigger things (e.g., Findlay & Thagard, 2012; Oppenheim & Putnam, 1958; Potochnik & McGill, 2012). Similarly, one may speak of levels in terms of complexity or organization (e.g., Bechtel & Richardson, 1993; Eronen, 2015; Wimsatt, 1976): as we look from lower to higher levels complexity increases and different organizational principles are robustly in place. Another well-known conception of levels is exemplified by Marr's (1982) work on the visual system. Marr suggests that we can analyze a system at three different levels (computational, algorithmic, and implementational) depending on what exactly we are interested in (what the system's function is, the algorithm by which it achieves it, and how this is implemented).[2]

Mechanists work with yet another conception of levels. Recognizing that the world is much more complex than a universal hierarchy can plausibly capture, they conceive of *levels of mechanisms* as strictly *local* (see Craver, 2007a, ch. 5; 2015; Kaplan, 2015). According to the mechanist, "there is no unique answer to the question of when two items are at the same mechanistic level" (Craver, 2015, p. 19). Levels of mechanisms do not cut nature at its joints. At which level a given entity is located cannot be determined in absolute ways. It is not the case, say, that all neurotransmitters are at a neurophysiological level or that all cognitive processes are at a cognitive level. Instead, levels of mechanisms are *relative* to any given mechanism. Levels of mechanisms are "defined fundamentally by the relations question: by the componency relationship between things at higher and lower levels" (Craver, 2015). The components of a mechanism are its *constitutively relevant* part; constitutive relevance can be established using the so-called *mutual manipulability criterion* (MM). MM provides a sufficient condition for *constitutive relevance*, which is that "one can wiggle the behavior of the whole by wiggling the behavior of the component and one can wiggle the behavior of the component by wiggling the behavior as a whole" (Craver, 2007a, p. 153).[3] Thus, interlevel relations between components and their mechanisms are a species of part-whole relations defined only locally for any given case. Phenomena at higher levels of mechanisms are constituted by the acting entities (i.e., the components in the mechanism) at lower levels of mechanisms. Importantly, though, phenomena are more than merely the sum of their parts; mechanistic components must

[2] A full discussion of different notions of levels is beyond the scope of this paper. But see Wimsatt (1976) and Craver (2015) for overviews.

[3] Harinen (2018) convincingly argues that for MM to be plausible we must consider manipulability in each direction *individually necessary*. Krickel (2018) holds that MM is best understood as *both* necessary *and* sufficient.

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