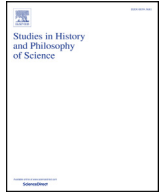




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## Saving the mutual manipulability account of constitutive relevance

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## ABSTRACT

Constitutive mechanistic explanations are said to refer to mechanisms that *constitute* the phenomenon-to-be-explained. The most prominent approach of how to understand this relation is Carl Craver's mutual manipulability approach (MM) to constitutive relevance. Recently, MM has come under attack (Baumgartner and Casini 2017; Baumgartner and Gebharter 2015; Harinen 2014; Kästner 2017; Leuridan 2012; Romero 2015). It is argued that MM is inconsistent because, roughly, it is spelled out in terms of interventionism (which is an approach to causation), whereas constitutive relevance is said to be a non-causal relation. In this paper, I will discuss a strategy of how to resolve this inconsistency—so-called *fat-handedness approaches* (Baumgartner and Casini 2017; Baumgartner and Gebharter 2015; Romero 2015). I will argue that these approaches are problematic. I will present a novel suggestion for how to consistently define constitutive relevance in terms of interventionism. My approach is based on a causal interpretation of manipulability in terms of causal relations between the mechanism's components and what I will call *temporal EIO-parts* of the phenomenon. Still, this interpretation accounts for the fundamental difference between constitutive relevance and causal relevance.

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## 1. Introduction

Defenders of the new mechanistic approach highlight the importance of so-called *constitutive* mechanistic explanations for the life sciences and other special sciences. Constitutive mechanistic explanations are taken to explain a phenomenon in terms of a mechanism that *constitutes* the phenomenon (Bechtel, 2008; Bechtel & Abrahamsen, 2005; Craver, 2007b; Craver & Darden, 2013; Illari and Williamson 2012; Machamer, Darden, and Craver 2000). A standard view is that this constitution-relation is a *non-causal dependency relation* that holds between parts (the mechanism's components) and a whole (the phenomenon). According to Carl Craver's popular mutual manipulability approach (MM), this non-causal dependency relation is to be analyzed in terms of *mutual manipulability* between the phenomenon's parts and the phenomenon (Craver, 2007b, p. 153), where mutual manipulability is spelled out in terms of Woodwardian *interventionism* (Woodward, 2003).

At a first glance, MM captures many aspects of the explanatory and experimental practice of the life sciences, especially the practice of interlevel experiments (Craver, 2002; Kaplan, 2012; Romero, 2015). Still, recently different authors have argued that MM is problematic because of its attempt to spell out a non-causal

dependency relation in terms of interventionism (Baumgartner & Casini, 2017; Baumgartner & Gebharter, 2015; Harinen, 2014; Kästner, 2017; Leuridan, 2012; Romero, 2015). This is problematic because interventionism draws on the notion of an *ideal* intervention. Ideal interventions have to satisfy what may be called the *transmission condition*<sup>1</sup>: in order for an intervention *I* into a variable *X* with respect to some other variable *Y* to be ideal *I* must change *Y* only indirectly *via X*. Michael Baumgartner and Alexander Gebharter (2015), Baumgartner and Lorenzo Casini (2017), Felipe Romero (2015), and Lena Kästner (2017) show that this condition is violated by interventions into phenomena with respect to their mechanistic components. These variables are necessarily *fat-handed*,<sup>2</sup> i.e., they change the component-variable on a causal path that does not go through the phenomenon-variable. As a consequence, ideal interventions into phenomena that are constituted by mechanisms are impossible. Hence, interventionism cannot be applied to constitutive relations. Therefore, MM fails.

There are different ways to react to this problem. One way is to simply reject the whole endeavor of trying to spell out constitution in term of interventionism. For example, Couch (2011) and

<sup>1</sup> There a further conditions; see Woodward (2003, 89), and Craver (2007b, 154).

<sup>2</sup> Woodward characterizes interventions as fat-handed if they affect "not just *X* and other variables lying on the route from *I* to *X* to *Y*, but also other variables that are not on this route and that affect *Y*" (Woodward, 2008, p. 209).

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Harbecke (2010) defend a regularity account of mechanistic constitution. Gillett (2013) argues that his dimensioned realization approach best accounts for mechanistic constitution. Gebharter (2016) investigates to what extent the PC algorithm, that was originally developed for detecting causal relations, can be used to discover constitutive relevance relations. Kästner (2017) suggests non-interventionist research strategies to distinguish causal from non-causal dependency relations. Another strategy is to interpret constitutive explanation as a variant of causal explanation (Harinen, 2014; Leuridan, 2012), and thereby reject the fundamental difference between causation and constitution and between causal and constitutive explanation.

In this paper, I want to focus on a rescue strategy that maintains the idea of using interventionism to spell out constitution but that respects the fundamental difference between causation and constitution. It has been suggested by Baumgartner and Gebharter (2015), Baumgartner and Casini (2017), and (independently) by Romero (2015). These authors exploit the notion of a *fat-handed intervention* for the purpose of providing a positive account of constitution. Both accounts rely on different formulations of a *fat-handedness criterion* that interventions have to satisfy in order to allow for inferences to constitution. In this paper, I want to analyze the two *fat-handedness approaches* and their differences. I will argue that both approaches fail for different reasons. Instead, I will provide a novel rescue strategy for MM. According to the account I will introduce here, mutual manipulability can be analyzed in terms of causal relations between a mechanistic component and what I will call *temporal EIO-parts* of the constituted phenomenon. Still, the account maintains the fundamental distinction between constitution and causation.

The paper proceeds as follows: in Section 2, I will introduce the general idea of constitutive mechanistic explanation and Craver's mutual manipulability account. In Section 3, I will present the problems that arise when combining constitutive relevance and interventionism in more detail. I will argue that in order to solve the problems two challenges have to be met. First, one has to provide a notion of an intervention that allows for inferences to causation without rendering constitutive relations causal. Second, one has to show how constitutive relevance can be spelled out in terms of interventionism. In Section 4, I will discuss different strategies for meeting the first challenge. In Section 5, I will present answers to the second challenge. I will first (5.1) present and criticize approaches based on fat-handedness. Then (5.2), I will present my own account. Section 6 concludes.

## 2. Constitutive explanations, mechanisms, and mutual manipulability

Different characterizations of mechanisms have been suggested. Despite their differences, one common assumption is that mechanisms consist of entities/parts/objects and their activities/interactions/operations in a certain organization (Machamer, Darden, and Craver 2000; Craver, 2007b; Illari and Williamson 2012; Craver & Darden, 2013; Glennan, 2017). Based on this characterization, usually two kinds of mechanistic explanations are distinguished (Craver, 2007b; Salmon, 1984): first, in *etiological* mechanistic explanations, a phenomenon is explained by the mechanism that *causes* it. Second, in *constitutive* mechanistic explanations, a phenomenon is explained by the *underlying* mechanism. Here, mechanism and phenomenon are not related by causation. Rather, the mechanism is taken to *constitute* the phenomenon.

One prominent example of a constitutive mechanistic explanation is the explanation of spatial memory. Spatial memory is often investigated by observing mice navigating the Morris water maze (a pool filled with an opaque liquid; the mouse is supposed to

find a platform that is hidden under the surface of the liquid). Spatial memory is usually described as being instantiated in the mouse's navigating the Morris water maze (the phenomenon), and the mouse's hippocampus generating spatial maps is supposed to be a component of the mechanism responsible for the navigation behavior (Bechtel, 2008; Bechtel & Richardson, 2010; Craver, 2007b). Other examples of phenomena that are constitutively explained are the action potential (Craver, 2007b, pp. 114–22), the human heart pumping blood (Bechtel & Abrahamsen, 2005, p. 425; Bechtel, 2006, pp. 29–30; Glennan, 2010, p. 257; Craver & Darden, 2013, pp. 98–117), a cell synthesizing proteins (Machamer, Darden, and Craver 2000; Darden, 2002; Craver & Darden, 2013), and long-term potentiation at synapses of neurons (Machamer, Darden, and Craver 2000, 8–11; Craver & Darden, 2001, 2013, pp. 115–17, pp. 167–72; Craver, 2007b, pp. 65–72) (see also Kaiser and Krickel (2016)).

What exactly does it mean to *constitutively* explain a phenomenon? When does a mechanism *constitute* a phenomenon? Craver illustrates the notion of this constitution-relation with the help of the following figure (Fig. 1):

According to Craver, “S's  $\Psi$ -ing is explained by the organization of entities  $\{X_1, X_2, \dots, X_i\}$  and activities  $\{\Phi_1, \Phi_2, \dots, \Phi_n\}$ ” (Craver, 2007b, p. 7). “S” refers to the mechanism as a whole;  $\Psi$  is the behavior of S that is to be explained. The Xes represent the entities that are components of the mechanism, and the  $\Phi$ s are the activities performed by the entities. The arrows stand for the different interactions between the Xes'  $\Phi$ -ings. Although the picture alone cannot provide a full understanding of what constitutive explanations are, it provides us with some information: first, the phenomenon and the mechanism occur at the same time (indicated by the fact that the phenomenon is located above the mechanism). Second, the relation between the mechanism and the phenomenon is not causal (indicated by the dotted lines; causal relations are represented as arrows). Both assumptions are commonly accepted among the new mechanists (Baumgartner & Casini, 2017; Baumgartner & Gebharter, 2015; Craver, 2007b; Leuridan, 2012; Romero, 2015).

What exactly is the relation between the mechanism/the mechanism's components and the phenomenon, if it is not causal? According to Craver (2007b; 2007a), in constitutive mechanistic explanations one refers to components of mechanisms that are *constitutively relevant* for the phenomenon. Constitutive relevance,

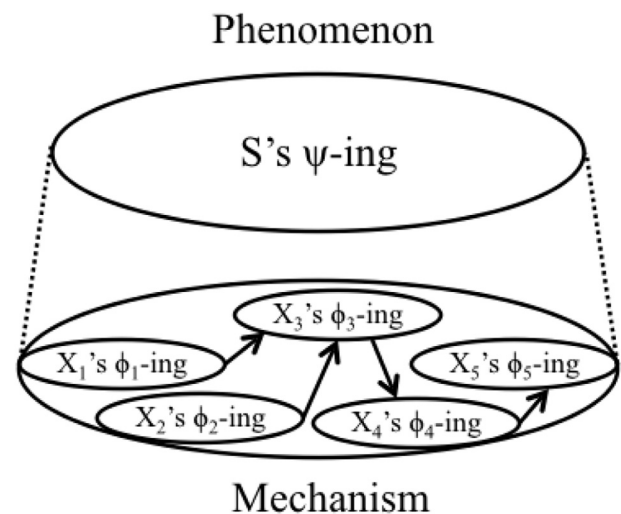


Fig. 1. Mechanisms that constitute phenomena according to Craver (adapted from Craver, 2007a, p. 7).

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