Manipulating the Contents of Consciousness
A Mechanistic-Manipulationist Perspective on Content-NCC Research

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Abstract

I argue for a manipulationist-mechanistic framework for content-NCC research in the case of visual consciousness (Bechtel 2008; Neisser 2012). Reference to mechanisms is common in the NCC research. Furthermore, recent developments in non-invasive brain stimulation techniques (NIBS) lend support to a manipulationist standpoint. The crucial question is to understand what is changed after manipulation of a brain mechanism. In the second part of the paper I review the literature on intentionalism, and argue that intervention on the neural mechanism is likely to change the intentional content of consciousness. This urges us to shift from content-NCC to what I call "intentional mechanisms". Such mechanisms, it is argued, should be understood as neural prerequisites of conscious visual experience.

Keywords: Consciousness; Manipulationism; NCC; Visual Experience; Intentionalism; NIBS; Mechanisms; Explanation.

Introduction

In the last years, we have witnessed a spurt of progress in the search for the neural correlates of consciousness (NCC). The growing scientific literature seems to suggest that, in the next years, non-invasive brain stimulation techniques (NIBS) will play an important role in NCC research (e.g. de Graaf & Sack 2014).

In this paper I focus on the search for content-NCC, i.e. the neural correlates of a specific conscious experience, the content of consciousness. Specifically, I narrow down my attention to NCCs of the *visual* contents of consciousness. This set of experiences embraces, for example, seeing something red, seeing an object, and so on.

Following the suggestion of Neisser (2012), I argue that NIBS urges us to rethink Chalmers's received view on content-NCC. However, in contrast with Neisser who suggests adopting Craver's (2007) account of explanation in neuroscience, I put forward Bechtel's (2008) account of mental mechanisms.

In the first section I outline the new frontier of NCC research through NIBS. In the second section I show how the received view should be changed, moving toward a manipulationist-mechanistic approach. This raises the challenge of understanding what is actually changed through manipulation of the neural machinery. I finally argue that what is changed is the intentional content of consciousness. Research on content-NCC does not target consciousness. The mechanisms behind the contents of visual consciousness should be understood as neural prerequisite of conscious vision. I call such systems "intentional mechanisms". In the final section, I briefly draw attention to some implications for future researches.

NIBS and NCC research

In his account of explanation in neuroscience, Craver (2007) observes that neuroscience is mainly driven by two goals. The first goal is explanation. Under this goal we group researches about how the brain develops from infancy to adulthood, how memory is realized by the brain, and so on. The second goal is to control the brain. Under this goal we find the attempt to diagnose and treat neural diseases, for example.

These two goals are also visible in neuroscience's search for NCCs. One goal is to explain consciousness, whilst the other is to manipulate and control brain mechanisms that implement our conscious experience. Intervention on the NCCs might prove helpful not only for diagnostic purposes, but also in locating them (e.g. Koubeissi et al. 2014; Parivizi et al. 2012). Furthermore, manipulating brain mechanisms somehow related to conscious experience can help us moving from a mere correlation to causation (Koch 2004: 100), thus helping us explaining consciousness. Finally, in a recent review paper, de Graaf & Sack (2014) highlight the role of NIBS techniques in disentangling neural prerequisite, substrates, and consequences of conscious experience (e.g. Aru et al. 2012; de Graaf et al. 2012).

Among NIBS techniques we find transcranial magnetic stimulation (TMS), and transcranial electric stimulation (TES), which includes transcranial direct current stimulation (tDCS) as well as transcranial alternating current stimulation (tACS). In the search for NCCs, NIBS does not represent an alternative, but a valuable complement to refined neuroimaging techniques (e.g. Friston 2011). The reason is simple: whilst a regional BOLD response in fMRI cannot tell us whether the neural processing is «imperative for the task at hand» (de Graaf & Sack 2014: 6), manipulating a specific brain mechanism thanks to NIBS might change the corresponding conscious percept. If manipulation of a mechanism disrupts or elicits a conscious percept, than we have good reasons to infer that such a mechanism has some functional role for consciousness.

The use of NIBS techniques in NCC research is flourishing. A TMS pulse on the occipital lobe can, for example, generate a phosphene (e.g. Kammer 1999). Application of TMS pulse on the motion area MT/V5

(Fellman & Van Essen 1991) elicits moving phosphenes (de Graaf & Sack 2014: 6). Another example of application of TMS is the induction of virtual lesions in the parietal cortex in cases of experiments in bistable vision (e.g. Carmel et al. 2010).

Such experiments suggest that, in the next years, manipulation of brain mechanisms will be a valuable tool in finding out the NCCs. In addition, I believe that they suggest us to revise the current paradigm of content-NCC research and to carefully rethink our understanding of the NCC problem.

Steps Towards a New Paradigm for NCC Research

The Standard NCC approach

The standard definition of content-NCC has been put forward by Chalmers:

> An NCC (for content) is a minimal neural representational system N such that representation of a content in N is sufficient, under conditions C, for representation of that content in consciousness. (Chalmers 2000: 31)

There are three features I would like to highlight in this study. First, between the neural system N and conscious experience there is only a *correlative* relation. In this sense, the correlation is better understood as a statistically significant co-occurrence of a given conscious content and activation of the putative content-NCC. The correlation is meant to capture a "metaphysically" neutral stance on the issue that sidesteps the causal problem (Neisser 2012).

The second feature is that the conscious experience at stake is a specific conscious state, what we in the philosophical jargon call a specific "content of consciousness" (e.g. Siegel 2010).

Finally, the neural system N is constrained through the condition of minimal sufficiency. Chalmers (2000: 24-25) argues that this requirement is introduced in order to screen off redundant neural activity. If one takes a content-NCC to be a merely sufficient neural system, then the whole brain would count as NCC. But obviously, what we are looking for is a much more specific brain system that appears to be directly involved in conscious experience.

Mechanisms and Manipulation

Neisser (2012) points out that the supposedly neutral connection between N and a specific conscious content does not capture the scientific understanding of the issue. Furthermore, he argues that the requirement of minimal sufficiency is a logical condition that betrays a commitment with a classical paradigm of explanation: the search for covering laws, well represented by the deductive-nomological (DN) model of explanation (Hempel & Oppenheim 1948).

In contrast with this paradigm, Neisser puts forward an alternative framework: the manipulationist-mechanistic model of explanation articulated by Carl Craver (2007). However, the search for the visual content-NCC is better described as the search for *mental* mechanisms (Bechtel 2008). Since "mechanisms" and "manipulation" are key concepts for the present analysis, we must first briefly dwell on their definitions.

Mechanisms. Bechtel defines a mechanism as:

> …a structure performing a function in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomenon (Bechtel 2008: 13).

The growing body of literature on mechanistic explanation often draws attention to the ubiquitous reference to mechanisms in psychology and the life sciences (Bechtel 2008; Bechtel & Richardson 1993; Darden 2006), and specifically in neuroscience (Craver 2007). Although very few philosophers have paid attention to this (exceptions are Hohwy 2009, Neisser 2012), reference to mechanisms is also ubiquitous in research on the NCCs. Consider only few examples: "Still wanted – the mechanisms of consciousness" (Aru & Bachmann 2015); «These [the NCC] are the smallest set of brain mechanisms […] sufficient for some conscious feeling […]» (Koch 2004: xv-xvi). Commenting on the problem of emergence, Francis Crick also seemed to suggest a mechanistic strategy in NCC research: «while the whole may not be the simple sum of the separate parts, its behavior can, at least in principle, be *understood* from the nature and behavior of its parts *plus* the knowledge of how all these parts interact» (1994: 11). Here we observe a typical mechanistic explanatory strategy: mechanistic decomposition (Bechtel & Richardson 1993; Kauffman 1971).

Mechanistic decomposition is a key step toward a mechanistic explanation. In contrast with the DN model, mechanistic explanation does not rely on covering laws, but explains a phenomenon by showing how entities and activities produce the explanandum (Bechtel & Abrahamsen 2005; Craver 2005). In short: a mechanistic explanation explains *why* a phenomenon occurred by exposing *how* it occurs.

Manipulation. The other key concept is that of manipulation. I think that Neisser's suggestion can receive substantial support precisely thanks to the recent developments in NIBS techniques that I outlined in the first section.

Relying on Woodward (2003), Craver defines X as causally relevant to Y iff there is:

…an ideal intervention on X that changes the value of Y, or the probability distribution over the values of Y (Craver 2007: 198).

Conceptualizing the search for content-NCC according to the manipulationist (or "interventionist") view means to intervene on the putative brain mechanism related to conscious content and observe the elicited change in visual phenomenology. In an experimental setting, this might involve screening off interfering factors that affects X in normal conditions (Campbell 2007 calls it "surgical" intervention).

It should be stressed that whilst manipulation can help us sorting out different kinds of neural activity, its role within a mechanistic explanation is that of localizing operations within specific mechanistic parts (Bechtel & Richardson 1993). This is likely to put additional constraints on the model, unveiling the mechanism's structure. However, localization also requires understanding of what operations are carried out by the different functions. This suggests that localization is but only one step towards a mechanistic explanation (Bechtel 2008).

Still, the manipulationist-mechanistic framework represents a promising conceptualization of the NCC problem. However, intervening on the brain mechanisms of the contents of consciousness demands to properly define the changed, altered, phenomenon. Understanding the function of such mechanism is of paramount importance in constructing a mechanistic explanation. Mechanisms are *for* a specific function (Glennan 1996). Circumscribing the function of the mechanisms of the contents of consciousness means to tackle the issue of what they actually do, which in turn enable us to put constraints in modeling a mechanism.

The relevance of this question is obvious: if we can establish a causal (manipulative) relation between a neural mechanism and a specific conscious experience we could finally explain consciousness. Unfortunately, things are not so easy. In the next section I review the philosophical literature on intentionalism and show that intervention on brain mechanism only elicits a change in the intentional content.

Manipulating the Intentional Content

In the definition given above, Chalmers (2000) made explicit reference to the representational (or "intentional") character of consciousness. As we know, *intentionalism* is the thesis according to which conscious experience has an intentional (i.e. representational) character. However, few, if any, philosophers contend that representing things to be thus-and-so exhausts what there is to say about consciousness.

We commonly distinguish different philosophical groups regarding the relation between intentionality and consciousness (Chalmers 2004; Fish 2010; Staudacher 2011). Here I adopt William Fish's (2010) taxonomy, and identify three forms of intentionalism: strong phenomenology-first, strong content-first, and weak intentionalism. According to the first and third group conscious intentional content has phenomenal properties, whilst the second group maintains a reductive stance towards phenomenal properties. I will examine them in this order: the third, the first, and finally the second group. As I declared in the outset, the reader should bear in mind that I only focus on visual experiences.

Weak Intentionalism

According to weak intentionalism, phenomenal experiences always have intentional content (Chalmers 2004; Peacocke 1983; Searle 1983). However, weak intentionalism allows that two distinct phenomenal experiences may have the same intentional content. Consider Block's argument (1993). Suppose that you are travelling through a dark tunnel and you see a brightly lit scene at its end. According to Block, there would be a phenomenal difference if you keep both eyes open or you close one of them, even though the intentional content remains the same. Conscious experience, according to weak intentionalism, is partially independent from the intentional content. This poses two problems for the manipulationist approach.

First, it is likely that the approach I have argued for does not actually target phenomenal properties. There is no compelling reason for thinking that manipulation of the neural mechanism should change conscious experience. Indeed, it is plausible to imagine the following scenario: a manipulation of the mechanism that does not produce a change in consciousness, but only in intentional content. Manipulating the neural mechanisms underlying the contents of visual consciousness therefore does not help us explaining *why* that content is conscious.

The second problem concerns the surjective relation between intentional and phenomenal properties. We individuate the contents of consciousness precisely in virtue of their being conscious. But since two different experiences might have the same intentional content, we are left with the difficult task of explaining why and how this is possible.

Strong Phenomenology-First Intentionalism

A way to sidestep the latter problem is to hold that every variation in phenomenal character is mirrored by a variation in intentional content. Byrne argues that:

For any two possible experiences *e* and *e**, if they differ in phenomenal character, then they differ in [intentional] content. (Byrne 2001: 217).

This is what Fish (2010) calls "strong phenomenology-first intentionalism". However, it should be clear that even this option does not solve the problem posed by weak intentionalism, since phenomenal properties are not identical with intentional properties.

Strong Content-First Intentionalism

Another option is to deny the existence of any phenomenal property, or simply to show that they can be reduced to some functional requirement or additional process. Strong content-first intentionalists espouse precisely this thesis. However, philosophers disagree about the nature of such additional requirements.

Higher order theories of consciousness (HOT) claim that a first-order intentional state is conscious only when it is object of a higher order state. The character of such higher order state is disputed. Lycan (1996) contends that the higher order state is a kind of internal scanner akin to a perceptual state, whilst Rosenthal (1990) claims that the higher order state is a belief, or thought.

According to HOTs, the manipulationist-mechanist approach does not suffice to explain consciousness. In addition to mechanisms for the visual contents of consciousness, we should also postulate the existence of other higher-order mechanisms whose overall function is necessary to make the first order state conscious. Furthermore, HOTs may lead to some empirical problems. For example, one would have to disentangle first-order from higher-order mechanisms, since they presumably co-activate when a subject is consciously visually aware of a specific content.

There is still another viable option. Some philosophers maintain that first-order intentional states suffice for consciousness if they have the right sort of content, and when it plays some functional role (Dretske 1995; Tye 1995). Michael Tye 's PANIC theory is a paradigmatic example:

> Phenomenal content, I maintain, is content that is appropriately poised for use by the cognitive system, content that is abstract and nonconceptual (Tye 1995: 137).

Specifically, the intentional content must be abstract and nonconceptual, and it must be functionally poised, i.e. must be available for other cognitive processes. (Hence the acronym: Poised Abstract Non-Conceptual Intentional Content). Can the manipulationist-mechanistic approach explain the contents of consciousness according to Tye's PANIC theory?

The answer should be a clear "no". The fact is that, again, intentional content alone does not suffice for consciousness. Tye's theory shows that in order to be conscious an intentional content must not only have some specific features – i.e. being abstract, and nonconceptual – but that it must also be functionally poised. This seems to imply that there is some additional functional requirement that can possibly be accounted for through additional mechanisms.

Intentional Mechanisms

The foregoing discussion makes clear that the manipulationist-mechanistic approach does not explain consciousness. However, it is entirely plausible to contend that the neural machinery can alter the intentional contents of consciousness. Indeed, there is no principal conceptual problem in linking functional and structural aspects of consciousness to the underlying brain mechanisms. The picture I am describing is perfectly compatible with the hard problem of consciousness (Chalmers 1996). Notice that this conclusion is convergent with recent debates on the nature of the NCCs (Bayne 2007; Howhy 2009; Searle 2004). Significantly, combining insights provided by the neurosciences and philosophy, I think that the framework that I have sketched out paves the way to some fruitful perspectives on the search for the NCCs.

If the mechanistic-manipulationist framework for content-NCC does not explain consciousness, nonetheless it can rightly be conceptualized as the search for visual *intentional mechanisms*. Following Bechtel's definition of mechanism (see §2), an intentional mechanism could be defined as:

> A structure performing the proper function of fixing the visual intentional content in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for the intentional content of vision.

Prerequisite Mechanisms and Matching Content Doctrine

Prerequisites of Consciousness. What is the relation between intentional mechanisms and consciousness? Even if intentional mechanisms do not account for conscious experience, they can be regarded as neural *prerequisite* for it (De Graaf et al. 2012). A neural prerequisite for consciousness is a neural system – in our case, a neural mechanism – whose function is required by other neural mechanisms directly related to consciousness. Once the intentional content has been processed by an intentional mechanism, it can then become conscious thanks to some further neural processing.

To see why, it is sufficient to reflect about intentionalism, which, as we have seen, is the thesis according to which consciousness has an intentional character. If consciousness – or at least visual consciousness – has an intentional content, it is entirely plausible to conceive the function of intentional mechanisms as a necessary prerequisite for conscious visual experience. One way to reject this conclusion is to reject intentionalism altogether, and simply deny that consciousness has any intentional content, or to (ideally, at least) disjoint conscious experience from any content[1].

Since intentional mechanisms are not directed at consciousness at all, the manipulationist view only fills in the causal gap between intentional content and brain mechanisms. Consequently, there still is a correlative relation between conscious experience and the underlying mechanism (see §2). It is obvious that understanding the

[1] Although I pass this problem in silence here, the very idea of being conscious without being conscious *of* something strikes me as utterly mysterious, if not preposterous (see also Hohwy 2009).

relation between phenomenal and intentional character still preserve its priority over the explanatory problem.

Revising the Matching Content Doctrine. An interesting aspect of standard content-NCC research is that the contents of consciousness should match, or correspond, to the neural content (Chalmers 2000: 35). The "matching content doctrine" (MCD) serves as a methodological guide to the search for content-NCC, and is expressed within the very idea of a correlation. Roughly stated, the idea is this: if a conscious content is "matched" by a specific neural population in a statistically significant number of cases, they are probably correlated. So far, criticism of the MCD has mainly been motivated on the basis of a phenomenological objection against the contents of consciousness (e.g. Noë & Thompson 2004; Neisser 2012). In this study, I merely observe that the intentional mechanisms standpoint conceptualizes the MCD as a function-to-mechanism relation. In other words: from a given content of consciousness (the function), one can (tentatively) infer the existence of a mechanism that produces it and test this hypothesis through empirical techniques.

Spandrels of Vision?

Before I conclude, I would like to mention a conceptual problem that follows from the final considerations on the MCD. Rigorous phenomenological descriptions might serve both the initial task of decomposing a mechanism (Bechtel & Richardson 1993; Darden 2006; Kauffman 1971) – thus leading us to look for a mechanism responsible for a specific kind of content – and the observation of the conscious percept elicited by NIBS techniques, which might help us refining and understanding the results.

Yet, not every single feature of our conscious visual field needs to have a specific functionally related mechanism. For example, it seems plausible to me that some features of our visual phenomenology might actually turn out to be *spandrels* (Gould & Lewontin 1979), rather than direct products of a single intentional mechanism. This latter aspect, I think, should urge us to adopt an evolutionary perspective regarding the contents of visual consciousness.

For reasons of space, I cannot elaborate on this suggestion here. However, I believe that the framework developed here offers us yet another reason, to think the mind-brain relation in evolutionary terms.

Conclusion

To sum up, I hope to have persuasively argued for a reconceptualization of the content-NCC problem. Recent work on NIBS techniques seems to support the manipulationist standpoint on the content-NCC problem. Although what I called "intentional mechanisms" cannot explain consciousness, they can clearly help us in the quest of finding out how the brain generates the intentional structure of our conscious experience.

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