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Consciousness as a graded and an all-or-none phenomenon: A conceptual analysis

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ABSTRACT

The issue whether consciousness is a graded or an all-or-none phenomenon has been and continues to be a debate. Both contradictory accounts are supported by solid evidence. Starting from a level of processing framework allowing for states of partial awareness, here we further elaborate our view that visual experience, as it is most often investigated in the literature, is both graded and all-or-none. Low-level visual experience is graded, whereas high-level visual experience is all-or-none. We then present a conceptual analysis starting from the notion that consciousness is a general concept. We specify a number of different subconcepts present in the literature on consciousness, and outline how each of them may be seen as either graded, all-or-none, or both. We argue that such specifications are necessary to lead to a detailed and integrated understanding of how consciousness should be conceived of as graded and all-or-none.

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1. Introduction

The quest of consciousness is an endeavor, which has solicited tremendous research efforts. What is it like to be a bat? This short thought experiment, first formulated by Timothy Sprigge and later spread by Thomas Nagel in a classic paper in 1974 (Nagel, 1974), characterizes subjective experience in an almost simplistic and circular way. How does it feel like to be a bat? At the same time it captures strikingly well the intuition we have about conscious experience. According to Chalmers (1996), even an advanced understanding of the nervous system and the dynamics of brain activity will not bring us closer to solving the mystery of consciousness, namely how these neurons and their activity patterns bring about consciousness. More specifically, the same goes for visual experience. How do our brains' neurons generate visual experiences of the world? Despite continuing disagreement on whether “the hard problem” (1996) and hence an upper limit to our fundamental understanding of consciousness and visual experience will remain, undoubtedly enormous progress has been made in characterizing conscious experience and the neural states that generate it. One of the central theories in consciousness research, and probably the most extensively developed and supported, is the Global Workspace Theory (GWT).

Originally put forward by Baars (1988, 1997, 2002), it assumes that the function of consciousness is essentially integrative. The brain can be seen as a collection of sub-networks processing specific inputs, in which consciousness makes this information available to a wide range of networks. We can more specifically refer to this as access consciousness. This model

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was further elaborated upon by Dehaene and colleagues via computational modeling (and later Dehaene & Changeux, 2005; Dehaene, Kerszberg, & Changeux, 1998; Dehaene & Naccache, 2001; Dehaene, Sergent, & Changeux, 2003), and via an impressive amount of neuroimaging studies (for reviews, see Dehaene & Changeux, 2011; Dehaene, Changeux, Naccache, Sackur, & Sergent, 2006; Dehaene, Charles, King, & Marti, 2014). The Global Neuronal Workspace Theory (GNWT), as put forward in Dehaene et al. (2006), essentially revolves around two dimensions: top-down attention and bottom-up stimulus strength. Only when the bottom-up strength of the sensory event is sufficient, for example when the word is not shown for a brief flash but for a sufficiently long duration, and attention is directed to the word, the word will be consciously visible. The moment at which a sensory event becomes consciously visible is when ignition in the global neuronal workspace takes place: top-down attention amplifies the processing related to the stimulus, thus broadcasting it to a wide set of brain regions, rendering it available for report. A state of global synchrony is thus installed based on long-range connections. Ignition is a non-linear phenomenon, appearing with a sudden onset, associated with the precise moment at which the stimulus goes from unseen to seen. According to GNWT, consciousness is thus an all-or-none phenomenon, with visual experience of a stimulus being dichotomous. Either it is present or absent.

However, just as for the dichotomous account of visual experience according to GNWT, there is also a growing body of evidence for a more graded characterization of consciousness. According to this view, conscious perception is not an all-or-none but a graded phenomenon, arguing that the transition from unconscious to conscious processing is gradual and involves multiple stages, including intermediate states of experience, where visual stimuli are not completely invisible but also not fully visible. We refer to a previous paper in which empirical evidence for both the dichotomous and the graded account from behavioral, computational modeling, and neuroimaging studies is discussed in detail (Windey, Vermeiren, Atas, & Cleeremans, 2014). In short, in many studies, a psychophysical design is used. Masked stimuli are presented for a range of different brief durations, and subjects are instructed to perform a categorization task on these stimuli. Frequently this discrimination task is followed by a subjective measure. Subjects are thus asked to provide a personal indication of how clearly visible the stimulus was (Ramsoy & Overgaard, 2004), how confident they are with regard to their categorization accuracy (Dienes & Perner, 2004), or how much money they would wager on their response (Persaud, Mcleod, & Cowey, 2007). A number of different analyses have been carried out to claim evidence for either the graded or the dichotomous account. For instance, psychophysical curves showing a linear relationship between accuracy or subjective clarity and stimulus durations have been linked to graded visual experience (Overgaard, Rote, Mouridsen, & Ramsoy, 2006), whereas more non-linear curve profiles were linked to dichotomous experience (Del Cul, Baillet, & Dehaene, 2007). Also the distribution of subjective ratings across all trials has been analyzed. More spread-out distributions indicating the existence of intermediate states of experience have supported the graded account (Overgaard et al., 2006), whereas distributions that appeared to cluster at the outermost ends of subjective scales have supported the dichotomous account (Del Cul et al., 2007; Sergent & Dehaene, 2004).

Given the wealth of evidence for consciousness as a graded as well as an all-or-none phenomenon, it is worth asking, what we should conclude from these two contradictory sets of evidence. Is visual experience graded or all-or-none? To illustrate the complexity of the issue, imagine being Paul Cézanne, standing behind his easel, looking in the distance at Mont Sainte-Victoire, studying the landscape. Imagine the tree leaves gently dancing up and down, rustling, a farmer walking down his land, a couple of birds flying over. Far away a steam train runs slowly across the bridge. Shadows subtly change with the hours passing by. Now consider whether to map this overall experience onto a single label “graded” or “dichotomous”. Looking around, do we gradually become more aware of things while accumulating sensory information about them? Or is consciousness more of an on-off phenomenon: either we perceive something, or we do not, without intermediate states of awareness? As the description makes clear, it seems challenging to capture all the aspects of visual experience, let alone consciousness, with a single term. Many objects in the scene are present very clearly, but even more seem to be not completely present, while still making a contribution to our experience at the moment. Claiming that consciousness or visual experience is only a matter of “seen” and “unseen” states alternating with non-linear dynamics does not seem to encompass the massive complexity of the multifaceted nature of our visual experience of the environment (i.e., the GNWT approach). Could a single seen/unseen distinction be a hallmark signature of consciousness? Arguably, if something is “a little bit there”, on a fundamental level it “is there”, and hence probably it could be seen as present or conscious.

This highlights the importance of being precise in what aspect of consciousness we want to characterize as being graded or dichotomous, or gradual or all-or-none. Whenever the term “consciousness” is used in consciousness research, this term in fact may refer to several different aspects of consciousness, such as momentary subjective visual experience as opposed to unconscious processing, reportability, or the stream of consciousness as it evolves over time, response patterns of subjects reporting on their visual experience, and potentially many other concepts. In order to make progress in the debate at hand, we need to specify explicitly what aspect we want to determine to be graded or dichotomous. A given aspect of consciousness may be graded and dichotomous, and different aspects of consciousness may be studied and found to be either graded, dichotomous, or both. Only a framework on a finer scale will allow going beyond intuition. In this conceptual analysis we will attempt to be specific in what we consider to be graded or dichotomous. We focus on *the nature of subjective visual experience when stimuli are transitioning from unconscious to conscious*. We will argue that the former specific aspect of consciousness should be conceived of as both graded and all-or-none. However, after addressing this issue in detail, we will also specify which other aspects of consciousness could be considered, and whether these in turn may be graded or dichotomous. We have started testing certain elements of this conceptual analysis, and whenever relevant the results of these studies will be briefly summarized.

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