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What is it like to have type-2 blindsight? Drawing inferences from residual function in type-1 blindsight

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ABSTRACT

Controversy surrounds the question of whether the experience sometimes elicited by visual stimuli in blindsight (type-2 blindsight) is visual in nature or whether it is some sort of non-visual experience. The suggestion that the experience is visual seems, at face value, to make sense. I argue here, however, that the residual abilities found in type-1 blindsight (blindsight in which stimuli elicit no conscious experience) are not aspects of normal vision with consciousness deleted, but are based fragments of visual processes that, in themselves, would not be intelligible as visual experiences. If type-2 blindsight is a conscious manifestation of this residual function then it is not obvious that type-2 blindsight would be phenomenally like vision.

1. Introduction

Blindsight was originally characterised as "visual capacity remaining after damage to striate cortex..." "even though the patient had no awareness of 'seeing' in blind portion of his field" (Weiskrantz, Warrington, Sanders, & Marshall, 1974). It was subsequently discovered that patients with blindsight did, under some circumstances, report some kind of experience associated with stimuli presented in their regions of blindness. This is now known as type-2 blindsight (e.g. Weiskrantz, 1997). The nature of type-2 blindsight has been controversial to say the least. If the experience reported in type-2 blindsight is like that of normal vision (something that Weiskrantz doubts) then this implies that conscious visual experience can be elicited in the absence of primary visual cortex (see e.g. ffytche & Zeki, 2011). The positive reports of experience associated with visual stimuli in type-2 blindsight need not, however, be like normal visual experiences. In experiments exploring type-2 blindsight the subject is typically asked to make decision about some property of a visual stimulus followed by a 'commentary' response indicating whether he or she had any awareness associated that stimulus. A positive response in this context might simply indicate 'feeling of knowing' – that is, a sense that the preceding discrimination decision was something other than a guess. Some phenomenal experience beyond a feeling of knowing may, however, also occur. In this paper will concentrate on the nature of any such phenomenal experience that may occur in type-2 blindsight.

One approach to answering this question is simply to assert that any phenomenal experience elicited by a visual stimulus will be, by definition, a visual experience. Others argue that this is not necessarily the case. A recent exchange of papers by Morten Overgaard (e.g. Overgaard & Grünbaum, 2011) and Berit Brogaard (e.g. Brogaard, 2011) explored these issues in depth. The possibility that a given type of experience may have multiple causes has been known since Muller coined his Law of Specific Nerve Energies in 1835. It is less clear whether a given cause, in this case a visual stimulus, can give rise to different types of experience. As Overgaard is at pains to point out, it is dangerous to reply on introspection. The degree

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to which blindsight report awareness and the ways in which they describe this awareness appear to be highly variable (see e.g. Zeki & ffytche, 1998) and may be influenced by their interpretations of their own condition and of the experimenter's expectations. It is also important to distinguish between patients who display blindsight and those who simply have severely impaired normal vision where stimuli that would be clearly seen by normal observers are, instead, near the threshold of vision. Azzopardi and Cowey (1997) used a signal detection theoretic approach to demonstrate that blindsight (specifically type-1 blindsight) was qualitatively distinct from near-threshold vision. If we accept these two concerns we might ask what we can learn by studying the abilities, rather than subjective reports, of patients who clearly display type-1 blindsight.

The case I want to make is that the residual visual abilities of blindsight patients are so different from normal vision that it is hard to imagine what it is like to experience them. I will argue that ways in which blindsight subjects succeed in colour discrimination, shape discrimination, motion discrimination or luminance discrimination tasks bears little resemblance to those that would be used in normal vision. If blindsight subjects have experiences elicited by visual stimuli we can only call these experiences 'vision' by asserting that they are by definition vision, not because they are like visual experience.

2. Colour and brightness

In 1999 Morland published a paper reporting experiments that explicitly tested whether the effects of visual stimuli presented in the blind field of blindsight patient GY were comparable with his experiences of the same stimuli in his sighted field (Morland et al., 1999). In one set of experiments GY was asked to adjust a stimulus presented in his blind field so that it matched a stimulus presented in his good field. Separate tests were made of his ability to adjust the luminance, colour (wavelength of light) and speed of motion of stimuli so that they matched between blind and seeing fields. GY was able to match both wavelength and speed between left (sighted for GY) and right (blind for GY) hemifields with almost the same accuracy as a normal observer. Although GY could match the luminance of a pair of stimuli both presented in his blind visual field, he was unable to match luminance between stimuli presented in the blind and sighted hemifields. Morland concludes "the luminance-modulated percept derived from the hemianopic field is not mapped to a perceptual dimension that can be compared with normal brightness perception. The two percepts seem to be unrelated and uncoupled" (p. 1189). Should we conclude that, even if GY's residual blind-field brightness processing is not like his normal brightness perception, nevertheless his residual motion and colour processing is like normal vision?

Morland includes some of GY's introspections about the manner in which he conducted the wavelength matching experiment. GY says "I make the stimulus neither too red nor too green compared to the stimulus in the normal field" (p. 1189) but when asked if his blind-field percepts were "the same as normal red or green. He responded by saying 'Nothing is the same; I just know I can do this match'" (p. 1190). So, even though he succeeds at the matching task his introspection suggests that he is not comparing the same kind of experiences.

Morland was asking GY to compare the wavelengths of lights presented in his blind and sighted fields. When we perceive colour normally, however, our experience depends upon much more than the wavelength of light reaching our eyes. When we perceive the colours of objects our percept is of a property of those objects in the world not a percept of the wavelength distribution of light reaching our retina. In perceiving colour the visual system estimates the efficiency with which a material reflects lights of different wavelengths. Roughly speaking a good reflector of long wavelength light looks red whilst a good reflector of short wavelength light looks blue. The spectrum of light that reaches our eyes from an object is not, however, solely determined by the reflectance properties of the object, it is also dependent on the wavelength composition of the light illuminating the object. The visual system takes account of variations in the spectral composition of lights illuminating objects so that their perceived colour remains relatively unaffected by changes in illumination – the process of colour constancy (see e.g. Smithson, 2005). Colour constancy allows us to judge whether two objects seen under different illuminants are made of the same material. It is important to realise, however, that colour constancy not only provides us with this cognitive ability but that it also affects our experience of colour. This is beautifully illustrated in some visual illusions prepared by Purves and Lotto (2003). We see what appears to be a pair of multi-coloured Rubik's cubes, one viewed through yellow cellophane and one view through blue cellophane. Some blue tiles and some yellow tiles can clearly be seen on both. What is remarkable is that the blue tiles on the cube seen through the yellow filter and the yellow tiles seen through the blue filter project identical lights to our eyes yet the colours we *experience* when looking at them are quite different (blue and yellow). Our experiences of these blue and yellow colours do not change even when we know that the lights reaching our eyes from the two tiles are identical.

The anatomy of colour vision shows a clear progression from ganglion cells in the retina where neural responses are determined primarily by the wavelength composition of light, through striate cortex where cells responding to wavelength contrast are found and extrastriate areas that appear to compute colour constancy. Cerebral achromatopsics, that is, patients with cortical colour blindness, lack these later extrastriate colour areas, do not experience colour and cannot make covert colour discriminations (Heywood, Kentridge, & Cowey, 1998a). These patients do, however, see the borders between regions of different colour (Heywood, Kentridge, & Cowey, 1998b) and make decision about the similarity of stimuli based on the chromatic contrasts they make with their backgrounds rather than their surface colour (Kentridge, Heywood, & Cowey, 2004). We subsequently showed that the blindsight patient DB, with damage to striate cortex, does not even respond on the basis of chromatic contrast, instead he simply makes matches on the basis of the wavelengths of light reflected by the patches being compared (Kentridge, Heywood, & Weiskrantz, 2007). Purely chromatic stimuli that we, or even a cerebral