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Type 2 blindsight and the nature of visual experience

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ABSTRACT

Blindsight is a kind of residual vision found in people with lesions to V1. Subjects with blindsight typically report no visual awareness, but they are nonetheless able to make above-chance guesses about the shape, location, color and movement of visual stimuli presented to them in their blind field. A different kind of blindsight, sometimes called type 2 blindsight, is a kind of residual vision found in patients with V1 lesions in the presence of some residual awareness. Type 2 blindsight differs from ordinary visual experience in lacking the particularity, transparency and fine-grainedness often taken to be essential to visual experience, at least in veridical cases. I argue that the case of type 2 blindsight provides a counterexample to the view that these characteristics are essential to veridical visual experience and that this gives us reason to resist the view that visual experience is essentially a perceptual relation to external objects. In the second part of the paper I argue that the case of type 2 blindsight yields important insights into the effects of attentional modulation on perceptual content and that cases of attentional modulation of appearance are not at odds with the view that the phenomenology of visual experience flows from its content.

1. Introduction

Blindsight occurs as the result of damage to the striate cortex (V1) which results in a scotoma, or region of blindness in the visual field (Perenin & Jeannerod, 1975; Poppel, Held, & Frost, 1973; Weiskrantz, Warrington, Sanders, & Marshall, 1974). Individuals with a scotoma typically report no visual awareness of visual stimuli presented to them in their blind field. But they nonetheless have a preserved ability to correctly guess the attributes of visual stimuli when forced to respond. Blindsight subjects have been shown to make above-chance determinations of the motion, location, form and wavelength of stimuli they report not seeing (Stoerig & Cowey, 1992; Weiskrantz, 1986). The exact mechanism underlying blindsight is unknown but it is believed that in most cases of blindsight the retinal information is projected to subcortical structures that project directly to extrastriate regions, thus bypassing V1. It remains a possibility that some blindsight subjects present with spared islands of V1 that carry information from subcortical structures to extrastriate regions. For example, one patient RD with extensive, unilateral lesions of VI was found to have complete blindness in the right lower quadrant and residual vision in the right upper quadrant that probably was due to spared islands of functional tissue in V1 (Barbur, Watson, Franckowiak, & Zeki, 1993). However, the majority of blindsight subjects do not seem to have any spared islands in striate cortex that could explain the residual visual abilities (Zeki & Ffytche, 1998).

Although blindsight was originally defined as visual abilities in the absence of reported visual awareness, some subjects have been found to have residual conscious awareness in their affected hemifield despite extensive V1 lesions. These

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patients appear to have residual vision for stimulus attributes that they are unaware of, but they show residual awareness of the presence and direction of fast moving and/or high-contrast visual stimuli, and this awareness often positively correlates with their abilities to discriminate (Barbur et al., 1993; Zeki & Ffytche, 1998). The observation that some blindsight subjects have a form of residual awareness has resulted in a division of blindsight into type 1 and 2 (Weiskrantz, 1998a, 1998b). In type 1 blindsight a subject with lesions to V1 has residual vision in the absence of reported awareness; in type 2 blindsight subjects with lesions to V1 have a form of residual awareness that is positively correlated with their residual visual abilities. Type 2 blindsight is also known as Riddoch syndrome, named after army officer George Riddoch, who found motion awareness in the scotomatous fields in soldiers with lesions to striate cortex but no abilities to characterize other attributes of the visual stimuli (Zeki & Ffytche, 1998). Riddoch's patients would report seeing the motion of objects but would claim that they had no distinct shape or color or that they had an appearance that they would describe as 'shadowy grey' or 'like a shadow'. One patient reported being able to determine the color of the stimulus when the stimulus was white and another denied seeing motion but reported that he knew when something had moved through his hemianopic field.

To what extent the phenomenology of blindsight is like degraded normal vision is still debated (Azzopardi & Cowey, 1997; Overgaard, Fehl, Mouridsen, Bergholt, & Cleeremans, 2008; Weiskrantz, 2009; Overgaard & Grünbaum, 2011; Brogaard, 2012). However, there is a growing consensus that type 2 blindsight is a kind of veridical visual experience (Ffytche & Zeki, 2011; Zeki & Ffytche, 1998). Here I will argue that the case of type 2 blindsight casts doubt on certain dogmas about the nature of visual experience. Though it's disputed whether the phenomenology of visual experience is constituted by external objects, it is widely held that the core phenomenology of visual experience can be given by citing the external object that gave rise to it (Brewer, 2007). Visual experience is furthermore said to be transparent in the sense that we see through any internal features of the experience and see only the external object and its visually perceivable property instances (Harman, 1990; Tye, 2002). Finally, it is often said that visual experience differs from thought in that maximally determinate properties are presented in visual experience (e.g., carmine as opposed to red), whereas determinable properties are presented in thought (e.g., red as opposed to carmine) (Bermudez, 1995; Brewer, 2007; Peacocke, 1992). However, type 2 blindsight appears to differ from other types of veridical visual experience in all of these respects. In type 2 blindsight subjects typically report that they are aware of 'something' or have a feeling that 'something is happening' but they deny being directly aware of the external object that triggered their experience. The external object is experienced as occluded by shadows or blackness. The reason type 2 blindsight differs from ordinary visual experience in terms of particularity, transparency and fine-grainedness may be that it is generated by an alternative visual pathway that bypasses V1. V1 has been found to be crucial for generating brightness perception (Morland et al., 1999). Type 2 blindsight cases thus give us reason to resist a view of visual experience as essentially object-involving, transparent and maximally fine-grained. Given that these characteristics are not essential to visual experience, we will have to rethink the proposal that visual experience is fundamentally a matter of being directly perceptually related to an external object. In the second part of the paper I argue that the case of type 2 blindsight yields important insights into the effects of attentional modulation on perceptual content and that cases of attentional modulation of appearance are not at odds with the view that the phenomenology of visual experience flows from its content.

2. Type 2 blindsight

Residual awareness in blindsight subjects was already reported when the first cases of blindsight were published by Larry Weiskrantz and others (Weiskrantz, 1986). However, researchers originally sought out experimental conditions that would eliminate the residual awareness. It was found that eliminating type 2 awareness sometimes resulted in an improvement in performance (Weiskrantz, 1986). Since the first reported cases of the condition, there have been numerous studies of residual awareness in blindsight subjects. In some cases, type 2 blindsight may be the result of spared islands of activity in V1. Subject RD, for example, was found to have abnormal conscious awareness of visual stimuli, including impoverished discrimination and unusual motion perception, describing moving lights as 'balls of fire' (Barbur et al., 1993). In this case the residual awareness might have been due to spared islands of activity in V1. However, activity in spared striate regions has been ruled out in most cases of blindsight. The widely studied blindsight subject GY was found to have large lesions to striate cortex GY that could not fully account for his residual visual abilities or the residual awareness under high contrast/high speed conditions (Barbur et al., 1993; Weiskrantz, Barbur, & Sahraie, 1995). It is widely thought that GY's residual vision in the absence of awareness involves direct projections from subcortical areas to extrastriate regions. Using an fMRI paradigm Zeki and Ffytche (1998) found that both fast-moving stimuli associated with awareness and slow-moving stimuli not associated with awareness in GY led to activity in V5/MT but at different levels of intensity. They also found covariation in the dorsal stream (area V3 and the parietal cortex) as well as the right middle frontal gyrus, but it is unclear to what extent this activity contributed to GY's residual awareness and visual abilities. On the basis of the data from studies of GY and other subjects with both type 1 and type 2 blindsight Zeki and ffytche (1998) hypothesized that the two conditions are manifestations of a single mechanism under different experimental conditions. V5/MT receives its input directly from V1 (Cragg, 1969) but there are also projections to this area directly from the lateral geniculate nucleus (LGN) (Benevento & Yoshida, 1981; Fries, 1981; Yukie & Iwai, 1981) and via the superior colliculus projecting to the pulvinar nucleus, which in turn projects to V1 (Benevento & Standage, 1983). So, a likely mechanism underlying type 1 and type 2 blindsight is that direct projections to V5/MT from subcortical regions bypassing V1 can result in vague conscious awareness of motion or residual vision without awareness depending on the contrast and speed of the stimulus. It thus appears that some forms of conscious vision can be had in the absence of functional striate cortical areas.

While it is now widely recognized that blindsight subjects can have residual awareness in spite of extensive V1 lesions, there has been some disagreement about how to categorize the residual awareness. GY originally described his experiences of stimuli in his blind hemifield as a visual experience of a shadow. He later described them as feelings of something happening or a feeling of certainty that something had happened and maintained that his earlier description was a metaphor (Ffytche & Zeki, 2011; Zeki & Ffytche, 1998). He subsequently described his experiences as that of 'a black shadow moving on a black background', maintaining that this was the best he could do by way of verbally expressing his experiences in a meaningful way. There is still no consensus about whether the feelings associated with type 2 blindsight are always indicative of a visual phenomenology, or whether they sometimes arise through the exercise of the blindsighters' ability to identify visual stimuli (Brogaard, 2012; Overgaard & Grünbaum, 2011). If the phenomenology is associated with the experimental task, the residual awareness may be cognitive and high-level rather than perceptual and low-level (Barbur, Weiskrantz, & Harlow, 1999; Brogaard, 2011a, 2011b; Brogaard, 2012; Kentridge & Heywood, 1999; Sahraie et al., 1997). GY's use of the word 'feeling' might also suggest that the phenomenology is similar to that of certain affective states. Some have argued that the residual awareness found in type 2 blindsight is a type of awareness correlated with abilities to detect visual stimuli but lacking qualia (Persaud & Lau, 2008; see also Foley, 2011 for discussion). However, the hypothesis that experience possesses qualia understood as ineffable, intrinsic, private and immediately apprehensible in consciousness is highly controversial (Dennett, 1990: 523). Most researchers who employ the term 'qualia' use it loosely as synonymous with 'phenomenal properties', which rules out conscious awareness without qualia, regardless of whether the awareness is sensory or not (Block, 2010; Kennedy, 2009).

Type 2 blindsight seems to be limited in some subjects to certain experimental conditions. Overgaard and colleagues, however, have questioned whether the limited reports of type 2 blindsight could be a result of a bias in the methods used for testing for awareness in blindsight subjects (Overgaard et al., 2008). Traditional blindsight studies have used binary methods ("do you see something?") followed by questions about the subject's certainty about his subjective report. It has been argued that these methods may not be sufficiently sensitive for gathering subjective reports (Morland et al., 1999; Ro et al., 2007; Stoerig & Barth, 2001). One problem is that the subject and the researchers may mean different things by 'see'. A second problem is that even if subjects and researchers mean the same thing by 'see', they could have different thresholds for what counts as 'seeing something'. A third problem is that the traditional binary methods ask about whether the subject 'sees' anything, not about the phenomenology of the experience (Lau & Passingham, 2007).

Based on prior testing of normal subjects, one team of researchers developed a four-point scale, the "Perceptual Awareness Scale" (PAS), for testing visual awareness in blindsight (Christensen, Kristiansen, Rowe, & Nielsen, 2008; Overgaard et al., 2008). Instead of the traditional yes/no strategy, they developed a so-called 'Perceptual Awareness Scale' (PAS). Normal individuals were asked to evaluate the clarity of their perceptual experiences when presented with visual figures of different shape. Most individuals spontaneously evaluated the stimuli on a four-point scale. (CI) "clear image" ("I know what was shown"), (ACI) "almost clear image" ("I think I know what was shown") (WG) "weak glimpse" ("something was there but I don't know what"), and (NS) "not seen". The scale was tested on other participants who were questioned about the meaning of their evaluations. The researchers found a strong correlation between reported clarity and reaction time/accuracy. When the stimulus was reported as a clear image, the response was faster and more accurate.

The team then used PAS to evaluate visual awareness in blindsight subject GR (Overgaard et al., 2008). In a series of trials on GR, using the PAS method, not nearly as many stimuli were reported as being clear as in the trials on her normal field, but it was found that accuracy correlated with reported visual clarity of the stimulus. The relationship between accuracy and awareness was the same in the intact and the blind fields. Reported awareness thus appears to be predictive of accuracy in GR. When comparing trials where standard methods were used to trials using the PAS method, it was evident that GR's threshold for reporting awareness was lower with the PAS method compared to binary methods (Overgaard et al., 2008). The researchers concluded that their findings call many of the traditional studies demonstrating unconscious vision in impaired or normal subjects into question. Many empirically demonstrated cases of unconscious visual abilities in subjects with V1 lesions, they argue, may turn out to be a form of type 2 blindsight.

Despite the controversy surrounding the frequency and nature of type 2 blindsight, researchers seem to largely agree on two data points concerning experiences in type 2 blindsight. The first is that type 2 blindsight and ordinary visual experience have a different phenomenology (ffytche & Zeki, 2011; Stoerig & Barth, 2001; Weiskrantz, 2009). Stoerig and Barth (2001) set out to find a stimulus to present to GY's intact hemifield that would be phenomenally similar to his awareness in his scotoma. Stimuli that had reduced spatial and temporal resolution and hence were thought to give rise to experiences similar to GY's type 2 experience were judged to be dissimilar. A better temporal match was obtained using a moving low-contrast texture in the normal and a moving luminance-defined bar in the impaired hemifield. The fact that different stimuli have to be used in the intact and blind fields to elicit a "match" suggests that there is a difference in processing, i.e. different features of the stimulus are being processed in the intact and blind fields (e.g., no brightness or chromatic information in the blind field). Though it was possible to achieve a match, the special stimuli required and the differences in the nature of the stimuli presented to the two hemifields support the hypothesis that the phenomenology of type 2 blindsight, with respect to the presented stimulus, is unlike that of normal experience when that stimulus is presented. Stoerig and Barth (2001) argue that vision in the impaired field is associated with a visual phenomenology but is 'enormously reduced in phenomenal content'.

The second data point that many researchers agree on is that experience in type 2 blindsight is sometimes best classified as a form of veridical visual experience (ffytche & Zeki, 2011). There are several reports showing that awareness can occur in blindsight that either does not track performance or is not veridical (ffytche & Zeki, 2011; Weiskrantz, 1986) but when the residual awareness appears to match features of the stimulus, and it positively correlates with residual visual abilities, it seems reasonable to classify the experience as veridical, though abnormal.

3. Particularity, transparency and fine-grainedness

Type 2 blindsight that tracks performance appears to provide a case of veridical visual experience that lacks three characteristics often taken to be essential to visual experience. The first is the particularity of experience. The particularity of experience is the idea that visual experience inherits its phenomenal character from the external object that triggers it (Brewer, 2007; O'Callaghan, 2011; see also Siegel, 2006). When describing what it is like to experience a garden spawned with trees, bushes, flowers and water fountains, it suffices to describe the objects and the perceptible properties of the external scene. Even if we occasionally resort to describing features of the experience itself, for example, its blurriness, the core phenomenology of experience can be given by citing the external objects and their properties (Brewer, 2007).

A second characteristics often attributed to visual experience is its transparency or diaphanousness, a characteristic closely related to the particularity of experience. Transparency captures the idea that when we try to introspect, it seems that we look right through the experience only to find external objects and their properties (Jackson 1977; Moore, 1903, chap. 1; Shoemaker, 1994; Sturgeon, 2000: 9; Harman, 1990; Kind, 2003; Tye, 1995; Tye, 2000, 2002). Moore put it succinctly as follows:

> The moment we try to fix our attention upon consciousness and to see what, distinctly, it is, it seems to vanish: it seems as if we had before us a mere emptiness. When we try to introspect the sensation of blue, all we can see is the blue: the other element is as if it were diaphanous.
>
> [Moore, 1903, p. 41 in 1993 reprint]

Moore's point is that in visual experience it is as if the external scene is simply presented to us. If we try to access features that are internal to experience, it seems as though we access the external object and its attributes.

A third characteristic often attributed to visual experience is its maximally fine-grained phenomenology. Ordinary visual experience differs from thought in that maximally determinate properties are presented in visual experience, whereas determinable properties are presented in thought (Bermudez, 1995; Brewer, 2007; Peacocke, 1992). For example, when Amy is looking at her elm tree in June, she is experiencing a hardy tree with a crown of light-green leaves forming a spreading canopy. When she is looking at the elm tree in the fall she has an experience of a hardy tree covered with orange, yellow and brownish leaves. The two temporally and phenomenally distinct experiences are extremely rich, attributing highly determinate shades of colors, shapes and textures to one and the same tree at two different times. Amy's *thoughts* of her elm tree as she progresses through autumn are unlikely to represent a similarly rich array of features. They may very well be quite generic tree experiences.

Some argue on the basis of these three characteristics that the phenomenology of visual experience is fully constituted by the external objects presented in the experience and their visually perceptible properties (Brewer, 2007; Campbell, 2002; Kennedy, 2009; Martin, 2002). As Campbell puts it, 'the phenomenal character of your experience, as you look around the room, is constituted by the actual layout of the room itself: which particular objects are there, their intrinsic properties, such as color and shape, and how they are arranged in relation to one another and to you' (Campbell, 2002: 116). The view that the external objects and their perceptible property instances constitute the phenomenology of visual experience is also known as direct realism. Direct realism is making an assertion about cases in which an external object triggers the experience. In veridical cases the perceiver is directly perceptually related both to an object and to its perceptible properties. In illusory experiences the perceiver is directly perceptually related to an object, even though it looks to the subject as if the object has properties that it does not in fact have (Brewer, 2007). How direct realists treat hallucinations depends on whether they take the nature of experience to be exhausted by the perceptual relation (Brewer, 2007; Fish, 2009; Martin, 2002; see also Haddock & Macpherson, 2008 for a review) or whether they think that the external objects to which experiences are directly related are constituents of a content of the experience (Chalmers, 2004; Logue, 2014; Schellenberg, 2010; Tye, 2000, 2002). The former group normally treats hallucinations as a fundamentally different type of mental occurrence that cannot be introspectively distinguished from visual experience (e.g., Fish, 2009). The latter group typically treats hallucinations as experiences with a gappy content (e.g., Schellenberg, 2010).

Transparency itself has been invoked both in arguments for direct realism (e.g., Kennedy, 2009) and in arguments for representationalism, the view that the phenomenology of visual experience flows from its content (e.g., Tye, 2002). However, it is questionable that transparency can serve a substantial role in arguments for representationalism that rejects direct realism. Representationalism that rejects direct realism holds that experience can be accurate even if its content is not constituted by external objects and their property instances (Davies, 1992; Dretske, 1995; McGinn, 1982). Moreover, indirect representationalism need not require that the constituents of the experimental content correspond exactly to objects and properties in the world. So, if it turns out that experience is not transparent, this does not necessarily present a threat to this form of representationalism. Since nontransparent features of experience (e.g., second-order properties, such as specificity, distinctness or shininess) may be present in the content of the experience without these features being features of the external stimulus, the transparency of experience does not provide direct evidence for representationalism. However, direct realism holds that the external stimulus exhausts the phenomenology of experience (Brewer, 2007; Campbell, 2002; Kennedy, 2009; Martin, 2002). So, if there are features of veridical experience that are not identical to property instances born by the external stimulus, then direct realism is false. So, nontransparency presents a serious threat to direct realism.

Particularity, transparency and fine-grainedness are exceedingly plausible as characteristics of the phenomenology of ordinary visual experience. Type 2 blindsight, however, provides an example of visual experience that does not satisfy these characteristics. In type 2 blindsight subjects typically report not having any awareness of external objects. Subjects have reported being aware of 'something' or being aware that 'something is happening' when presented with a fast-moving, high-contrast stimulus in their blind field but they were unable to consciously identify any other characteristics of the stimulus (Ceccaldi, Mestre, Brouchon, Balzamo, & Poncet, 1992; Fendrich, Wessinger, & Gazzaniga, 1992; Sanders, Warrington, Marshall, & Weiskrantz, 1974; Weiskrantz, 1986; Zeki & Ffytche, 1998). Other subjects have reported seeing 'shadows' (Barbur, Ruddock, & Waterfield, 1980; Riddoch, 1917) or 'pinpoints of light' (Weiskrantz, 1980). But all subjects explicitly denied *seeing* the object causing the experience in their blind field. The phenomenology of type 2 blindsight thus does not seem to satisfy particularity.

Type 2 blindsight does not satisfy the related transparency criterion either. Subjects report seeing attributes they are aware of in their blind field through a veil of perception. Several of Riddoch's subjects described their experiences of moving stimuli in their blind fields as 'shadowy' (Riddoch, 1917). Gordon Holmes's (1918) subject 11 reported awareness of moving white stimuli but described them as seen 'through a mist', and as having a 'dirty grey colour'. GY has described his experiences of moving objects as that of a normal person, with his eyes shut, who looks out of the window and moves his hand in front of his eyes (Barbur et al., 1980) and as that of 'a black shadow moving on a black background' (Zeki & Ffytche, 1998). More recently three blindsight subjects GN, FB and CG were asked to report on their residual awareness and to draw their experiences in their blind field (Ffytche & Zeki, 2011). They were able to draw the features they were aware of but described the stimulus as 'foggy' or as a flash seen behind a screen filtering out anything other than the change in light. These characterizations seem to explicitly contradict the idea that the phenomenology of visual experience is such that we see through any internal features and simply see the external objects and their visually perceptible property instances without any 'fogginess'.

It may seem that one could simply respond to the claim that type 2 blindsight fails to be transparent that blindsighters are aware of certain features of the object (e.g. reflective luminance properties), but not other features (e.g., shape or color), and hence that type 2 blindsight is not a counterexample to transparency. However, this response does not capture the subjects' reports of the stimulus being presented as foggy or as seen behind a screen. So, if we take the subjects' reports concerning the phenomenology of type 2 blindsight at face-value, type 2 blindsight violates the transparency criterion.

Finally, the attributes experienced in type 2 blindsight appear to be less determinate than the properties experienced in ordinary vision. When shown different letters, blindsight subject DB would sometimes report being aware of the direction of the stimulus and having a feeling of whether the stimulus was 'smooth' (the O) or 'jagged' (the X) (Weiskrantz et al., 1974). When pressured, blindsight subject KP described experiencing 'a very faint flash' (Weiskrantz, 1980), and subject JP reported being aware of ill-defined and poorly formed 'blobs' when the words were flashed in her blind field (Shefrin, Goodin, & Aminoff, 1988). Several subjects have reported having feelings of 'something' or 'something happening' (Weiskrantz, 1986). These reports testify to the hypothesis that the properties that subjects are aware of in their blind field in type 2 blindsight are determinables, sometimes of the most general kind ('something', 'something happening').

The reason type 2 blindsight differs from ordinary visual experience in all of these respects is likely that it is generated by an alternative visual pathway that bypasses V1. Morland et al. (1999) investigated GY's ability to make luminance matches in his hemianopic field and between both hemifields. They found that GY was able to make matches when the stimuli were presented in the blind field but was unable to establish matches based on luminance when the stimuli were presented in opposing fields. The most likely explanation for this observation is that the perceived luminance of the stimuli in his blind field (perception of brightness) is derived from direct projections from subcortical areas to extrastriate areas bypassing V1, whereas the perceived luminance of the stimuli in his intact field originates in the normal visual pathway that includes V1. This would make it possible for him to compare stimuli on the basis of luminance when both are presented in the hemianopic field but when the stimuli are presented to opposing fields, the distinct pathways would yield different kinds of percepts, making lawful matching difficult. This suggests that V1 plays a crucial role in generating brightness perception. And if GY's blindsight vision violates particularity, transparency and fine-grainedness, this further suggests that brightness perception is required for generating conscious awareness of determinate properties.

In spite of impoverished luminance awareness, the awareness of stimuli in type 2 blindsight contributes significantly to the subject's ability to determine the attributes of the stimulus, making these cases analogous to other cases of veridical vision in that there is a significant correlation between awareness and discrimination. So, the unusual phenomenology and alternative visual pathway underlying the condition do not provide evidence against the veridicality of type 2 blindsight. It might be held that some of the descriptions of the residual awareness in type 2 blindsight suggest that type 2 blindsight is illusory, representing some features of the external stimulus correctly and representing other features incorrectly. For example, the description of a moving stimulus as a black shadow on a black background or the description of seeing the stimulus the way a sighted person with his eyes closed would see a moving hand might suggest that the subjects misperceive features of the external stimulus. The thought would be that subjects sometimes attribute the wrong features (e.g., black) to the stimulus. However, I think there is considerable reason to resist this conclusion. Subjects with type 2 blindsight emphasize that they use these metaphors in order to describe their experiences to ordinary, sighted people. When GY describes a moving stimulus as a black object on a black background, he does not seek to report on a conscious experience of a black object on a black background. In fact, he explicitly denies that he can consciously perceive the color of a stimulus in his blind field. While type 2 blindsight undoubtedly has a very different phenomenology from ordinary experience, there is good reason to think that subjects with type 2 blindsight are aware of features that correspond to attributes of the stimulus.

If, indeed, type 2 blindsight that tracks performance is a form of veridical visual experience that is not object-involving, transparent or fine-grained, the condition gives us reason to resist a view of veridical visual experience as essentially having these characteristics. But if there are cases of veridical visual experience lacking these features, then we will need to rethink the proposal that visual experience is fundamentally a matter of being perceptually related to an external object.

4. Block's case against representationalism

I will now argue that the case of type 2 blindsight yields important insights into the effects of attentional modulation on perceptual content and that cases of attentional modulation of appearance are not at odds with the view that the phenomenology of visual experience flows from its content. Following a suggestion by Harman, Ned Block calls the view that the phenomenology of experience does not flow from its content 'the mental paint view' (Block, 1990, 1996, 2010; Harman, 1990; Loar, 2003; Shoemaker, 1982). One of the strongest considerations in favor of the mental paint view is that attention appears to modulate phenomenal appearance without making a difference to the properties presented in experience. Though it is widely agreed that attention and consciousness are distinct phenomena with functionally and anatomically distinct, underlying neural substrates (Crick & Koch, 2003; Kentridge, Heywood, & Weiskrantz, 2004; Koch & Tsuchiya, 2007), there is less consensus about how consciousness and attention causally depend on each other. The function of attention appears to prevent informational overload by selecting relevant information and filtering out irrelevant information from crowded visual scenes. For the case of vision, it has been found that attention can modulate responses in extrastriate and striate visual cortex and even LGN (O'Connor et al., 2002) and in that way affect the nature of our visual experiences. It has been reported to do this in three different ways. Attention enhances neural responses to attended stimuli, attenuates responses to ignored stimuli and increases the baseline activity in the anticipation of visual stimulation (Koch & Tsuchiya, 2007).

The question is how the enhanced neural responses to visual stimuli that we attend to is manifested in the phenomenology and content of experience. If we focus on a point in front of our eyes, the periphery is not fully attended to. The phenomenology of the experience of things in the periphery appears to be different from the phenomenology of the experience that occurs when we turn our heads and attend directly to the objects. In this case there is a difference in *overt* attention, a kind of attention that involves a shift in the location of the retina relative to the stimulus. Block (2010) argues that an experience in the absence of full *covert* attention and the corresponding experience that results when attention is shifted (without moving the eyes) differ phenomenally but represent the same properties (see also Chalmers, 2004; Wu, 2011). If, however, attention can make a difference to the phenomenology of experience without making a difference to which properties are presented in experience, then the phenomenology of visual experience does not flow from its content. Representationalism, which holds that the phenomenology of visual experience does flow from its content, then, is wrong and the mental paint view is right.

The thought that attention does not make a difference to which properties are presented in experience is compelling, even in the case of overt attention. If I see a table with a cup on it slightly to the left of the focal point of my visual field, I might not see it clearly but I nonetheless still see a table with a cup on it. When I turn my head and attend to it, I see the table and the cup more distinctly but it appears that my experiences in the two cases represent the very same properties, viz. properties of the cup and the table. The question, however, is whether it is true that the very same properties are presented in the two cases. As argued above, visual experience can sometimes represent determinable properties. In type 2 blindsight, the properties that subjects are aware of are at the extreme end of the determinable-determinate spectrum. Subjects sometimes are aware only of 'something' or of 'something happening'. In ordinary experience the properties that we are aware of are typically more determinate than that but they may not be maximally determinate. Rather, the level of determinacy is likely to vary across the range of visual experiences. For example, in good viewing conditions we might be aware that a ripe tomato has a particular shade of red, but in poor viewing conditions we may not be able to visually determine the exact shade of color. One promising proposal, then, is that when we overtly or covertly attend to an object, we become aware of more determinate properties of the same determinables that we are aware of when we do not attend directly to the object.

The suggestion that attention can make a difference to the determinacy of the properties we are visually aware of gains traction from considerations of the neurological underpinnings of attentional modulation and changes in luminance. Neurophysiological studies have shown that attentional modulation and changes in luminance can create identical modulations of firing rates (Carrasco, Ling, & Read, 2004). It has also been found that the same mechanism may be shared for attentional modulation and intensity of brightness (Treue, 2001).This points to a neural mechanism according to which attention modulates the strength of a stimulus by altering its perceived luminance.

But if attentional modulation and changes in luminance have a shared neural mechanism, then we can provide an argument for the view that attentional modulation yields a difference in the determinacy of the perceived attributes. As discussed earlier, neurophysiological evidence points to a defect in the awareness of luminance (brightness perception) in type 2 blindsight. Awareness of luminance is likely compromised because type 2 blindsight takes place via a visual pathway that bypasses V1, a region that may be associated with generating awareness of luminance. It also appears that only highly determinable properties are consciously represented in type 2 blindsight. This then suggests that when the mechanism for generating conscious awareness of luminance is compromised, then visual experience cannot consciously represent very determinate properties. But if attentional modulation and changes in luminance share an underlying neural mechanism, then we should expect that experience cannot represent very determinate properties either when attention is compromised. So, a difference in attention, then, may yield a difference not only to the phenomenology of experience but also to the level of determinacy of the properties presented in experience.

Our ordinary experience also seems to suggest that attention can make a difference to the determinacy of the properties presented in experience. When you focus on a point right in front of you, you can visually tell that there is something with a determinable shape and a determinable color in the outermost periphery of your visual field but you cannot visually tell that there is a black cat curled up in the corner of a carmine loveseat. This only becomes apparent once you move your eyes or turn your head and look more directly in the direction of the stimulus. This suggests that that attention to a stimulus changes both the phenomenology and content of experience from determinable to more determinate properties. Presumably this is a result of a lowered visible contrast and spatial resolution in unattended parts of a visual scene. The less attention is allocated to a stimuli, the lower the contrast and spatial resolution and the less determinate the properties represented by the experience. Consider the differences in visual features between the images in Fig. 1.

The original image represents highly determinate colors, shapes, buildings and trees, whereas the low-contrast image represents only determinable features and no longer represents a full range of colors. It represents some determinable yellowish-green but not blue, and we can visually make out some tree or other and some building or other, but we cannot visually tell which tree or building is presented. The example illustrates that when a stimulus phenomenally appears to have lower contrast, this leads to an experience that represents less determinate features. So, if a shift in attention leads to a shift in contrast and spatial resolution, we should also expect it to lead to a difference in the level of determinacy of the properties presented. Increased attention to a visual stimulus thus seems to change not only the phenomenology of the experience but also the properties that the experience represents. In the absence of full attention, the experience represents determinable properties, such as being warmly colored or being red (as opposed to being crimson or vermilion) or a building (as opposed to a church or a villa). On a version of representationalism that rejects direct realism, an experience does not become inaccurate simply by virtue of representing determinable properties rather than more determinate properties. So, attentional modulation of appearance is consistent with representationalism.

Fig. 1. Original and low contrast images. With high contrast very specific features are represented. With low contrast the image represents only very general features, for example, a building and a tree and some very generic colors in parts of the image.

Block's case for the mental paint view rests on an experiment carried out by Carrasco et al. (2004). Carrasco and her colleagues showed that covert attention increases contrast at the attended location and decreases it at the ignored location. Subjects were asked to fixate on the fixation point between two gradients, so-called Gabor patches, that have different contrasts and then to one of the two gradients (Fig. 2). When the subjects attended to the fixation point the two gradients appeared to have different contrasts. However, when the subjects attended to the left patch, the two gradients appeared to have the same contrast. In the original experiment attention was involuntarily drawn to the left side of the stimulus (attentional capture). However, in a subsequent experiment it was shown that the same effects could be achieved with voluntary covert attention (Liu, Abrams, & Carrasco, 2009).

Block argues that Carrasco's results show that the experiences that result from attentively seeing and less attentively seeing, say, the 22% patch differ phenomenally but that the properties represented by the experiences are the same in the two cases. If, however, attention makes a change to the phenomenology of the experiences but not to the properties represented by the experience, then the phenomenology does not flow from the content. So, representationalism is false. Block also thinks the case undermines direct realism. This is so, he says, because direct realism takes the stimulus to be constitutive of the phenomenology in veridical cases. But direct realism then predicts that the phenomenology cannot be different when the stimulus remains the same. The case against direct realism requires the further plausible premise that the experience of, say, the right 28% Gabor patch is accurate both when subjects are attending to the fixation point and when they are attending to the left 22% Gabor patch. Attention varies greatly across different visual experiences but differences in attention normally do not make a difference to whether we are perceiving veridically. If a moderate change in attention really did make a difference to whether the experience is accurate, then it would be impossible to say on principled grounds what level of attention is the right one for visual perception. If only one of the experiences were accurate, it would be entirely arbitrary which one we take to be the accurate one. For these reasons, Block argues, both experiences must be accurate.

Block considers the possibility that the contrast properties that the subjects in Carrasco's experiments are aware of are of 'different levels of specificity, grain or determinacy'. He proposes that one could argue that subjects experience a 22% and a 28% contrast when attending to the fixation point but experience the right patch as the determinable *medium–low contrast* when attending to the left side. However, Block discards this proposal on the grounds that the subjects experience the contrast in the two cases at the same level. The contrast of the right side is experienced as lower when the attention is moved to the left side, not as more generic or abstract.

James Stazicker (2011) has subsequently proposed an alternative analysis that bypasses this latter concern. He argues that experience always represents determinable properties. In the case at hand, the subjects' experiences represent determinable contrast properties both when they look at the fixation point and when their attention is left-shifted. For example, the experience of the right 28% gradient that results from attending to the fixation point may represent a determinable contrast property that subsumes determinate contrasts between 22% and 34%, whereas the experience of the right 28% gradient

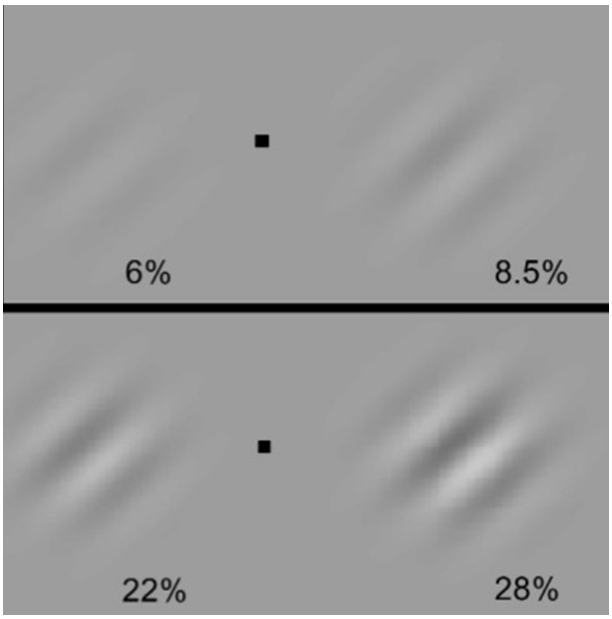

Fig. 2. The contrast difference between the pairs of gratings illustrates the effect of attention on apparent contrast. If subjects attend to the fixation point, the two patches appear to have different contrasts. If, on the other hand, subjects' attention is drawn to the left stimulus it appears to be of similar contrast as the (unattended) right stimulus (Carrasco et al. ,2004; Montagna, Pestilli, & Carrasco, 2009).

that results from attending to the 22% gradient represents a determinable contrast property that subsumes determinate contrasts between 16% and 28%. In that case, attention would alter the range of perceived contrasts by 6% but both experiences would be accurate because the actual contrast of 28% would be a determinate property of both determinables. Moreover, since the subjects experience determinable contrast properties in both cases, they experience the contrast in the two cases at the same level.

Stazicker's point that we are always only aware of determinable properties is disputable. But it certainly seems right that we often are aware of determinables rather than fully determinate properties. For example, you might be aware of a tree in the background without being aware of an elm. However, Stazicker's proposal is unlikely to accommodate Block's point that small shifts in attention should not normally make a difference to the accuracy of experience. His suggestion seems to entail that the accuracy of our experience might turn on small shifts in attention. As Sebastian Watzl (forthcoming) argues, while there could be a case in which the experiences of determinable properties represent a 6% difference in contrast and represent determinables that subsume the right determinate property, this need not be the case. For example, the experience of the right 28% Gabor patch that subjects have when attending to the fixation point might represent a determinable property that subsumes determinate contrasts between 26% and 30%, whereas the experience of the right 28% Gabor patch that results from attending to the left Gabor patch represents a property that subsumes determinate contrasts between 20% and 24%. In this case attention would alter the range of perceived contrast by 6%, so the first experience with a higher level of attention is accurate and the second inaccurate, but Block's point is that small changes in attention shouldn't ordinarily make a difference to whether an experience is accurate.

The correct response to Block's argument, I think, is to reject the assumption that the contrast properties represented by visual experience correspond to properties in the external world independently of opponent processes of the visual system and a certain level of attention. When we attend to the left 22% gradient, the right 28% gradient is perceived to have the same contrast as the 22% gradient. So, if the right 28% gradient had an objective degree of contrast independently of attention, the experience of the right 28% gradient would be inaccurate. However, the gradients do not have an objective degree of contrast independently of attention. The 28% gradient is correctly said to have a 28% contrast when it is perceived as having approximately that contrast when we are attending to it in good viewing condition. So, when the 28% gradient is perceived as having, approximately, 28% contrast when attending to it and as having a lower contrast when not attending directly to it, both levels of perceived contrast are correct. The accuracy of both experiences can be explained on the grounds that because contrast properties are mind-dependent, attention makes a difference to the properties presented in visual experience in the two cases. So, the Carresco experiments that show that attention can alter perceived contrast do not present a problem for direct realism or representationalism.

Gobell and Carrasco (2005) subsequently performed analogous experiments, showing that attention can also affect features, such as the size of a gap in a square and the spatial frequency of horizontal lines. Though these cases are initially more compelling, upon further scrutiny they turn out not to present any obvious problems for a version of representationalism that rejects direct realism. The demonstrated shifts in gap size and spatial frequency were significant but very small. The apparent spatial frequency was 3.5 cycles/degree with a neutral cue and 3.68 cycles/degree with an attention-directing peripheral cue on average, and the apparent gap size was 0.20° with a neutral cue and 0.23° with an attention-directing peripheral cue on average. These differences are only barely noticeable even when fully attended to in good lighting conditions. Small differences in size and number are what we should expect, given the view that attention can introduce a shift in the determinacy of the properties presented in experience. If a shift in attention can make a difference to the determinacy of

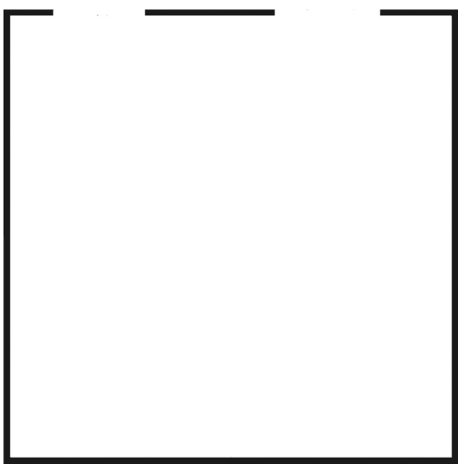

Fig. 3. Illustration of difference in gap size. The difference in gap size between the gap on the left (0.20°) and the gap on the right (0.23°) is barely noticeable with joint attention.

properties presented, less than full attention will prevent awareness of very fine-grained properties. For example, in the absence of full attention, we are not aware of differences in gap sizes in the magnitude of 0.03° of the total length (see Fig. 3). An experience that represents a determinable property that subsumes both the determinate properties 0.20° and 0.23° is thus accurate, although it represents with less precision than an experience of the gaps in the presence of full attention.

This explanation of the effect of attentional modulation on appearance is not available to the direct realist, however. If experience represents less determinate properties in the absence of full attention, then the visual stimuli do not exhaust the phenomenology of experience. So, like type 2 blindsight cases, these cases of attentional modulation of appearance present a problem for direct realism but not for a version of representationalism that rejects direct realism.

5. Conclusion

Blindsight was originally defined as residual visual abilities in patients with lesions to V1 in the absence of any reported awareness. It was subsequently established that some blindsight patients have abnormal conscious awareness in response to fast-moving, high contrast stimuli. The residual visual abilities in these conditions are now commonly referred to as type 2 blindsight. Though there is currently no consensus on whether the residual awareness is distinctly visual, there is widespread agreement that at least some forms of type 2 blindsight are a kind of veridical visual experience associated with radically altered luminance processing yielding abnormal luminance awareness (brightness perception).

The phenomenology of veridical visual experience is commonly characterized as satisfying conditions known as particularity, transparency and fine-grainedness. The phenomenology of visual experience is said to be particular, or object-involving, in the sense that it can be fully described by citing the external, mind-independent object that triggered the experience and its perceptible properties. It is said to be transparent in the sense that when we try to introspect visual experience, we see right through any internal properties of the experience and notice only the external object and its perceptible properties. Finally, it is said to be fine-grained in the sense that it appears to present very determinate properties (e.g., carmine as opposed to red), a feature of visual experience that makes it different from thought. Type 2 blindsight seems to be an exception to the hypothesis that the phenomenology of visual experience satisfies particularity, transparency and fine-grainedness. Subjects with type 2 blindsight appear to experience only highly determinable properties in their blind field, and they have no awareness of the bearer of these properties. Furthermore, they often report being aware of features hidden behind an occluder that obscures the identity of the stimulus. The view that the phenomenology of veridical visual experience is object-involving, transparent and fine-grained is crucial to direct realism, which holds that the external object and its property instances exhaust the phenomenology of veridical visual experience. So, type 2 blindsight cases give us reason to reject direct realism as a general theory of visual experience.

The case of type 2 blindness also gives us reason to think that ordinary visual experience can represent determinables rather than fully determinate properties. Neurophysiological studies have shown that changes in luminance and attentional modulation may share a common underlying neural mechanism. As awareness of luminance is defective in type 2 blindsight, and this defect appears to lead to a type of awareness that involves determinables rather than fully determinate properties, we should expect that less than full attention to a stimulus also will involve awareness of less than fully determinate properties. This insight blocks an objection to the view that the phenomenology of visual experience flows from its content based on the effects of attentional modulation on the phenomenology of visual experience.

References

Azzopardi, P., & Cowey, A. (1997). Is blindsight like normal, near-threshold vision? *Proceedings of the National Academy of Science, USA, 94*, 14190–14194.
Barbur, J. L., Ruddock, K. H., & Waterfield, V. A. (1980). Human visual responses in the absence of the geniculo-calcarine projection. *Brain, 103*, 905–928.
Barbur, J. L., Watson, J. D. G., Franckowiak, R. S. J., & Zeki, S. (1993). Conscious visual perception without V1. *Brain, 116*(6), 1293–1302.
Barbur, J. L., Weiskrantz, L., & Harlow, J. A. (1999). The unseen color aftereffect of an unseen stimulus: Insight from blindsight into mechanisms of color afterimages. *Proceedings of The National Academy of Science, USA, 96*, 11637–11641.
Benevento, L. A., & Standage, G. P. (1983). The organization of projections of the retinorecipient and nonretinorecipient nuclei of the pretectal complex and layers of the superior colliculus to the lateral pulvinar and medial pulvinar in the macaque monkey. *Journal of Comparative Neurology, 217*, 307–336.
Benevento, L. A., & Yoshida, K. (1981). The afferent and efferent organization of the lateral geniculo-prestriate pathways in the macaque monkey. *Journal of Comparative Neurology, 203*, 455–474.
Bermudez, J. L. (1995). Nonconceptual content: From perceptual experience to subpersonal computational states. *Mind and Language, 10*(xxxxx), 333–369.
Block, N. (1996). Mental paint and mental latex. *Philosophical Issues, 7*, 19–49.
Block, N. (2010). Attention and mental paint. *Philosophical Issues, 20*(1), 23–63.
Block, N. (1990). Inverted Earth. In J. Tomberlin (Ed.), *Philosophical perspectives 4*. Atascadero, CA: Ridgeview.
Brewer, B. (2007). Perception and its objects. *Philosophical Studies, 132*(1), 87–97.
Brogaard, B. (2011a). Are there unconscious perceptual processes? *Consciousness and Cognition, 20*(2), 449–463.
Brogaard, B. (2011b). Color experience in blindsight? *Philosophical Psychology, 24*(2011), 767–786.
Brogaard, B. (2012). Non-visual consciousness and visual images in blindsight. *Consciousness and Cognition, 21*(1), 595–596.
Campbell, J. (2002). *Reference and consciousness*. Oxford: Oxford University Press.
Carrasco, M., Ling, S., & Read, S. (2004). Attention alters appearance. *Nature Neuroscience, 7*(3), 308–313.
Ceccaldi, M., Mestre, D., Brouchon, M., Balzamo, M., & Poncet, M. (1992). Ambulatory autonomy and visual motion perception in a case of almost total cortical blindness. *Revue Neurologique, 148*, 343–349.
Chalmers, D. J. (2004). The representational character of experience. In B. Leiter (Ed.), *The Future for Philosophy* (pp. 153–181). Oxford: Oxford University Press.

Christensen, M. S., Kristiansen, L., Rowe, J. B., & Nielsen, J. B. (2008). Action-Blindsight in healthy subjects after transcranial magnetic stimulation. *Proceedings of the National Academy of Science, USA, 29*, 1353–1357.
Cragg, B. G. (1969). The topography of the afferent projections in circumstriate visual cortex studied by the Nauta method. *Vision Research, 9*(7), 733–747.
Crick, F., & Koch, C. (2003). A framework for consciousness. *Nature Neuroscience, 6*(2), 119–126.
Davies, M. (1992). Perceptual content and local supervenience. *Proceedings of the Aristotelian Society, 92*, 21–45.
Dennett, D. C. (1990). Quining qualia. In W. G. Lycan (Ed.), *Mind and cognition*. Cambridge, MA: Blackwell.
Dretske, F. (1995). *Naturalizing the mind*. Cambridge, MA: MIT Press.
Fendrich, R., Wessinger, C. M., & Gazzaniga, M. S. (1992). Residual vision in a scotoma: implications for blindsight. *Science, 258*(5087), 1489–1491.
ffytche, D. H., & Zeki, S. (2011). The primary visual cortex, and feedback to it, are not necessary for conscious vision. *Brain, 134*(1), 247–257.
Fish, W. (2009). *Perception, hallucination, and illusion*. New York: Oxford University Press.
Foley, R., 2011. Type-2 blindsight, self-attribution and Qualia: A problem for qualia-based accounts of blindsight, Philosophical Writings. In *Proceedings of the fifteenth annual British postgraduate philosophy conference*.
Fries, W. (1981). The projection from the lateralgeniculate nucleus to the prestriate cortex of the macaque monkey. *Proceedings of the Royal Society of London. Series B. Biological Sciences, 213*, 73–80.
Gobell, J., & Carrasco, M. (2005). Attention alters the appearance of spatial frequency and gap effect. *Psychological Science, 16*(8), 644–651.
Haddock, A., & Macpherson, F. (2008). Introduction: Varieties of Disjunctivism. In Haddock & Macpherson (Eds.), *Disjunctivism: Perception, action knowledge*. Oxford University Press.
Harman, G. (1990). The intrinsic quality of experience. *Philosophical Perspectives, 4*, 31–52.
Holmes, G. (1918). Disturbances of vision caused by cerebral lesions. *British Journal of Ophthalmology, 1918*(2), 353–384.
Jackson, F. (1977). *Perception: A representative theory*. Cambridge: Cambridge University Press.
Kennedy, M. (2009). Heirs of nothing: The Implications of transparency. *Philosophy and Phenomenological Research, 79*(3), 574–604.
Kentridge, R. W., & Heywood, C. A. (1999). The status of blindsight: Near-Threshold vision, islands of cortex & the Riddoch phenomenon. *Journal of Consciousness Studies, 6*, 3–11.
Kentridge, R. W., Heywood, C. A., & Weiskrantz, L. (2004). Spatial attention speeds discrimination without awareness in blindsight. *Neuropsychologia, 42*(6), 831–835.
Kind, A. (2003). What's so transparent about transparency? *Philosophical Studies, 115*(3), 225–244.
Koch, C., & Tsuchiya, N. (2007). Attention and consciousness: Two distinct brain processes. *Trends in Cognitive Sciences, 11*(1), 16–22.
Lau, H. C., & Passingham, R. E. (2007). Relative blindsight in normal observers and the neural correlate of visual consciousness. *Proceedings of the National Academy of Sciences of the United States of America, 103*(49), 18763–18768.
Liu, T., Abrams, J., & Carrasco, M. (2009). Voluntary attention enhances contrast appearance. *Psychological Science, 20*(3), 354–362.
Loar, B. (2003). Transparent experience and the availability of qualia. In Jokic Aleksandar & Smith Quentin (Eds.), *Consciousness: New philosophical essays* (pp. 77–96). Oxford: Oxford University Press.
Logue, H. (2014). Experiential content and naïve realism: A reconciliation. In B. Brogaard (Ed.), *Does perception have content?* (pp. 220–241). New York: Oxford University Press.
Martin, M. G. F. (2002). The transparency of experience. *Mind and Language, 4*, 376–425.
McGinn, C. (1982). *The character of mind*. Oxford: Clarendon Press.
Montagna, B., Pestilli, F., & Carrasco, M. (2009). Attention trades off spatial acuity. *Vision Research, 49*, 735–745.
Moore, G. E. (1903). The refutation of idealism. In *Philosophical studies* (pp. 1–30). Totowa, NJ: Littlefield, Adams & Co. (1965).
Morland, A. B., Jones, S. R., Finlay, A. L., Deyzac, E., Le, S., & Kemp, S. (1999). Visual perception of motion, luminance and colour in a human hemianope. *Brain, 122*(Pt 6), 1183–1198.
O'Callaghan, C. (2011). Lessons from beyond vision (sounds and audition). *Philosophical Studies, 153*(1), 143–160.
O'Connor, D. H., Fukui, M. M., Pinsk, M. A., & Kastner, S. (2002). Attention modulates responses in the human lateral geniculate nucleus. *Nature Neuroscience, 5*(11), 1203–1209.
Overgaard, M., Fehl, K., Mouridsen, K., Bergholt, B., & Cleeremans, A. (2008). Seeing without seeing? Degraded conscious vision in a blindsight patient. *PLoS ONE*, 3.
Overgaard, M., & Grünbaum, T. (2011). Consciousness and modality: On the possible preserved visual consciousness in blindsight subjects. *Consciousness and Cognition, 20*, 1855–1859.
Peacocke, C. (1992). Scenarios, concepts, and perception. In Tim Crane (Ed.), *The contents of experience* (pp. 105–135). Cambridge University Press.
Perenin, M.-T., & Jeannerod, M. (1975). Residual vision in cortically blind hemifields. *Neuropsychologia, 13*, 1–7.
Persaud, N., & Lau, H. (2008). Direct assessment of qualia in a blindsight participant. *Consciousness and Cognition, 17*, 1046–1049.
Poppel, E., Held, R., & Frost, D. (1973). Residual visual function after brain wounds involving the central visual pathways in man. *Nature, 243*, 295–296.
Riddoch, G. (1917). Dissociations of visual perception due to occipital injuries, with especial reference to appreciation of movement. *Brain, 40*, 15–57.
Ro, T., Farne, A., Johnson, R. M., Wedeen, V., Chu, Z., Wang, Z. J., et al (2007). Feeling sounds after a thalamic lesion. *Annals of Neurology, 62*, 433–441.
Sahraie, A., Weiskrantz, L., Burbur, J. L., Simmons, A., Williams, S. C., & Brammer, M. J. (1997). Pattern of neuronal activity associated with conscious and unconscious processing of visual signals. *Proceedings of the National Academy of Science, USA, 94*, 9406–9411.
Sanders, M. D., Warrington, E. K., Marshall, J., & Weiskrantz, L. (1974). "Blindsight": Vision in a field defect. *Lancet, i*, 707–708.
Schellenberg, S. (2010). The particularity and phenomenology of perceptual experience. *Philosophical Studies, 149*(1), 19–48.
Shefrin, S. L., Goodin, D. S., & Aminoff, M. J. (1988). Visual evoked potentials in the investigation of "blindsight". *Neurology, 38*(1), 104–109.
Shoemaker, S. (1982). The inverted spectrum. *Journal of Philosophy, 79*(7), 357–381.
Shoemaker, S. (1994). Phenomenal character. *Nous, 28*, 21–38.
Siegel, S. (2006). Subject and object in the contents of visual experience. *The Philosophical Review, 115*(3), 355–388.
Stazicker, J. (2011). Attention, visual consciousness and indeterminacy. *Mind and Language, 26*(2), 156–184.
Stoerig, P., & Barth, E. (2001). Low-level phenomenal vision despite unilateral destruction of primary visual cortex. *Consciousness and Cognition, 10*(4), 574–587.
Stoerig, P., & Cowey, A. (1992). Wavelength discrimination in blindsight. *Brain, 115*, 425–444.
Sturgeon, S. (2000). *Matters of mind*. London: Routledge.
Treue, S. (2001). Neural correlates of attention in primate visual cortex. *Trends in Neurosciences, 24*(5), 295–300.
Tye, M. (1995). *Ten problems of consciousness*. Cambridge, MA: The MIT Press.
Tye, M. (2000). *Consciousness, color, and content*. Cambridge, MA: The MIT Press.
Tye, M. (2002). Representationalism and the transparency of experience. *Nous, 36*(1), 137–151.
Watzl, S. (forthcoming). Can intentionalism explain how attention affects appearances? Forthcoming. In A. Pautz & D. Stoljar (Eds.), *themes from block*. The MIT Press.
Weiskrantz, L. (1980). Varieties of residual experience. *Quart. J. Exp. Psychol., 32*, 365–386.
Weiskrantz, L. (1986). *Blindsight: A case study and implications*. Oxford: Oxford University Press.
Weiskrantz, L. (1998b). *Introduction to the new paperback edition of blindsight. Blindsight: A case study and implications*. Oxford: Clarendon Press.
Weiskrantz, L. (2009). Is blindsight just degraded normal vision? *Experimental Brain Research, 192*, 413–416.
Weiskrantz, L., Barbur, J. L., & Sahraie, A. (1995). Parameters affecting conscious versus unconscious visual discrimination with damage to the visual cortex (V1). *PNAS, 92*(13), 6122–6126.

Weiskrantz, L. (1998a). Consciousness and commentaries. In S. R. Hameroff, A. W. Kaszniak, & A. C. Scott (Eds.), *Towards a science of consciousness II: The second tucson discussions and debates* (pp. 371–377). Cambridge, MA: MIT Press.

Weiskrantz, L., Warrington, E. K., Sanders, M. D., & Marshall, J. (1974). Visual capacity in the hemianopic field following a restricted occipital ablation. *Brain, 97*, 709–728.

Wu, W. (2011). What is conscious attention? *Philosophy and Phenomenological Research, 82*, 93–120.

Yukie, M., & Iwai, E. (1981). Direct projection from the dorsal lateral geniculate nucleus to the prestriate cortex in macaque monkeys. *Journal of Comparative Neurology, 201*, 81–97.

Zeki, S., & Ffytche, D. H. (1998). The Riddoch syndrome: Insights into the neurobiology of conscious vision. *Brain, 121*(1), 25–45.