Cite as: Brogaard, B, Marlow, K, Rice, K. "Unconscious influences on decision making in blindsight", Behavioral Brain Sciences, forthcoming.

Unconscious influences on decision making in blindsight

Berit Brogaard[1], Kristian Marlow[1], and Kevin Rice[1]

Abstract:
Newell and Shanks (2012) argue that an explanation for blindsight need not appeal to unconscious brain processes, citing research indicating that the condition merely reflects degraded visual experience. We reply that other evidence suggests that blindsighters' predictive behavior under forced choice reflects cognitive access to low-level visual information that does not correlate with visual consciousness. Thus, while we grant that visual consciousness may be required for full visual experience, we argue that it may not be needed for decision making and judgment.

Main Text:
Blindsight—the ability that some people with striate cortical lesions have to make solid predictions about visual stimuli in the absence of any reported visual awareness—is a paradigmatic example of unconscious perceptual influence on conscious behavior. Newell and Shanks (2012) are skeptical about the influence of unconscious processes on decision making in blindsight, given that blindsight seems to have alternative explanations that do not appeal to unconscious processes. To back up their claim, they cite research indicating that blindsight may just be degraded visual experience (Campion et al. 1983; Weiskrantz 2009; Overgaard 2011). A review of further empirical and theoretical work in the area of blindsight reveals that Newell and Shanks's conclusions primarily based on Overgaard's (2011) findings on blindsight are premature (Hardin 1985; Stoerig & Cowey 1992; Cowey 2001; Heywood & Kentridge 2003; Brogaard 2011a, 2011b, 2011c, 2012b).

Using a multipoint awareness measurement (PAS), Overgaard (2011) shows that the reported degree of conscious experience in blindsight correlates with the blindsight subjects' predictive success in visual tasks. These considerations appear to indicate that it is conscious perception, rather than unconscious processes, that is responsible for blindsighters' predictive behavior. For these reasons, Newell and Shanks conclude that we need not appeal to unconscious processes in explaining blindsighters' success in decision making. However, Overgaard's studies do not completely rule out that the reported awareness that corresponds to predictive success in blindsight is awareness associated with the higher-order predictive act rather than genuine *visual* awareness. The subjects may not have the abilities to distinguish between being aware of thoughts or judgments and being visually aware of a visual stimuli (Brogaard 2011a, 2012b), in which case the PAS studies don't show that unconscious influences are not needed for the predictive behavior.

Further, it's only under forced-choice paradigms that blindsighters are in a position to make predictions about visual stimuli. This suggests that, unlike neurotypical individuals, blindsighters lack full visual awareness in their access to visual information. Even if Overgaard's findings are granted, blindsighters' degraded conscious experience may reflect cognitive access to low-level information deriving from visual, *un*conscious processes taking place in the retina

[1] Department of Philosophy and Center for Neurodynamics, University of Missouri, St. Louis, Lucas Hall, St. Louis, Missouri 63121, USA. Corresponding author: Berit Brogaard, brogaardb@gmail.com

and the LGN (and perhaps to some extent in V1). Likewise, the correlation between accurate responses and subjective reports of consciousness may only reflect the subject's level of cognitive access to information derived from visual, unconscious processes. If this is the case, then visual processes that do not correlate with visual awareness may well be at work in blindsighters' decision making, even if the information that is unconsciously processed can be cognitively accessed in forced-choice paradigms. In light of such observations, Newell and Shanks' conclusion to the effect that blindsighters' predictive behavior is not influenced by unconscious processes does not hold up.

Theories and research about color processing, together with blindsight data, provide additional evidence that blindsighters must be tapping into unconscious processes in order to make successful predictions about visual stimuli (Brogaard 2011a, 2011b). Though blindsight patients have lesions to striate cortex, they can still process information from opponent processes in the retina and the LGN. The Hering-Hurvich-Jameson opponent-process theory is the most popular explanation of how the brain interprets signals from the cones and rods in the retina (Hardin 1985; Brogaard 2012b). Three types of cones (L for long, M for medium and S for short) are responsible for detecting chromatic (colored) daylight, while rods are responsible for detecting achromatic (black-white) nightlight. Because the three types of cones overlap in the wavelengths of light they record, color is processed via three opponent channels manifested in bipolar cells. These cells measure differences between red (L) and green (M), blue and yellow (the differences between L plus M and S) and black and white (the sum of L and M). For example, when the activity of M exceeds L, the resulting perceived color is green. When the activity of S exceeds the joint activity of L and M, the perceived color is blue.

Blindsighters can detect these outcomes, yet they have degraded function of the double opponent cells of striate cortex and in areas upstream from the primary visual cortex. As a result, they cannot detect the standard dimensions of color, such as brightness, saturation and hue. Even if damage to V1 does not prevent weak visual experiences, it does preclude full visual experience of colors (Hardin 1985; Stoerig & Cowey 1992; Brogaard 2011a, 2011b, 2011c, 2012b). Likewise, people with achromatopsia, which results from a defect to the V4/V8 color complex, lack conscious color experience of the full range of colors (Heywood, Kentridge & Cowey 2001; Heywood & Kentridge 2003; Brogaard 2011a).

Despite reporting no or only weak awareness of visual stimuli, blindsighters are able to act reliably in response to wavelengths of light presented to their blind field region, or scotoma. For example, Stoerig and Cowey (1992) showed that under forced choice, three blindsighters were able to discriminate among narrowband wavelength stimuli despite lacking experience of any conscious visual stimuli. A more recent study showed that inhibiting activity in V1 via transcranial magnetic stimulation (TMS) can result in the absence of color awareness in neurotypical individuals despite the retained ability to discriminate among wavelengths in a forced-choice paradigm (Boyer, Harrison & Ro 2005).

Studies have also shown that blindsighters can be trained to detect wavelengths in the absence of conscious color experience (Zihl 1980; Bridgeman & Staggs 1982; Zihl & Werth 1984; Stoerig & Cowey 1992). Stoerig (1993) presents the case of patient F.S. who initially, for several years, showed no statistically significant detection of visual stimuli. However, his performance eventually began to improve. The trainability of blindsighters provides further evidence that blindsight patients do in fact lack conscious visual experience. If blindsighters did have degraded visual perception, we should expect subjective reports made by trained subjects to reflect greater visual awareness in correspondence to their improved ability to accurately respond to visual stimuli. This, however, is not the case. Trained blindsighters consistently report no or only weak conscious visual experiences. Although patients such as F.S. consistently report a lack of conscious visual experience, trainability suggests that these blindsighters learn to report on other information that may be easily available for conscious access. In these cases, blindsighters presumably act on the physical bases of color experience despite lacking normal conscious visual experience.

Thus, while visual consciousness may be needed for full visual perception, certain cases show that visual consciousness may not be needed for decision making and judgment. Cognitive access to information processed unconsciously appears to suffice for reliable decision making in blindsight. In these cases visual information that does not correlate with visual consciousness influences predictions about features of the visual stimuli present in the subject's blind field.

Works Cited:

Boyer, J. L., Harrison, S. & Ro, T. (2005) Unconscious processing of orientation and color without primary visual cortex. PNAS 102(46):16875-16879.

Brogaard, B. (2011a) Are There Unconscious Perceptual Processes?. Consciousness and Cognition 20:449-63.

Brogaard, B. (2011b) Conscious Vision for Action Vs. Unconscious Vision for Action. Cognitive Science 35:1076–1104.

Brogaard, B. (2011c) Color Experience in Blindsight?. Philosophical Psychology 24:767-786.

Brogaard, B. (2012a) Non-Visual Consciousness and Visual Images in Blindsight. Consciousness and Cognition 21: 595-596. http://dx.doi.org/10.1016/j.concog.2011.12.003

Brogaard, B. (2012b) Colour Eliminativism or Colour Relativism?. Philosophical Papers 41:305-321.

Bridgeman, B. & Staggs, D. (1982) Plasticity in human blindsight. Vision Research 22:1199-1203.

Campion, J., Latto, R. & Smith, Y. M. (1983) Is blindsight an effect of scattered light, spared cortex, and near-threshold vision?. Behavioral and Brain Sciences 6:423-486.

Hardin, C. L. (1985) Color for Philosophers: Unweaving the Rainbow (Expanded Edition). Indianapolis: Hackett Publishing Company.

Heywood, C. A. & Kentridge, R. W. (2003) Achromatopsia, colour vision & Cortex. Neurological Clinics of North America 21:483-500.

Heywood, C. A., Kentridge, R. W. & Cowey, A. (2001) Colour & the Cortex: Wavelength Processing in Cortical Achromatopsia In: Varieties of Unconscious Processing: New Findings & Models, eds. B. De Gelder, E. De Haan & C. A. Heywood, [52-68]. Oxford: Oxford University Press.

Newell, B. R. & Shanks, D. R. (2012) Unconscious influences on decision making: A critical review. Behavior and Brain Sciences, forthcoming.

Overgaard, M. (2011) Visual experience and blindsight: A methodological review. Experimental Brain Research 209:473-479.

Stoerig, P. (1993) Sources of blindsight. Science 261:493-494.

Stoerig, P. & Cowey, A. (1992) Wavelength Discrimination in Blindsight. Brain 115:425-444.

Weiskrantz, L. (2009) Is blindsight just degraded normal vision?. Experimental Brain Research 192: 413-416.

Zihl, J. (1980) Blindsight: improvement of visually guided eye movements by systematic practice in patients with cerebral blindness. Neuropsychologia 18:71-77.

Zihl, J. & Werth, R. (1984) Contributions to the study of 'blindsight' II. The role of specific practice for saccadic localization in patients with postgeniculate visual field defects. Neuropsychologia 22:13-22.