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More than meets the eye: Implicit perception in legally blind individuals

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ABSTRACT

Legally blind participants (uncorrected vision of 20/200+) were able to identify a visual stimulus attribute (clock hand position) in the absence of consciously identifying its presence. Specifically, participants—with their corrective lenses removed—correctly guessed the hour-hand position above chance (8%) on a clockface shown on a computer screen. This occurred both when presented in a 1-clockface display (28%), as well as when shown a display containing 4 clockfaces (21%), in which only 1 face contained a hand. Even more striking, hand identification accuracy in the 4-clockface condition was comparable whether the clockface containing the hand *was* (21%) or *was not* (20%) correctly identified. That legally blind individuals are capable of identifying stimulus attributes without conscious awareness provides an additional vehicle for exploring implicit perception. Consistent with previous research, the visualsystem can apparently cope with degraded visual input through information available through a(n unconscious) secondary pathway via the superior colliculi.

1. Introduction

Research on perception without awareness has focused for many years on establishing an unambiguous empirical paradigm (Marcel, 1983; Merikle & Reingold, 1990; Mitchell, 2013). The psychophysical concept of defining an "objective" consciousness threshold has been elusive, even with signal detection, linear regression, and relative sensitivity measures (Hannula, Simons, & Cohen, 2005). Furthermore, although self-report is the clearest indication of a lack of conscious awareness, its very subjectivity raises concerns about participants' confidence and decision criteria. Indeed, subjective awareness estimates vary widely with different measures, e.g., Perceptual Awareness Scale, confidence ratings, and post-decision wagering (Sandberg, Timmermans, Overgaard, & Cleeremans, 2010).

Kihlstrom and his colleagues (Kihlstrom, 2008; Kihlstrom, Barnhardt, & Tataryn, 1992) suggested redefining subliminal vs. supraliminal perception as implicit vs. explicit perception, parallel to implicit vs. explicit memory (Mitchell, 2006; Roediger & McDermott, 1993; Schacter, 1987). Regarding an event or object "in the current environment," Kihlstrom (2008) defined implicit perception as "…any change in the person's experience, thought, or action that is attributable to such an event, in the absence of (or independent of) conscious perception of that event" (p. 588).

Kihlstrom et al. (1992) reviewed a number of paradigms used to measure implicit perception, including phenomena with normal participants (perceptual defense; hypnotic suggestion), participants with psychopathology (conversion disorders, or hysterical blindness), and patients with the neurological impairment known as "blindsight." The methodological difficulties

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in this area of research range from response bias (perceptual defense; hysterical blindness) to subject selection (hypnotic suggestion). In spite of these methodological issues, research interest in implicit perception has been robust in the two decades following Kihlstrom et al.'s (1992) review. The phenomenon of "blindsight" presents a particularly compelling instance of implicit perception. Patients with primary visual cortex (V1) damage who are unable to consciously acknowledge the presence of a stimulus can nevertheless identify stimulus characteristics such as location, color, contrast, and orientation (Pöppel, Held, & Frost, 1973; Sanders, Warrington, Marshall, & Weiskrantz, 1974; Weiskrantz, 1980, 1986). Some even equate "unconscious visual processing" with blindsight in terms of the functional dissociation between awareness and performance (Marzi, Minelli, & Savazzi, 2004).

In attempting to mimic blindsight phenomena in visually intact observers, Meeres and Graves (1990) used traditional threshold setting procedures and presented an open circle subliminally (25–55 ms, followed by a pattern mask) at various locations in the visual field. When asked to identify the circle's location, participants were correct above chance even when they claimed that no stimulus was present. Blindsight in normal observers was also demonstrated by Kolb and Braun (1995) with a binocular rivalry paradigm, but their phenomenon was not replicated (Morgan, Mason, & Solomon, 1997; Robichaud & Stelmach, 2003). More recently, Lau and Passingham (2006) used metacontrast masking to produce "relative blindsight" inhealthy observers, but again, their paradigm was challenged on methodological grounds (Jannati & Di Lollo, 2012).

Related to the present investigation, Hannula et al. (2005) indicate that "observers are often under-confident about their perceptual experiences and report no awareness even when detection of stimuli by forced-choice methods is better than chance" (p. 248). This illustrates the critical dissociation between subjects' reports of their own awareness vs. their forced-choice accuracy. Hannula et al. underscored that both proponents of implicit perception and its skeptics can agree on two key points: (1) "the evidence for implicit perception cannot rely solely on participants to accurately report their state of awareness," and (2) "qualitative differences in performance can support claims of implicit perception even if they are not definitive on their own" (p. 247).

In the present research, we eschew perceptual threshold per se (whether dichotomous or continuous, cf. Overgaard, 2011) and focus instead on stimulus clarity (vs. intensity or duration), which circumvents some difficulties with prior implicit perception research. Our use of participants classified as "legally blind" addresses the first concern above regarding participants' subjective judgments of their own awareness: without their corrective lenses, their inability to see a stimulus is a genuinely objective condition. In other words, asking our participants to remove their glasses served as a proxy for setting an objective threshold. The second criterion above will emerge if these individuals exhibit qualitative differences in performance with and without their lenses. Thus, we manipulated lens maladjustment rather than stimulus duration to mimic thresholds in legally blind individuals *without* (subthreshold) and *with* (suprathreshold) their corrective lenses. We examined their ability to identify the hour hand location on a clockface.

A variety of orientation tasks were tested with D.B., the famous blindsight patient (Weiskrantz, 1986, 1987; Weiskrantz, Warrington, Sanders, & Marshall, 1974). Using forced-choice procedures, he was able to discriminate a vertical bar from a horizontal bar, the letters "X" vs. "O," a horizontal vs. a non-horizontal grating, square vs. diamond, and even "T" vs. "4." However, we reasoned that these simpler orientation tasks used by Weiskrantz and colleagues would be too easy for our subjects. The clockface has the advantage of a forced-choice paradigm, but with 12 multiple-choice answers instead of a binary decision. Also, all of our subjects were completely familiar with the basic stimulus format. In addition, based on D.B.'s performance, Weiskrantz (1986) argued that orientation "must be reckoned to be one of the most sensitive" residualcapacities (p. 72).

In the 1 clockface condition, participants simply provided the hand location. In the 4 clockface condition, participants identified both the hand location as well as the face containing the hand. Following Kihlstrom (2008), we refer to uncorrected and lens-corrected viewing conditions as implicit and explicit perception, respectively.

2. Method

2.1. Participants

A total of 23 "legally blind" individuals participated in the present investigation. They were affiliated with either Southern Methodist University or a medical facility in San Antonio, Texas. All of the participants had uncorrected vision of 20/200+ in both eyes and corrected vision (via glasses) of 20/20 in both eyes. Participants ranged in age from 20 to 49 yrs (mean = 35 yrs) and participated on a voluntary basis. Students were given extra course credit as a reward for their participation, and the IRB at both institutions approved the research.

2.2. Design

A 2×2 within-subjects factorial design was used, with the variables of vision (implicit, or lens uncorrected vs. explicit, or lens corrected) and clockface (1 vs. 4). On the 1 clockface trials, a single 3-in diameter clock face was presented in black in the center of a white background on a computer screen. The border of the clock was 1/8 in wide. Twelve 1/16-in wide "spokes" projected inward 3/8 in from the outer border, in locations representing the hour positions of an analog clock face. On each trial, one 1/16-in wide hand projected from the center of the clock face outward toward *one* of the 12 h positions (see Fig. 1).