

Awareness: More Than Meets the Eye

***A Review of Consciousness Lost and Found: A Neuropsychological Exploration* by Lawrence Weiskrantz**

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1. Introduction

Larry Weiskrantz has made a substantial contribution to the field of neuropsychology over the last 30 years. In particular, his seminal work on blindsight and the amnesic syndrome has led to the gradual acceptance by the scientific community of what were previously dismissed as mere artifacts of poor experimental design. Today there is an explosion of interest in the covert processing found in such neuropsychological deficits in the absence of awareness. It is rather timely, therefore, that a review has been written to summarise the major and rapid advances in research on blindsight and amnesia. Although this is essentially what this latest monograph of Weiskrantz's (appropriately subtitled, "A Neuropsychological Exploration") represents, the book also contains a statement of the author's views on awareness and speculations on how research in this area should continue. In some parts, this book reads like an updated version of Weiskrantz's 1986 monograph on blindsight (*Blindsight: A Case Study and Implications*), only vastly

simplified in order to be accessible to a non-specialist. In particular, the central theme of this book (commentaries as being crucial for awareness) appears to be an elaboration of the final chapter in the 1986 monograph (on commentaries).

Weiskrantz confronts a number of formidable issues of consciousness in this book, but frames them all in the context of patient performance in neuropsychological deficits which demonstrate a double dissociation. For example, blindsight subjects may actually be able to detect and discriminate visual stimuli of which they are unaware in a two-alternative forced-choice paradigm, while amnesic patients may be able to retain information which they do not realise is in memory. Hence, the title: by "lost", he means the loss of awareness in these neuropsychological syndromes, and by "found", he refers to the retention of a capacity for covert processing.

His review of previous research, mainly in blindsight and amnesia, culminates in an argument on the ontological nature of awareness itself. Essentially, the argument is that the ability to render a parallel acknowledged commentary is a *sine qua non* for consciousness. Weiskrantz uses the many examples of perceptual or attentional deficits in the literature to bolster this argument and, based on neuroimaging techniques, even speculates on sites which may be integral to the generation of awareness and the possible experiments which might reveal these sites. He also broaches a number of subsidiary but nevertheless relevant issues, namely those of animal awareness and the evolutionary value of awareness.

The organisation of the book sees Weiskrantz switch from topic to topic, with some degree of repetition between chapters (which was deemed necessary for each chapter to be intelligible on its own). As such, this review will highlight features of the book according to their conceptual significance, rather than in the strict order in which they arise.

2. Surveying the Dissociative Disorders

The first two chapters are spent orienting the reader to the general neuropsychological deficits which reflect "performance without awareness." Of course, today it is acknowledged that covert processing occurs in a great many, if not all, perceptual and attentional deficits. Unsurprisingly, Weiskrantz chooses to head the list with the amnesic syndrome and blindsight, on which Weiskrantz is arguably the foremost authority. Other deficits are not ignored, however. There are references in the text to such disorders as unilateral neglect, blind touch (numbsense), deaf hearing, prosopagnosia, anosagnosia, acquired dyslexia, aphasia and achromatopsia; and the performance of commissurotomy (split-brain) patients is also addressed briefly in the introductory chapters. It is commendable that such a wide range of disorders are sampled in the text, albeit in considerably less detail than the author's two main preoccupations (blindsight plays an unquestionably dominant role in the book). But this was all to Weiskrantz's advantage,

for the data gleaned from those who suffer from these other deficits only offer additional support for the argument which he later advances.

Having said that, it is rather unfortunate that the author chose not to elaborate on some of the syndromes mentioned. For example, some researchers of unilateral neglect (which is essentially an *attentional* problem) suggest that it may offer significant insight into the neural basis of visual awareness, especially when contrasted with a *perceptual* deficit such as blindsight (e.g., Driver & Mattingley, 1998). Weiskrantz does briefly allude to the differences between the two, when he describes blindsight as a disconnection between visual inputs and a commentary system, and unilateral neglect as a bias within the commentary system itself (p. 220). However, further explicit and somewhat less abstract contrasts might have reinforced some of the propositions that he advances (e.g., that VI is necessary but not sufficient for visual awareness). It would be unfair, however, to criticise the author for negligence in having to deal with so many deficits. Clearly blindsight and amnesia were chosen to play central roles in the book and Weiskrantz does offer his apologies in advance for any omissions or over-simplifications of his colleagues' research (p. 5).

As far as the centrepieces of this monograph are concerned, the author's reviews are succinct and accurately encapsulate the more significant research in each area. The amnesic syndrome was probably the first to be seriously considered in the context of performance in the absence of awareness, with some amnesics (the famous HM, for one) now known to show excellent residual retention of motor skills (such as following a track on a pursuit rotor) and learnt pictorial or verbal material, as well as the ability to be primed and classically conditioned. The observation of a syndrome with such double dissociations has had a major impact on theories of memory, leading to the highly influential theory of multiple memory systems.

A similar double dissociation was found in the celebrated blindsight subject, who is capable of detecting and discriminating certain aspects of a visual stimulus in the absence of awareness. Much has been learnt about blindsight since the publication of the author's 1986 monograph. Indeed, the extensively tested subject of that book (DB) would appear to have disappeared from the blindsight scene, to be replaced by the long-suffering and much sought-after "professional subject," GY. The review of the blindsight literature synthesises some of the older research with more recent findings into a coherent whole, giving due credit to several well-established researchers in the area, such as Alan Cowey, Petra Stoerig and Tony Marcel, to name but a few. In his broad survey of the literature, Weiskrantz describes the residual visual abilities of blindsight subjects (e.g., in spatial localisation; orientation, colour and form discrimination; motion detection and direction discrimination), as well as the results of numerous animal studies by Gazzaniga and Nakamura and Mishkin, for example.

The fact that blindsight commands most of the author's attention is unsurprising and largely warranted. After all, the literature demonstrates that blindsight is an example *par excellence* of a double dissociation. Coupled with the fact that the visual system is one of the most extensively studied sensory modalities in humans and other primates, blindsight

has a great potential to reveal something about visual awareness; in particular, the neuroanatomical structures that give rise to it. In this monograph, blindsight data facilitate a discussion on neural pathways of awareness, while amnesia provides insight into the nature of the patients' commentaries.

However, as Weiskrantz would be the first to point out, neither the amnesic syndrome nor blindsight has always been accepted as valid instances for covert processing in the absence of awareness. Indeed, there have been (and continue to be) numerous attacks on the legitimacy of blindsight as an example of performance without awareness (e.g., Campion, Latto, & Smith, 1983; Fendrich, Wessinger, & Gazzaniga, 1992). For example, it has been claimed that the above-chance performances of blindsight subjects represent nothing more than the artifactual effect of stray light; spared islands of visual cortex; or differential response criteria. Blindsight has also been described as nothing more than degraded normal performance.

We see in this monograph some evidence of the exasperation that has arisen from a lifetime of having to defend against such criticisms and of having to dispel the skepticism and frank disbelief initially expressed by the scientific community. For instance, he writes "These were healthy responses... although they were pursued in some instances with unseemly zeal and persistence beyond the point of positive relevance" (p. 37). In fact, to digress slightly, there are many examples in the book of facetiously snide remarks towards his critics or to those whose opinions he challenges. Witness, for instance, the author's rebuff of Dennett's hypothesis of multiple drafts: "Nor will the blindsight subject wish to have visual awareness dismissed as a by-product of multiple drafts.... He is likely to be a multiple draft-dodger" (p. 202).

To return to Weiskrantz's main line of thought, both blindsight and amnesia (along with the spectrum of other neuropsychological deficits) are deficits which have resulted in a loss of some aspect of awareness. Blindsight subjects are unable to acknowledge awareness *of* a visual event, while amnesic subjects are unable to acknowledge awareness *that* retrieved information can be accessed. Therefore, these subjects may be able to perform in forced-choice tasks at a better-than-chance level, but they are unable to provide a parallel acknowledged commentary of their performance. This is the hallmark of all of the syndromes considered in the book. We are thus brought one step closer to the core of Weiskrantz's argument.

3. The Commentary and Its Relation to Consciousness

Weiskrantz argues that commentaries (or the lack of them) are crucial in studies on consciousness because they provide the means by which we decide whether or not a subject is aware of an event. As such, the commentary-key paradigm figures prominently in a number of chapters. This paradigm has been instrumental in research on blindsight and it is appropriate that its success be described here by the man who first proposed it (Weiskrantz, 1986). In this paradigm, the subject is told, as usual, to guess which of two

alternatives was presented (e.g., horizontal vs. non-horizontal movement of a visual stimulus). The innovation involves a second set of response keys ("commentary keys"), through which the subject indicates his awareness of the visual event (indicating "yes" for any experience whatsoever of the stimulus and "no" only if he had no experience at all).

This paradigm has allowed numerous advances to be made in understanding the differences between the processing of visual information of which the blindsight subject is and is not aware. Responses to moving stimuli are particularly useful in this regard, for it has been shown that subjects such as GY can actually report some conscious experience of a sharply transient or rapidly moving visual stimulus. By applying the commentary-key paradigm to moving stimuli (whose stimulus parameters may be adjusted), it has been possible to precisely compare GY's performance in the aware mode (involving high velocity visual stimuli) with his performance in the unaware mode (involving low velocity stimuli). Doing so has confirmed that GY can perform very accurately even when he reports being completely oblivious of the stimuli that had been presented.

The versatility of the commentary-key paradigm is also highlighted as Weiskrantz takes a chapter-long foray into the slippery area of animal consciousness. The investigation of animal consciousness hinges on behavioural studies, but the problem of such studies is usually that awareness does not always accompany a behavioural response. Here, again, it is the commentary key to the rescue. Since first proposing a *gedanken* experiment involving apparently blindsighted monkeys and the commentary key in his 1986 book, such an experiment has actually been conducted and it demonstrates the close parallels between human and animal blindsight. While variations of the commentary-key paradigm have been applied to other neuropsychological syndromes such as amnesia (both in animals and humans), the remaining syndromes remain largely unexplored in animals, due mostly to a difficulty in finding the appropriate animal correlates to test.

Despite the seemingly diverse range of neuropsychological deficits in which covert processing has been found to occur, Weiskrantz proposes that they all reflect the fact that commentaries are a *sine qua non* of consciousness. This is the central argument around which the entire monograph revolves. In both blindsight and amnesia, the ability to render a commentary is lost. Consider memory, for example. Weiskrantz argues that it is the interaction between current and stored information that yields a commentary in normal healthy subjects. In the amnesic syndrome, when the ability to provide such a commentary is lost, the amnesic may be able to access stored information, but not in remembered form.

Similarly, in blindsight, the fact that above-chance discrimination of a visual stimulus is not accompanied by awareness implies that, "*awareness always requires a parallel and separate response to the discrimination itself for it to be identified and acknowledged as such by the subject*" (p. 76, italics his). This general hypothesis can be interpreted in two forms. The weak form of the argument suggests that commentaries simply *enable* an acknowledgement of awareness to occur, while the stronger states that awareness arises

out of the very ability to make a commentary (i.e., this ability *endows* a creature with awareness).

Although it is impossible to adjudicate objectively between these versions of the argument based on current evidence, Weiskrantz does state his preference for the stronger (and more challenging) version. Indeed, the weak form of the argument seems almost intuitively obvious. It could perhaps even be said that this version leads us nowhere in understanding the nature of awareness, given that *ex hypothesi* the commentary is formed *post hoc* -- awareness must occur before one can make a commentary to acknowledge it. Regardless of which position one adopts, however, this general argument of commentaries as being a *sine qua non* for awareness is certainly consistent with most of the psychophysical and behavioural data on the neuropsychological deficits described.

4. The Evolutionary Value of Consciousness

The disabilities that are incurred upon suffering such neuropsychological deficits are reviewed in a chapter on the evolutionary value of awareness. It is clear that *sans* awareness, one is without the ability to manipulate explicitly thoughts or images for the purposes of survival. While the residual processing that remains following, for example, a striate cortical lesion or a temporal lobe lesion is impressive, it cannot be used in thinking or activity by the subject, who must be forced to provide their above- chance responses (p. 66). Prompted by this observation, Weiskrantz asks the practical question of whether it is possible to restore overt processing in these syndromes -- a question that has obvious implications for patient rehabilitation and retraining. As far as most of the neuropsychological deficits are concerned, especially amnesia, Weiskrantz expresses his pessimism about finding a means to do so.

In blindsight, however, he raises an intriguing question; one which some have labelled the problem of "super-blindsight" (Tye, 1996). Imagine a blindsight subject whose performance is optimised by providing him/her with feedback after every trial. Over time, suppose that this person is trained to will him/herself to respond without being cued; to "guess when to guess." If the subject comes to believe these reports, and if these are identical to those which normal healthy subjects would issue when confronted with the same stimuli, the question is: would conscious perception emerge as a result?

Dennett (1991), who initially proposed this *gedanken* experiment, is confident that it will, but Weiskrantz does not share this optimism. On the basis of subjective reports given by the extensively-tested GY, Weiskrantz believes that the visual system of a super-blindsight subject is unlikely to ever graduate to be conscious of the contralesional visual world. In the many years that GY has been tested, he could only use vague terms such as "feeling" that the stimulus had been presented, even when he was confident of the stimulus having appeared. Clearly, however, the answer is not obvious *a priori* and it would be a very interesting experiment to attempt (not to mention one at the height of heroism), for even if a super-blindsight subject is not fully "conscious" of the stimulus

presented, there is still the perplexing question of how a such a subject's *belief* that a stimulus had occurred would differ from a normally sighted individual's *experience* of its presence.

5. The Method of Triangulation

Having emphasised the integral role of the commentary stage in sensory awareness, the question arises as to its possible underlying neural substrate. Weiskrantz does not shy from confronting this challenging problem and proposes a general interdisciplinary approach towards it. He could hardly go wrong here -- after all, "interdisciplinary" seems to have been the catch phrase of the '90s (one need only look at the title of this very journal for evidence of this). Flanagan (1992), for example, has proposed a similar approach (the "natural method") which encompasses each and almost every discipline of relevance (including phenomenology and evolutionary science). Weiskrantz is more specific. He believes that the three key disciplines of philosophy, neuroscience and psychology should spearhead investigations into consciousness ("triangulation"), with psychology at the leading apex, and philosophy and neuroscience at the trailing ends.

Weiskrantz claims that psychology is apt to be at the leading apex of the triangle because consciousness cannot be understood by examining the brain *qua* neurons. This is very much a personal view, of course, and is far from universally accepted. Whilst being a scientist these days almost invariably entails adopting a default materialist standpoint, Weiskrantz is quick to separate himself from the reductionist and eliminativist philosophies. This sets him apart from the neuroscientists who might claim, for example, that, "It is premature to try to describe how the brain really works using just a black-box approach.... *The language of the brain is based on neurons.*" (Crick, 1994, p. 256, italics his). However, Weiskrantz's point that "If a Martian looked at the human brain and read every terrestrial textbook of physiology describing its intrinsic activity, he would never discover the organ allowed comprehension and generation of speech" (p. 194) is well taken.

Consistent with the inclusion of philosophy in his method of triangulation are his frequent references to the work of such philosophers as Rosenthal, Searle, Dennett and Block. Unlike most other scientific investigators of consciousness, therefore, Weiskrantz does not ignore or simply dismiss the opinions of philosophers, which is highly commendable (compare this, for example, to one such as Crick, who does not hold philosophers in as high a regard, e.g., "Philosophers have had such a poor record over the last two thousand years that they would do better to show a certain modesty rather than the lofty superiority that they usually display," Crick, 1994, p. 258). In fact, Weiskrantz's very commentary argument has a philosophical grounding, one based on David Rosenthal's Higher-Order Thought (HOT) theory (Rosenthal, 1986, 1993).

The HOT theory states *inter alia* that second-order thoughts about first-order thoughts must occur for the first-order thoughts to be rendered conscious. There does appear to be

a strong relation between Rosenthal and Weiskrantz's positions, insofar as Weiskrantz believes that the commentary stage (analogous to Rosenthal's "second-order thought") achieved in the processing of an input (or "first-order thought") is what allows one to be aware of that input. It is a rare occasion indeed when two theories arising from disparate fields and separate observations (one philosophical and the other based on empirical evidence) concur so elegantly, and I believe this does much for the theories and positions of both Weiskrantz and Rosenthal.

6. "C" for Consciousness and Commentaries

After describing his general strategy on uncovering the neural substrate of awareness, Weiskrantz attempts to actually apply it. He poses two questions (p. 142) that he attempts to answer with his method of triangulation:

1. What brain structure(s) are necessary and/or sufficient for visual awareness?
2. What removes experience from the discrimination in blindsight and what allows it to occur in normal perception?

Weiskrantz first briefly reviews a number of solutions that have been proposed (such as Schacter's DICE model, Crick & Koch's gamma oscillation hypothesis, quantum theory and Strong AI), and states his position against the more esoteric of these (e.g., quantum theory). He then continues by describing the relevance to visual awareness of areas such as V1, extrastriate cortex, and all other closely-related structures with a direct connection to V1.

In essence, the upshot of Weiskrantz's extensive and well-synthesised review is that both V1 and extrastriate cortex are necessary for consciousness, but are ultimately insufficient. In his view, V1 is a major distribution point, *but not the origin*, of visual inputs. It is postulated that the major role of "higher" visual cortices in normal perception is to select a particular relevant stimulus attribute (say, colour) and then feed this information back to V1. In addition, he postulates the existence of a target area "C", quite separate from V1 and its closely associated areas, which may light up when the subject is aware of a visual stimulus but not when she or he is unaware (alternatively, it might light up in both the aware and unaware modes, but more strongly when the subject is aware of the stimulus). This area "C" can potentially receive visual information from both V1 and associated areas, as well as from visual afferent fibres which completely bypass these areas. Should such a region be shown to exist, he surmises that it must ultimately feed back into the region of V1 and its interconnections, as must the back-projections from "higher" visual cortices, in order to gain access to the commentary stage. Since V1 effectively acts as a funnel in receiving visual information from these different areas, its destruction prevents this information from being fed forward to the commentary stage, resulting in a loss of awareness. Motion, however, may still be able to gain access to the commentary stage via

subcortical pathways. This independence of motion processing may be due to its evolutionary value (e.g., being aware of sudden movements by an aggressive predator).

Weiskrantz does speculate on a number of possible candidates for area "C", such as prefrontal cortex, while paying attention to empirical findings from animal lesion studies. He expresses a hope that neuroimaging studies will reveal the location of this area, and proposes an experiment in which a blindsight subject is tested in both the aware and unaware modes (with rapid- and slow-moving stimuli respectively) while being imaged. Just prior to the book's publication, such an experiment was actually conducted and is described in the Postscript. The results indicated that there might not be an isolated "C" for visual awareness; rather, the data demonstrated a shift of activity between the aware and unaware modes, from dorsolateral to medial prefrontal cortex, and from cortex to superior colliculus. In the absence of a Post-Postscript, it appears that we must await further experimentation in order for these data to be more completely interpreted and understood in the context of visual consciousness.

7. General Considerations

This book is about commentaries and their relation to awareness. As such, the title could be misleading, insofar as "consciousness" is taken to be synonymous with "awareness." Admittedly, "consciousness" is an irritatingly non-specific, polysemous term, and Weiskrantz does acknowledge that it is "used in a large variety of different ways and with all kinds of nuances, but here we restrict it to those dissociations that have emerged from the neuropsychological syndromes under review" (p. 164). This is certainly acceptable, although it was somewhat disappointing that the "hard problem" of consciousness was not more extensively addressed. In particular, the delicious mystery of qualia is largely sidestepped: Weiskrantz does concede that, "If [commentaries are endowing of awareness], I do not necessarily take this to be an easy solution to the question of how qualia... arise" (p. 204). But "what it is like" to undergo a particular phenomenal experience is an issue at the very heart of consciousness -- it is what makes the mystery of consciousness so intractable -- and I believe such issues should have been addressed to a greater degree in this book.

In terms of style, this monograph was written with the non-specialist in mind and, as such, there is some degree of repetition between chapters, with the language at times being quite informal -- but always clear. While the author has had to be selective in the material which he presents, his choice of experiments is appropriate, well-organised and undoubtedly succeeds in delivering an impression of the field as it exists today. He goes to some lengths to keep the reader informed of recent progress in the area, as reflected in his inclusion of a postscript, written between the submission of the manuscript and its publication. I imagine that a non-professional would find the book very readable (perhaps with some assistance from its glossary and appendix), despite its rather technical flavour. A basic knowledge of neuroanatomy would be of benefit, especially in appreciating the subtleties of experimental design which have the potential to be obscured by the

overlying complexities. Largely, however, the significance of the major experiments he describes speak for themselves (e.g., those based on the commentary-key paradigm).

To the experienced neuropsychologist, much of the monograph will be familiar territory. After all, while the syndromes he describes may be stunningly counterintuitive to the non-expert, they are the stock-and-trade of neuropsychological research. However, even though the extensive reviews may not enlighten, Weiskrantz's opinions on the role of the commentary in awareness are well worth reading.

Consciousness Lost and Found does not claim to be a monograph that will revolutionise neuropsychology. Instead, it is an excellent review of the vast amount of research conducted primarily on two most fascinating neuropsychological phenomena, and is a privileged insight into the author's position on awareness and his impression of the status of current research. This monograph makes a strong claim for the potential that deficits such as blindsight and amnesia possess in helping to expose the secrets of awareness. Given the strength of such a potential, we would do well to continue the process of unravelling this most tantalising of problems, the solution to which appears to lie right beneath (or at least behind) our noses.

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