A brief view on blindsight: philosophical importance and a recent case study.

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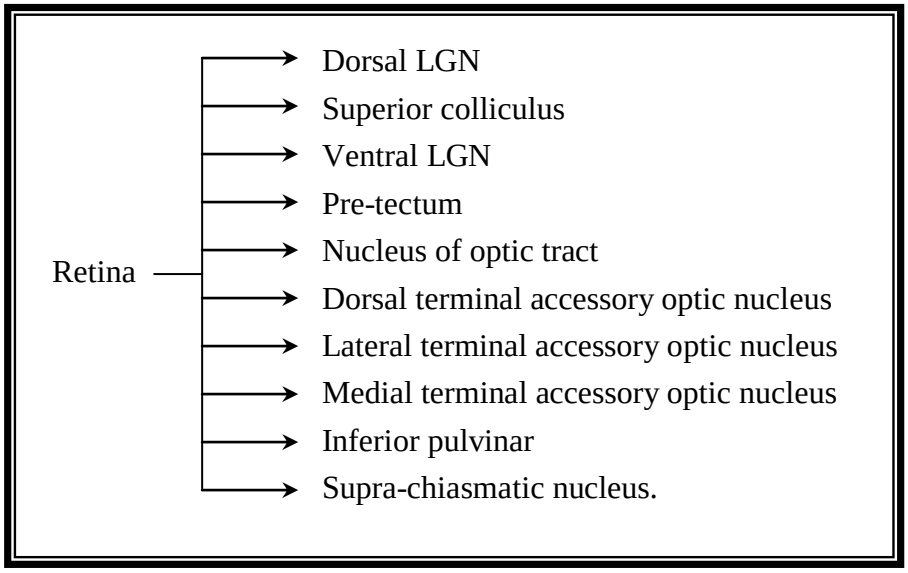
Presented to Professor Michel IMBERT, as a validation work to the NS8.

This work is divided in two parts: a very short, introductory, 'philosophical' prelude, and then a second part in which we will highlight some of the main points of a recent study on 'affective blindsight'.

I
— A philosophical prelude —
Some considerations on the methodological importance of blindsight for neuroscience.

Blindsight is the ability of physically discriminating visual stimuli of which there is no awareness. We could say that we are in a presence of an ability only observable from a third (and not a first) person perspective. It is a very hot and debated problem in some circles, and a battle-horse of people like Weiskrantz (and his team) or Stoerig; it has also generated a lot of controversies in the past decades. However, when we look closely at it, it is difficult to see why it has brought such controversy. In fact, why should it appear remarkable that people without a functioning V1, can in fact remain with some faint visual processing abilities disconnected from conscious experience? It is a triviality that a large part of the cognitive processes present in the brain are not accessible to conscious observation (like processing of visual depth, pitch or spatial localization of sounds, etc), so, if stimuli are incapable of reaching V1 but are nevertheless (through the remaining 10%-15% of intact neural pathways) capable of reaching other destinations in the brain, why shouldn't this give rise to some faint (unconscious) discriminative ability? The following is a table showing the connections that, according to Weiskrantz, remain active even in the absence of V1 (taken from Weiskrantz, 1997, p.128).



This kind of reasoning has been raised against blindsight on more than one occasion and Weiskrantz at least has responded ferociously to all attempts to trivialize blindsight. On his book *Consciousness Lost and Found,* (thereafter called: Weiskrantz, 1997) he even says:

> "it can be argued that patients' sensory information is too weak to 'reach the sensorium', in the language of the nineteenth century, but is nevertheless capable of

> having a covert effect on some parts of the nervous system. … I confess that I feel uneasy with such a simplistic view as a general account of dissociations of awareness. … Nor can I understand just how to set the 'threshold' for awareness, or why there should be one. … In case 'sensorium' is thought to be a relic of nineteenth-century language, note that it appears in one pristine twentieth-century physiological treatise…" etc. (pp. 39-40)

Without entering into these kinds of controversy here we would like simply to remind that the (major) contributions that makes blindsight so important seem independent of aetiological considerations. We will distinguish three main contributions on the scientific part: [1]

1. An augmentation of the kinds of possible laboratorial experiments: Blindsight shows that consciousness is something that can be studied by scientific experiments in laboratorial conditions. New experiments on blindsight involving animals show that these experiments can be redesigned in a way to show if animals are in fact experiencing objects or just making forced choices.
2. A restriction of the kinds of laboratory settings – since some limits on experimentation are also imposed. For instance, in a study made to access musical appreciation despite of partial cortical deafness, it was assessed that musical appreciation did exist since the subject could choose, among several tunes, the ones that were the more pleasing. Experiences like blindsight show that results based on forced choice decision can yield unintended results since subjects can still guess correctly even without awareness that they are doing so.
3. An understanding of the mechanisms that explain the dissociation between function and awareness will suggest candidates for theories of consciousness. Weiskrantz, for instance, is striving to determine, in his more recent experiments on blindsight, which structures of the brain might apply as neural correlates of consciousness (NCC). (It is in this study that we will engage in the second part of our text.)

In general, blindsight is not important for what it says of the brain but for what it demands on scientific research. Some years ago awareness was considered some kind of ineffable property without the reach of contemporary (at least) science. Now we are beginning to see not also that it can be assessed scientifically, but that it cannot even be ignored if we are concerned with the exactitude of laboratorial results. Of course, blindsight is far from unique in this change of perspective in current neuroscience (in fact, it would be completely incapable of making a shift just by itself). By the contrary it is accompanied by a set of related research themes, all of them unintelligible without the concept of consciousness (or awareness). We describe them due to its importance in understanding the importance that blindsight might have in helping to make a shift in current research (the following list was presented by me as part of an oral exposition to S. Thorpe, NS7 course).

[1] There are also some interesting implications for current philosophical argument. I will not treat this here but it includes themes like: determining a function for consciousness, considerations on the self (specially following Dennett's multiple drafts view), and a slight difficulty for functionalist accounts of consciousness.

Pathologies in which there is a dissociation between behaviour and consciousness or verbal reportability (Following Weiskrantz, 1997).

Amnesia: ability to learn /train behaviour is maintained even without awareness of pastthe learning process or even the behaviour effectively learned. The evolution of learning is comparable to non-amnesic subjects. This distinction between ability and awareness is also present in other memory impairments like **prosopagnosia** in which the inability to recognise subjects at a conscious level is contradicted by the involuntary responses at the body level (for example by differences in skin conductance) when in the presence of familiar faces.

Acquired Dyslexia: A subject unable to distinguish meaningful from non-sense words on a conscious level may distinguish them correctly (in suitable conditions) if asked to discriminate them by chance. The same applies to more specific tasks: "[using forced-choice responding] he could say whether the written name of a country belonged to the inside or outside of Europe, whether the name of a person was that of an author or politician, or whether the name of an object was living or non-living" (Weiskrantz, 1997, p.27. ref. article Shallice and Saffran, 1986). This dissociation also occurs in different kinds of **aphasia**, regarding both semantic and syntactic content (for references see Weiskrantz, 1997, pp.27-29)

Blindsight: Ability to behave as if the external stimuli was detected but with no (visual or any kind of) awareness of the stimuli (in fact this ability to react appropriately was so good that the unawareness passed unnoticed in the first studies of monkeys in which the V1 was ablated). More recently it was found out that the identification of affective expressions could also be made without awareness, which was dubbed **affective blindsight**. (see Gelder, 1999, and Gelder, 2000)

Blind Touch (or numbsense): ability to react to tactile stimuli of which the subject is not aware of the stimuli. For instance a subject is able to 'guess' correctly the location of a tactile stimulus on a numb arm. (see Paillard, 1983, also Rossetti, 1995)

Deaf Hearing: not much explored, see Michael and Peronnet, 1980. Other literature shows that familiars of the patients sometime describe involuntary reactions to sounds in otherwise complete cortical deaf patients, but these cases were not experimentally studied.

Unilateral neglect: Although the subjects deny any awareness of objects in their neglected field, they can nevertheless guess correctly about some of their properties (see Marshal and Halligan, 1988; Bisiach, 1992, Ladavas et al., 1993 (for semantic priming) and Berti and Rizzolatti, 1992 (for visual priming)).

Anasognosia: In all the previous cases the "subject may not 'know' it, but some of part of the brain does" (Weiskrantz, 1997, p.26). In this case, there is still a dissociation between function and awareness, although we observe the inverse relation: the subject consciously maintains he continues to possess an ability that he no longer maintains (for example in blindness or paralysis).

II
A brief analysis of some of the main points in recent experiments on 'affective blindsight'

We will now analyse one article on affective blindsight[2] followed by a critical review[3] and a response.[4] The experiment under analysis tried to detect unconscious processing of the emotional content of facial expressions in patients suffering from blindsight.

Introduction:

The experiment was done on GY, a well-known subject in experiments on blindsight. GY is blind in his right hemifield in result of 'damage to his left occipital lobe at the age of 8.'[2] Several videos were presented to GY showing faces expressing emotional states (fear, anger, sadness or happiness). The faces were all of the same person (an actress) and sequences of visual stimuli were grouped into separate blocks. The blocks varied according to the size of the image, the number of options available (either two (fear/anger or sadness/happiness), either four), the congruence between the available responses and the stimuli presented (explained bellow), the orientation of the stimulus (upright or inverted), and, in some cases, still pictures were used instead of videos. An EEG was also recorded.

After the presentation of each video or still picture in his blind hemifield, GY was asked to 'guess' the kind of stimuli he had just been presented to. GY always denied having any awareness of the stimuli although he "frequently reported detecting the offset and onset of a white flash' (p.3760)[2]. As a control measure the stimuli were also presented to GY's good hemifield and he was able to categorise 'flawlessly' every stimulus.

Results:

Perhaps the most interesting result is that GY was unable to distinguish the emotional content of facial expressions in the case of still pictures. More predictably, he was also unable to distinguish facial expressions where the available choices did not match the pictures showed. This happened in the last experiment where GY was presented (in his blind hemifield) with videos showing angry or fearful faces and he could only choose between happy or sad labels. In this case 'there was a clear majority of sad responses but without any relation with the video that was shown.' (p.3762)[2]. Using happy versus sad videos and angry / fearful labels 'the relative frequencies of the two response labels show very little relation to the presented videos.' (p.3762)[2] However, although there is a clear lack of processing abilities in the case of non-congruency between videos and labels "GY did not report experiencing anything strange or different between congruent and non-congruent blocks." (p.3761)[2]

Using video as stimuli the GY performed always better than chance, either with small versus bigger image, either with the upright versus inverted image, either presented with two or four available options.[5]

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[2] "Non-conscious recognition of affect in the absence of striate cortex", by de Gelder, Vroomen, Pourtois and Weiskrantz, 1999, *Neuroreport*, 10, 3759-3763.

[3] "Affective blindsight?", by Charles Heywood and Robert Kentridge, *Trends in Cognitive Science*, April 2000, 4(4): 125-126.

[4] "Affective blindsight?: are we blindly led by emotions?", by de Gelder, Vroomen, Pourtois and Weiskrantz,, *Trends in Cognitive Science*, April 2000, 4(4): 126-127.

[5] Generally the videos were presented in just two alternatives: either Happy/Sad, either Angry/Fearful. GY was then asked to choose only among the relevant alternatives. However, when all four possibilities were available GY guessed correctly 52% of the time (the chance level would be of 25%).

Conclusions:

The main consequence of this experiment is that it gives support to a hypothesis raised by Morris,[6] according to which there would be a subcortical visual pathway from the retina bypassing V1, and that can activate the amygdala via a colliculo-pulvinar pathway. Both data from the EEG and the abilities demonstrated by GY support that hypothesis.

On the other hand, this study also poses the problem of understanding how the amygdala can process visual information that was not visually processed by the visual cortex. As Heywood and Kentridge say:

> "there has been little previous evidence that blindsight subjects can discriminate between even simple shapes let alone something as complex as facial expression. How did GY demonstrate 'affective blindsight'?"(p.125)[3]

In their review they suggest that 'it could be telling' that the discrimination could only be made using moving stimuli since 'Considerable more information … can be conveyed through a limited capacity channel when the face moves." And they illustrate with a study in which 7-month-old infants can 'discriminate facial expression from the motion of just a few moving points of light attached to a moving face.' (p.125)[3]

But, in their reply, de Gelder et al, show that further (yet unpublished) studies have showed that this capacity can be elicited even with still pictures. This has been found when

> "we measured the impact of a face to the blind field on the response to a facial stimulus presented to the intact, seeing field. The results showed that incongruency between the expressions presented to the two hemifields significantly delayed judgement of the facial expression in the seeing field."(p.126)[4]

However strong this evidence might turn out to be, it is certainly strange that the discrimination between facial expression, which would seem to demand heavy visual processing, can be accomplished without the visual cortex entirely.

Other evidence for the very specific character of the discrimination made by the amygdala is that "covert discrimination of other facial attributes such as personal identity, gender and facial speech are not observed."[7] Note that it seems at least as easy to distinguish gender as facial expression from the perspective of strict visual processing. [8]

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[6] Morris, Friston, Büchel, et al, 1999, A subcortical pathway to the right amygdala mediating unseen fear." *Proceedings of the National Academy of Sciences*, U.S.A., 96, 1689,1685.

[7] Op.cit., p.126. The authors are here referring to the results of a study made by Rossion, B., et al, "Early extrastriate activity without primary visual cortex." *Neuroscience Letters*, (in press).

[8] We think some insights can be gained here from comparing the experiments made by Bach-y-Rita regarding vision in the blind through the use of tactile stimulation (for a review of the literature see Bach-y-Rita, 1984, "Tactile vision substitution: past and future. *Int. J Neurosci*, 19(1-4): 29-36). In these experiments an array of vibrators were connected to the photosensors of a camera, and, when the camera was allowed to move in the control of the person having the array of vibrators, it gave the person some visual processing abilities.This can be astonishing if we think that, in this particular case, no information was passing to or through the visual cortex. And, even so, the subjects could recognise shapes, distance, and other properties of objects. After some time they claimed that the sensations were no longer felt on the skin but on the exterior. Now, what we would like to propose is that we should not regard this kind of stimuli as visual stimuli in the same way that stimuli used by blindsight patients should not be regarded as visual. We would like to suggest that there is a strong parallel between the two experiments in that they both allow for processing abilities that we would normally consider to be visual, but nevertheless do not apparently involve the visual cortex (although in blindsight some ramifications of the optical nerve still get to V2, V3, V4, MT, and other areas of the visual cortex, even in the complete absence of V1. Cf. Weiskrantz, 1997, pp. 128-9).