

the pop-out target in a visual search task, gist perception of a scene, categorization of peripheral targets when a very intensive cognitive-resource task has to be performed at fixation, and iconic memory.

Consider Sperling's original iconic memory experiment (Sperling 1960) or Landman et al.'s (2003) variant. Subjects report that they clearly, vividly, and consciously see a field of letters or a bunch of bars arranged on a circle. This is also what we experience when we look at such displays. However, it is well known that subjects have only very limited access to the detailed properties of the individual elements, unless top-down attention is directed to a subset of stimuli using appropriately timed cues. Our basic point is that phenomenology without conscious access is an example of consciousness without top-down attention processing, though the converse is not true; that is, not every example of conscious perception in the absence of top-down attention is cognitively non-accessible. For example, the gender of a briefly presented face can be accurately reported even if subjects are engaged in a highly demanding task at the fixation (Reddy et al. 2004).

So what is the story at the level of the brain? Decades of electrophysiological recordings in monkeys have proven that the spiking response of neurons in the ventral visual stream (e.g., in areas V4 and IT) representing attended stimuli is boosted at the expense of the response to non-attended items. According to Crick and Koch (1995), this enables these neurons to establish a reciprocal relationship with neurons in the dorsolateral prefrontal cortex and related regions that are involved in working memory and planning (and language in humans), leading to reverberatory neuronal activity that outlasts the initial stimulus duration. Critical to the formation of such a single and integrated coalition of neurons are the long-range axons of pyramidal neurons that project from the back to the front of cortex and their targets in the front that project back to the upper stages of the ventral pathway (possibly involving stages of the thalamus, such as the pulvinar [Crick & Koch 1998b], and the claustrum [Crick & Koch 2005]). The subject now consciously sees these stimuli and can report on their character (e.g., identify the letter [Sperling 1960] or the orientation of the square [Landman et al. 2003]). Furthermore, the subject also has a strong conscious sense of the entire scene ("I see an array of letters") that is likewise mediated by a loop that involves the inferior temporal cortex and the frontal lobes half-way across the brain.

But what happens to those stimuli that do not benefit from attentional boosting? Depending on the exact circumstances (visual clutter in the scene, contrast, stimulus duration) these stimuli may likewise establish coalitions of neurons, aided by local (i.e., within the cortical area) and semi-local feedback (i.e., feedback projections that remain consigned to visual cortex) loops. However, as these coalitions of neurons lack coordinated support from feedback axons from neurons situated in the prefrontal cortex, thalamus, and claustrum, their firing activity is less vigorous and may decay much more quickly. Yet, aided by the neuronal representation of the entire scene, these weaker and more local coalitions may still be sufficient for some phenomenal percepts.

Block cites fMRI studies of patients with visuospatial hemineglect (Driver & Vuilleumier 2001; Rees et al. 2000; 2002b) that offer evidence of enhanced hemodynamic activity in the fusiform face area contralateral to a face that the patient is not aware of. For Block, this raises the question of whether this is likewise an example of phenomenal consciousness without cognitive access. We answer this question clearly in the negative. First, one should trust the first-person perspective: That is, in the absence of compelling, empirical evidence to the contrary (such as Anton's blindness, also known as hysterical blindness; Sackeim et al. 1979), if the subject denies any phenomenal experience, this should be accepted as a brute fact. If we take the existence of mere recurrent, strong neuronal activation as evidence for consciousness, why not argue that the spinal cord or

the enteric nervous system is conscious but is not telling me (Fearing 1970)? Second, the relationship between neuronal firing activity and the associated hemodynamic BOLD response is a very complex one. In particular, there are well-documented cases where a vigorous fMRI signal is observed in the absence of any spiking from the principal neurons in that area (Harrison et al. 2002; Logothetis 2003; Logothetis & Wandell 2004; Mathiesen et al. 1998). Synaptic activity is a much larger driver of hemodynamic activity than are action potentials. Therefore, a much more cautious reading of these studies is that they demonstrate synaptic input into the fusiform face area in these patients; however, whether or not this input is vigorous enough to establish a sustained coalition of neurons is totally up in the air and requires further investigations.

In conclusion, the quiddity of the neuronal correlates of conscious access are long-range loops between the back and the front of cortex and its associated satellites (thalamus, basal ganglia and claustrum), enabled by top-down attention. Without this amplification step, most coalitions in the back are fated to die; however, given the right conditions, a few may survive and may be consciously experienced by the subject. Yet, as the informational content of these coalitions are not accessible to working memory and planning circuits in the front, the subject cannot consciously access the detailed stimulus attributes. Our explanation provides a plausible account of how phenomenal consciousness can occur without cognitive access.

## Partial awareness and the illusion of phenomenal consciousness

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**Abstract:** The dissociation Block provides between phenomenal and access consciousness (P-consciousness and A-consciousness) captures much of our intuition about conscious experience. However, it raises a major methodological puzzle, and is not uniquely supported by the empirical evidence. We provide an alternative interpretation based on the notion of levels of representation and partial awareness.

In his target article, Ned Block is dealing with a difficult problem: how to empirically demonstrate that phenomenal consciousness (hereafter P-consciousness) is dissociable from access consciousness (hereafter A-consciousness). An a priori argument in favor of this dissociation is the common intuition that the representational content of phenomenal experience is much richer than the limited content we can access at a given time. In Block's words, "phenomenology overflows cognitive accessibility" (sect. 8, para. 6). This intuition is so strong that it appears very easy, at first glance, to show how much richer P-consciousness is, compared with A-consciousness.

However, providing an empirical demonstration of this dissociation leads to a major methodological difficulty: any measure of consciousness seems inevitably to require the involvement of A-consciousness. From there on, it seems impossible to show evidence for P-consciousness without A-consciousness. This methodological puzzle arises also in dissociating consciousness and top-down attention. Demonstrating consciousness without attention seems impossible for similar reasons: To assess consciousness of the stimulus, one needs to direct the subject's attention on the stimulus! Although there is converging evidence that attention can affect both conscious and unconscious

perception, the reverse dissociation involving the possibility of consciousness without attention remains highly debated (see Dehaene et al. 2006; Koch & Tsuchiya 2007). Block acknowledges this methodological issue and proposes to take the set of evidence at hand *as a whole* and see whether it points towards the researched dissociation. Using, among others, examples from perception of unattended objects (e.g., attentional blink, change blindness), and from partial report Sperling-like experiments, Block assumes that we should adopt the A- versus P-consciousness dissociation and look for its respective neural bases.

Unfortunately, the evidence Block is using cannot unequivocally prove his theory. Furthermore, we think that the empirical data reviewed in his target article do not provide more support for his accounts over alternative and crucially simpler explanations. In the empirical phenomena that Block is using, one can distinguish two types of situations: those involving partial access and those involving undetectable stimuli.

The first type of situation involves stimuli that are visible but unattended – and importantly, not even detected – implying the absence of any conscious access. This is usually the case during attentional blink and inattentive blindness experiments. Block uses the fact that the stimulus is supra-threshold (it can be reported when attention is drawn towards it) to argue for P-without A-consciousness. But there is no evidence for this claim, since subjects do not even detect the unattended stimulus. Moreover, Block's claim that participants forget their phenomenal episode appears impossible to test, because any probe would modify their attention and hence make the stimulus consciously accessible (Kouider et al. 2007).

In the second type of situation, by contrast, subjects are aware of “some” information: stimuli are presented very briefly and/or in a degraded fashion, such that they are not fully visible but not subliminal either. Block assumes that this situation gives rise to P- without A-consciousness. We propose instead that what happens here is rather a form of partial awareness in the absence of full awareness. Partial awareness reflects the situation where subjects have transient access to lower but not higher levels of representation. For instance, visual word recognition implies the processing of several hierarchically organized levels (e.g., fragments, letters, whole word). With degraded presentation conditions, lower levels can be accessed (e.g., fragments/letters) while higher levels cannot (whole word). Still, subjects can use such partial information in conjunction with context/expectations to make hypotheses about the representational content at higher levels of processing (Kouider & Dupoux 2004). Under this perspective, Block's richness of phenomenal experience can be reinterpreted as the transient activation of a large quantity of degraded low-level information. In such partial awareness conditions, the available information is quantitatively rich but qualitatively poor.

This hypothesis allows us to construe the Sperling phenomenon (see Sperling 1960) as resulting from partial awareness: subjects have a transient and degraded access to fragments of all the letters in the grid. As subjects are not expecting anything other than letters, fragments are used to reconstruct as many letters as possible. Due to mnemonic decay and attentional overflow, subjects are able to reconstruct at most about four letters. Crucially, the unreported items are never identified as letters per se and remain coded as unidentified letter fragments. A similar situation of partial without full access is the McConkie experiment, in which subjects see “letter-like” fragments in the periphery and infer that these are real letters. In our previous work (Kouider & Dupoux 2004) we have extended this phenomenon to a dissociation between the letter and the word level. We have induced subjects to access some but not all letters of a real or false color word (GREEN or GENER). We found that both the real and false color words are identified and treated as real words, as assessed by both subjective reports and the magnitude of the Stroop effect.

An important question for future research will be to characterize whether such reconstruction processes imply metacognitive/

inferential interpretations or rather more direct perceptual illusions. Block acknowledges that McConkie's experiments involve a reconstruction process (what Block labels “cognitive illusions”). However, Block assumes that subjects in Sperling-like experiments are not reconstructing the visual scene but genuinely experiencing the whole set of items. To justify this special treatment, Block argues that the Sperling phenomenon is somehow mandatory and does not require subjects to explicitly report the stimuli, implying that it is a perceptual rather than a metacognitive reinterpretation. Yet, these statements remain highly speculative, as none of them has been empirically demonstrated. For us, it is highly probable that Sperling-like paradigms also lead to the “experience” of letters even when the uncued items consist of false letters. Of course, disentangling this issue requires further empirical research.

All these remarks point towards the same direction: Including a typology in terms of levels of representation during conscious access, along with the associated notion of partial awareness, provides a unified description of the empirical evidence at hands. In particular, this account offers more explicit specifications of the functional mechanisms leading to conscious perception.

## Sue Ned Block!

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**Abstract:** Block makes a case for the existence of conscious experience without access. His case would have been much stronger, however, if he had woven fully unconscious processing into the “mesh argument,” and considered arguments that are intrinsic to neuroscience.

Sometimes, science looks like a court of law. There is a scientific hypothesis – the defendant – and there are its advocates and opponents – the defense and prosecution. Here, the defendant is conscious experience. It stands accused of not existing in its own right. Conscious experience is what we *say* we see or hear, what we cognitively access and manipulate – so claim the prosecutors. Ned Block is leading the defense team, arguing that we should not equate conscious experience with cognitive access. Many psychological experiments show mental representations that have higher capacity than what is reported by the subject. These mental representations have phenomenal qualities and might just as well be conscious representations. There is sufficient evidence to cast *reasonable doubt* on the accusation. Should the defendant be satisfied with such a defense, or litigate for malpractice? I think the latter. Block has made only half a plea (his “mesh argument” lacks a key consideration), and left out all the forensic evidence (arguments *intrinsic* to neuroscience).

Neurophysiological studies in primates (Supèr et al. 2001b), as well as EEG (Sergent et al. 2005), fMRI (Haynes et al. 2005), and TMS (Silvanto et al. 2005b) studies in human subjects, show that recurrent or re-entrant processing between different regions of the brain is necessary for conscious experience. In the Global Workspace theory (GWT) (Baars 2005; Dehaene et al. 2006), the content of information processed in, say, visual areas, is broadcast and made available for global access by means of recurrent amplification. “Workspace neurons,” in prefrontal cortex, are vital to this amplification, because they provide long-range connections between sensory and motor cortices. With global

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