Current theories of consciousness posit a dissociation between ‘phenomenal’ consciousness (rich) and ‘access’ consciousness (limited). Here, we argue that the empirical evidence for phenomenal consciousness without access is equivocal, resulting either from a confusion between phenomenal and unconscious contents, or from an impression of phenomenally rich experiences arising from illusory contents. We propose a refined account of access that relies on a hierarchy of representational levels and on the notion of partial awareness, whereby lower and higher levels are accessed independently. Reframing of the issue of dissociable forms of consciousness into dissociable levels of access provides a more parsimonious account of the existing evidence. In addition, the rich phenomenology illusion can be studied and described in terms of testable cognitive mechanisms.

One or two types of consciousness?

The arguments: phenomenal overflow and neural purity
Box 1. Dissociating consciousness: from philosophy to neurobiology

**Easy vs. hard problem.** The easy problem of consciousness consists of a set of issues about the informational properties of conscious states that are tractable with the standard tools of cognitive science: we can use objective measures of consciousness to explore its relationship with the integration of sensory information, attention, working memory, etc. The hard problem of consciousness consists of explaining the experiential dimension of consciousness: the first-order subjective nature of qualia and phenomenal states, the ‘what is it like to be conscious’, and how and why we experience consciousness at all [8,34].

**Access vs. phenomenal consciousness.** The epistemic distinction between easy and hard problems maps, according to Block [9], on two forms of consciousness. Phenomenal consciousness is related to the private first-person experience (i.e. qualia). Understanding this constitutes the hard problem. Access consciousness corresponds to the fact that some representations are ‘poised for direct control of thought and action’ [9]. Block further links conscious-accessed contents with global broadcasting [35], similar to workspace theories of consciousness [3,6]; that is, ‘contents information about which is made available to the brain’s “consumer” systems: systems of memory, perceptual categorization, reasoning, planning, evaluation of alternatives, decision-making, voluntary direction of attention, and more generally, rational control of action.’ Arguably, this property can be explained in terms of computational mechanisms that, through attention, amplify transitory information, maintain it in short-term memory and exploit it in controlled cognitive operations, eventually leading to long-term memory storage and report. Phenomenal consciousness presumably occurs without attention (Box 3) and reflects rich-capacity contents in sensory memory (e.g. iconic buffer), whereas access consciousness necessitates attention and reflects a limited set of elements in working memory.

**Dissociative theories in neuroscience.** Several theories have adopted Block’s dissociation and explicitly distinguish between two neural correlates of consciousness. For instance, the duplex vision theory of Milner and Goodale [36] has recently been updated to associate sustained ventral stream activity with phenomenal consciousness, whereas only the involvement of more anterior (e.g. prefrontal) regions supports conscious access [37]. Similarly, Zeki [38] has recently linked micro- and macro-consciousness in his original theory [39] with the phenomenal consciousness of specific attributes (colors, contrasts, etc.) and bound objects, respectively, whereas unified consciousness is somewhat analogous to access consciousness. In the local recurrence theory of Lamme [15,40], phenomenal experience is explicitly associated with any recurrent neuronal activity (i.e. local or global loops), whereas conscious access occurs only for global recurrence. Although all these theories diverge in many respects, they all link phenomenal consciousness with posterior (i.e. occipitotemporal) regions, whereas anterior (i.e. prefrontal, workspace) areas are linked to conscious access (see [2] for a review). Notably, the original motivation underlying Block’s distinction has been somewhat lost. Although it was primarily intended to stress the non-functional, non-mechanistic nature of phenomenal contents, neurobiological accounts actually treat phenomenological aspects in terms of functional (i.e. neurocomputational) mechanisms and are rather driven by the motivation to probe consciousness in the absence of subjective reports. In any case, both neurobiological and philosophical dissociative accounts share the assumption that a fundamentally inaccessible form of consciousness exists.

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**Figure 1.** Two interpretations of Sperling’s classical study on the availability of information in brief presentations [11]. In the original study, observers were presented with flashed arrays of 12 letters. Although they could report only three or four items, they had the impression of ‘seeing all the letters’. When Sperling presented an auditory cue following the array, instructing subjects to report only one of the three rows, they reported nearly all items, indicating that there were indeed more contents available than the three or four items they could initially report. The green ellipse represents attentional capture and amplification. According to dissociative approaches (Interpretation 1), subjects are phenomenally conscious of all the items in the array, but then, because of time pressure, can only access a few elements before they fade away from the iconic buffer. According to the partial awareness hypothesis (Interpretation 2), observers consciously access a large quantity of low-level information (i.e. fragments) that is transiently activated and are also heavily biased towards the presence of letters in the entire array. Consequently, when the information is only fragmentary, subjects automatically fill in the array either with reconstructed letters (perceptual illusions) or with letter tags (cognitive illusions), leading to the impression of a rich and complete visual experience (Box 2). According to this proposal, the impression of richness is not basic and primary, but is actually a late construct [12].
and workspace theories of consciousness. Our counter-arguments center on the fact that the phenomenal overflow argument is confounded with partial awareness situations, whereas the neural purity argument reflects the confusion between phenomenal consciousness and unconscious perception. We start with the overflow argument.

First, it is important to stress that limits in (verbal) reportability should not be equated with limits in access. Perhaps our visual experience seems rich because we lack the conceptual representations and the words to describe it. Perception involves non-conceptual contents that are difficult to verbalize, such as shades of colors, smells, etc. However, the relative poverty of verbal reports in these domains should not be equated with poverty in access. Indeed, the hallmark of psychophysics is precisely to uncover the rich, graded and multidimensional aspects of domains such as color and smell perception using indirect measures such as similarity judgments. Furthermore, because verbal reports take time and are performed in a sequential manner, accessible information might have disappeared prior to verbalization. Nonetheless, subjects’ performance in non-verbal tasks such as detection (e.g. ‘Is there something or nothing on the screen?’) or discrimination (e.g. ‘Is it X or Y?’) shows that information can be accessed before it fades away. In other words, the overflow argument might only show that access overflows verbal report.

Second, the intuition of a rich phenomenal experience on which the overflow argument is built might be overstated. Indeed, observers might overestimate both the quantity and accuracy of the information they experience at a given moment, lured either by a ‘cognitive illusion of seeing’ or by perceptual illusions (Box 2).

Third, the possibility of inaccessible consciousness is methodologically dubious: if subjects do not have access to their experience, how can we determine that they are conscious of it? What difference would it make to them if

Box 2. Partial awareness and perceptual illusions

Cognitive vs. perceptual illusions. When a complex stimulus is degraded (e.g. brief, masked, peripheral), observers cannot report its total content but nonetheless experience a rich visual experience. This has been described as a form of cognitive illusion, whereby subjects have a feeling of seeing that does not correspond to what they can access [14,27]. This cognitive illusion occurs because a scene can normally be inspected at will, and hence temporarily missing information is not a cause of alarm. In other words, the perceptual system uses the external world as a memory buffer. However, recent research has shown that perceptual contents at a given level of representation reflect the merging of bottom-up stimulus-related information with information already present at that level. For instance, observers can rapidly extract the gist from a brief visual presentation and use this information as prior information for identification of the details [41]. Furthermore, perceptual interpretation of a visual stimulus can be biased by means of expectations [42] or prior exposure [43]. Although cognitive illusions are probably real, it seems more appropriate to account for overflow phenomena in terms of perceptual illusions whereby partially represented sensory signals contribute, along with top-down expectations, to the reconstruction of perceptual contents.

Perceptual illusions under partial awareness. Partial awareness situations are those in which the subject accesses the stimulus information at some but not all representational levels. Information at other levels can remain inaccessible or, in some situations, can be accessed by filling in plausible content. This occurs when the signal is weak or degraded and reliance on prior information is high. We studied such illusory contents in two previous studies (Figure I). In a modified Stroop priming paradigm with visible but degraded stimuli, subjects treated nonwords as if they were real color words (e.g., GEREN perceived as GREEN) only under conditions that combined 1) strong expectations that there were real color words and 2) the possibility of detecting letters without identifying words accurately [44]. In a modified Sperling paradigm, we intermixed classical trials (Figure 1) with trials containing nonletters (e.g. rotated letters) in the uncued part of the array that shared the same features as letters (Figure I below). Furthermore, at the end of some trials, subjects were asked to decide which of several alternatives were actually present in the uncued parts of the array. We found that not only did subjects fail to detect nonletters, but also actually tended to perceive them as real letters [12].

Figure I. Modified versions of the Stroop (left) and Sperling (right) paradigms (based on Refs [12,44]).
Box 3. Consciousness without attention?

Following from the assumption that phenomenology overflows access [14], it has recently been proposed that consciousness overflows attention [40,45]. In this perspective, consciousness without access is roughly equivalent to consciousness without attention [46]. Whether consciousness is independent of attention remains highly controversial, notably given the difficulty of demonstrating consciousness without attention [13,45,47]. Koch and colleagues base their claims for consciousness without attention on two types of evidence [45,48,49]. First, they showed that under dual-task conditions, which they term the near absence of attention, although subjects are performing a main task on a target at a central location, they can still perceive, at least indistinctly, a stimulus in the periphery. Second, they rely on situations in which attention and consciousness, presumably, have opposite effects (see [45] for a review).

However, as for inaccessible consciousness, demonstration of a psychological state of consciousness without attention is plagued by the observer effect described above. Indeed, probing an individual’s consciousness of a stimulus necessitates directing the observer's attention to the stimulus. Thus, it seems to be extremely difficult, if not impossible, to assess whether subjects consciously perceive objects in the periphery without relying on some form of access, as doing so inevitably requires observers to engage their attention on the stimulus. We contend that, similar to consciousness without access, the possibility of consciousness without attention is usually based on a restrictive definition that does not take into account the possibility of residual attention at lower (i.e. sensory, non-conceptual) levels of processing. For instance, a peripheral stimulus in Koch’s paradigm can be considered as both conscious and unattended when spatial attention is defined as a focal, all-or-none component of the cognitive system. However, the same data can be interpreted quite differently if we consider that there are residual or non-focal components resulting from the division of attention [50,51]. In this view, although a large part of attentional resources is indeed engaged on the central stimulus, it is arguable that subjects can also attend to lower levels of information in the periphery.
Figure 2. (a) Proposed hierarchical view of access in terms of levels of representation. Five example levels of representation are shown, ranging from lower to higher levels. (b) At each level the perceptual content reflects the interplay between the input signal, confidence in the signal and prior information. The levels are interconnected through the processing architecture. (c) Proposed typology of cognitive states (for each level of representation) resulting from the interplay between signal strength, confidence and prior information. A strong signal can lead to two possible states based on the degree of confidence in the signal. Normal faithful perception (state 1) corresponds to a strong signal and high confidence. Because the signal is strong, prior information can only have a slight impact. Cognitive blindness (state 2) is a state in which the same signal strength yields a very low confidence of seeing. This pathological state might be reflected in psychiatric reports of hysterical blindness, otherwise termed visual conversion disorders. A weak signal can lead to illusory perception (state 3) when the weak signal interacts with prior information in the presence of high confidence, or alternatively to subliminal perception (state 4) when confidence is low. Importantly, in subliminal processing, prior information is turned off by default (de Gardelle et al., unpublished data). Finally, in the absence of a signal, hallucinations (state 5) arise when confidence is high. In this state, perceptual content is entirely driven by prior information. Normal non-perception (state 6) arises in the absence of a signal and with low confidence. In this state prior information is also turned off by default.
Additional assumptions: exploring the illusion of phenomenal richness

Concluding remarks and future directions

Continuous vs. all-or-none conscious access
cognitive illusion (Box 2), characterization of the illusion for future research on consciousness. Nevertheless, although the impression of rich—psychology promoted by dissociative theories of consciousness. In this case, and how does this relate to limits in working memory representations solely at the decision level. In this case, possibility be accessed only one level at a time by switching back and forth between task-relevant representations.

References

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