Trends in Cognitive Sciences

CellPress

Opinion

On a confusion about there being two types of consciousness

Liad Mudrik [1,2,3,*], Nathan Faivre [4], Michael Pitts [5], and Aaron Schurger [6,7]

Progress in the scientific study of consciousness has been impeded by several fundamental controversies. One pertains to a major divide between theories: sensory versus cognitive. Here, we argue that the key to resolving this controversy is to re-evaluate the conceptual distinction proposed by Block in 1995 between phenomenal consciousness (P) and access consciousness (A). We propose that P and A should not be understood as two different types of consciousness, but as two necessary conditions for consciousness. We illustrate how this conceptual shift allows making substantial progress in answering several unresolved questions, such as the neural mechanisms and functions of consciousness, and the relationship between consciousness and attention. Our proposal motivates a selective unification across these different classes of theories.

Highlights

The field of consciousness is divided between sensory theories and cognitive theories.

Both types of theory have been supported by empirical data, suggesting that both are true.

We suggest that a possible unification of these types can be achieved by reframing the classic distinction between phenomenal and access consciousness (i.e., P versus A).

Instead of considering P and A as two types of consciousness, we suggest that they are two necessary conditions for consciousness.

This suggestion implies that any state that is only accessed (A-without-P), or only represents phenomenal content (P-without-A), should be considered a case of unconscious processing.

Cognitive versus sensory theories of consciousness

Despite decades of concerted efforts directed at identifying the neural basis of consciousness [1–4], there are still more open questions than answers: what are the neural mechanisms specifically involved in conscious (versus unconscious) processing? How do they unfold in time? Does consciousness have a specific function? How is it related to attention? Does it interface with other cognitive functions, or is it encapsulated from them? Is it rich or sparse?

Researchers studying consciousness disagree on these questions, as evidenced by corresponding divides among **theories of consciousness** (see Glossary) [5,6]. As a case in point, consider the debate around the neural correlates of consciousness being mostly anterior [7] or posterior [8]. With respect to theories of consciousness, this conflict typically (although not exclusively) aligns with the distinction between **cognitive theories of consciousness** and **sensory theories of consciousness** [9,10].

Cognitive theories, such as the **Global Neuronal Workspace Theory (GNWT)** [11], posit that cognitive processes implemented in non-sensory cortices (i.e., frontoparietal networks) are needed for sensory content to be consciously experienced. By contrast, sensory theories, such as the **Integrated Information Theory (IIT)** [12], commonly argue that certain kinds of processing within sensory cortices are sufficient for consciousness, while the apparent necessity of cognitive processing stems from design confounds in experiments that ask participants to report what they experience [13].

To address this conflict, several experiments in recent years have used 'no-report' methods [13,14] to test whether neural activity in sensory areas is sufficient for conscious perception or whether non-sensory areas, and specifically the prefrontal cortex (PFC), have a necessary role [14–19]. No-report manipulations typically lead to substantial reductions in the extent of PFC

[1]School of Psychological Sciences, Tel Aviv University, Tel Aviv, Israel
[2]Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel
[3]Canadian Institute for Advanced Research (CIFAR), Brain, Mind, and Consciousness Program, Toronto, ON, Canada
[4]Université Grenoble Alpes, Université Savoie Mont Blanc, CNRS, LPNC, 38000 Grenoble, France
[5]Psychology Department, Reed College, Portland, OR, USA
[6]Department of Psychology, Crean College of Health and Behavioral Sciences, Chapman University, Orange, CA, USA
[7]INSERM U992, Cognitive Neuroimaging Unit, NeuroSpin Center, Gif-sur-Yvette, France

*Correspondence: mudrikli@tauex.tau.ac.il (L. Mudrik).

Box 1. What do we mean by access?

Access consciousness, as defined by Block [45], refers to the availability of information to cognitive systems. If some information is A conscious, the system/creature is able to report it, reason about it, and use it to guide flexible behaviors. Notably, since 'access' is a transitive verb, it implies that something or someone is doing the accessing. Thus, the notion might be taken to be homuncular or even dualist.

However, this is not what Block meant by 'access', and not what we mean by it here either. The brain is not a single uniform information-processing substrate, but rather is a collection of different, more or less independent, subsystems that interact (the theorist Daniel Kahneman long ago grouped them into 'system 1' and 'system 2' [47]). Thus, 'access' refers to the availability of information encoded in certain subsystems involved in perceptual decision-making to other subsystems that have their own particular relationship with behavior; exactly which subsystems remains a matter of contention that we do not aim to settle here.

Another potential confusion might hold 'access' to refer to 'objective' or 'physical' aspects of consciousness while 'phenomenal' refers to 'subjective' or 'mental' aspects [108]. To clarify, we think that both the A and P conditions are characteristics of mental states, which, as we adopt a physicalist stance, are physical states. Furthermore, although phenomenality is indeed subjective, we hold that, similar to access, it can also be studied using objective scientific measures (for recent attempts, see [70,109,110]).

This reframing can help settle key debates about consciousness, relating to its neural correlates, richness, functions, and relationship with attention.

involvement, leaving activity patterns in sensory cortices largely unaffected, although recent studies have found some evidence for frontal activity tracking conscious perception in Binocular Rivalry in the absence of report [15,16]; (for reviews and discussions, see [17]). Moreover, using a variety of manipulations and after ruling out task-related activity, most no-report studies have found that subareas of PFC (e.g., inferior frontal cortex) remain linked with conscious visual perception [17]. Overall, these results provide both supporting and countervailing evidence for these two classes of theory: some of the predictions made by prominent cognitive theories should be revised, such as those linking consciousness with 'widespread' or 'global' neural activity patterns [11]. However, the claim regarding the need for PFC, alongside other domain-general areas, appears to have survived these tests, which challenges the strong sufficiency claim made by sensory theories [18].

Another controversy pointing to a similar conclusion pertains to predictions about the maintenance of a conscious percept over time. GNWT and IIT provide divergent predictions about the neural substrates of sensory experiences that last for different durations [19,20]. IIT predicts that sustained patterns of neural activation in posterior sensory regions should match the durations of the stimuli, serving as proxies for the duration of experience. GNWT predicts that brief 'ignitions' in prefrontal and parietal cortices should index updates to the workspace. Interestingly, results from a set of recent no-report experiments provided support for both of these predictions [19,21,22] (although ignitions were mostly found for stimulus onset rather than offset; see also [23]). In other words, at least some aspects of these supposedly competing classes of theories may be simultaneously correct.

Taken together, these examples call for a more nuanced approach to theory testing and development. While more extreme versions of sensory and cognitive theories are challenged by recent empirical data (i.e., those that claim processing in sensory areas is sufficient for consciousness, or that global, widespread information sharing is necessary for consciousness), key aspects of each class of theories remain supported by recent data and may be jointly needed to solve the larger puzzle of consciousness. If so, then instead of arbitrating between these theories and trying to find points of disagreement [6,19,24], it might be more fruitful to develop a framework under which both cognitive and sensory theories might complement each other and potentially even be integrated [25–31]. Thus,

our goal here is to demonstrate how such an integration might be possible by reframing the current discussion.

From contradictory to complementary theories: lessons from the history of science

Both divergence and unification have a historical precedent. At one end of the continuum are clear cases where theories oppose each other. For example, in the debate about the neuron doctrine, Cajal argued that neurons are individual units that interact but do not fuse [32], while Golgi claimed that the nervous system processes information via a large net of fused, non-individuated axonal structures. Ultimately, in this case, Cajal was correct, directly contradicting Golgi's account (but see [33]).

At the other end of the continuum are cases where two opposing theories proved to be complementary and both correct, each explaining a different aspect or stage of a complex process. A clear example of such a turn of events was the longstanding competition between Maxwell's trichromatic theory of color vision and Hering's opponent-process theory [34,35]. Eventually, both theories turned out to be correct; they were simply describing different stages of a multistage process ([36,37], but see [38]). To explain color vision, a unification, rather than competition, of trichromatic and opponent-process theories was needed.

Perhaps a similar kind of unification might reconcile the seemingly disparate positions of cognitive and sensory theories of consciousness. Despite several suggestions to that effect [25,26,39,40], the field has become more divided (e.g., [41–44]). Here, we argue that a unification attempt must be rooted in a more tectonic shift in the overall conceptual framework. Namely, we argue that many of the current controversies in consciousness research, with respect to both theories of consciousness and other key questions, stem from a highly influential proposal, made 30 years ago, regarding the distinction between **phenomenal consciousness and access consciousness** [45]. We suggest a reframing of this distinction that might resolve these controversies, while opening the door to a unification of theories.

P versus A consciousness

In a landmark paper [45], Block argued for a confusion between two types of consciousness. P consciousness is the qualitative, subjective nature of conscious experiences, or 'what it is like' [46] to have them, and A consciousness is the availability of information to cognitive systems, such that it can be reported, reasoned about, and used to guide flexible behaviors (see Box 1 for further discussion of the meaning of 'Access').

Although controversial, the phenomenal/access distinction has been enormously influential. Significant effort has been put into empirically substantiating it, either by showing that participants perceive more than they can report (i.e., that perception overflows report [10,47]; see, for example, [48–52]) or by devising situations whereby participants deny having a conscious experience in real time, but retrospectively report having had the experience [53]. Yet, many question whether these results indeed support a dissociation between two types of consciousness. Some have pointed out the difficulty of differentiating between P-without-A consciousness and unconscious processing [53–57], while others have questioned the absence of access in these studies [58].

A prominent example of the influence of the P versus A distinction can be found in **Recurrent Processing Theory (RPT)** [59,60]. RPT holds that phenomenal consciousness can occur independently of access, such that participants can have a conscious experience even if they firmly deny it [60]. Beyond RPT, other theories of consciousness either adopt this distinction, purporting to explain P consciousness independently of cognitive access [12], or argue that A

Glossary

Access (A) consciousness: originally suggested by Block as a type of consciousness, A consciousness occurs when some content is available for the system to use in controlling reasoning and behavior. Here, we suggest considering A consciousness instead as a necessary condition for consciousness.
Attention Schema Theory (AST): suggests that the brain has a (second-order) schema of its own selective attention. This internal representation engenders the percept of being consciously aware of the attended content.
Cognitive theories of consciousness: theories that focus on cognitive mechanisms when explaining consciousness, typically targeting access mechanisms that determine how a certain piece of information becomes consciously experienced.
Dendritic Integration Theory (DIT): proposes that consciousness emerges from the way in which dendrites (the branched extensions of neurons) integrate and process electrical signals. The complex interactions between dendrites are considered key to producing the integrated brain activity associated with conscious awareness.
Functionalism: philosophical theory according to which mental states, including consciousness, are defined by their functional roles rather than by their physical realization Thus, any system that performs the same function as a brain should have consciousness.
Global Neuronal Workspace Theory (GNWT): posits that consciousness arises from the global sharing of information across various brain areas through a 'workspace' of specialized neurons with long-range projections. Such global broadcasting allows integration between different cognitive processes and access to various unconscious modules.
Higher Order Theory (HOT): a group of theories claiming that consciousness is the result of a higher-order state that re-represents, indexes, or points at a first-order representation.
Integrated Information Theory (IIT): suggests that consciousness is integrated information generated by a main complex in the brain. It is accordingly identical with the unfolded cause-effect structure that is determined

consciousness alone can explain its phenomenal aspects [54]. In a way, this distinction stands at the heart of the divide between cognitive and sensory theories of consciousness, with the former pertaining more to A consciousness and the latter to P consciousness.

We do not deny that the P/A distinction is meaningful. We agree that the two concepts are not identical: having access to a bit of information does not logically entail that it will be accompanied by phenomenal, subjective experience, and perceptual information could be encoded in just the right way to be (potentially) phenomenally experienced without necessarily being accessed at that stage. However, critically, we think that Block's proposed dissociation was itself conceptually confused, with the confusion lying in the claim that these are two types of consciousness, as opposed to two necessary conditions for consciousness.

The main novelty of our suggested framework is not that access is necessary for consciousness, or that P and A are related to each other. Such claims have been made before, in different ways, including in the original responses to Block's target articles (Table 1) ([10,45]; see also [61]). The novelty here lies in our suggestion that P and A are necessary conditions for consciousness, and that accepting P and A as such can help resolve several key controversies in the field, from competing classes of theory to disputes about attention, function, and richness, allowing us to move beyond existing disagreements and facilitating progress.

Our proposed update to Block's conceptual framework entails that every conscious experience must have (1) potentially phenomenal content that is (2) accessed. If either 1 or 2 is lacking, it should be considered as a form of unconscious processing. Accordingly, to be consciously experienced, a given bit of information must be both potentially phenomenal (i.e., structured in such a way that provides distinctive qualities from a first-person perspective; P condition) and accessed (i.e., integrated with other systems, enabling at least a minimal influence on cognition/behavior; A condition). For example, information must be perceptually organized (RPT [59]) or differentiated and integrated (IIT [12]) to be potentially phenomenal. Moreover, some access mechanism, such as global broadcasting (GNWT [11]), higher-order 'pointers' that index first-order representations [62], or modeling of selective attention [63], must occur to make this potentially phenomenal content conscious. Since both conditions must take place for consciousness to occur, a theory that only explains one of them is necessarily incomplete.

Conscious states must accordingly be available to the system (i.e., capable of influencing it to make a difference in what it does next), and feel like something to the system (i.e., there is a distinctive first-person quality to them). For example, an artificial intelligence (AI) system can have access to its internal states, but that would not necessarily entail that it is conscious (for a recent attempt to formulate markers for AI consciousness, see [64]) or that this access has any phenomenal content (here, our proposal diverges from GNWT, which equates the two [54,65]). Thus, access, on its own, is not a type of consciousness. Similarly, if information is processed in a format that is potentially phenomenal (i.e., giving it a distinctive quality), but is cut-off from having any possible influence on behavior, it remains unconscious [62,66,67]. Critically, our proposal is not merely semantic (i.e., replacing 'types' with 'conditions'); it substantively aims to change the way consciousness is defined (Figure 1, Key figure), which carries concrete implications for key issues in the science of consciousness, including the ways in which theories of consciousness should be evaluated, as we describe below (for a similar proposal about the importance of properly defining consciousness, see Lamme's section in [68]).

While our framework does not specify the precise relationship between the P and A conditions, it allows for the possibility that the two interact. For example, it might turn out that the P condition cannot fully be met without the A condition also being met, and vice versa; thus, the two might be mutually

by the way a system is organized, and the state it is in.

Phenomenal (P) consciousness: originally suggested by Block as a type of consciousness, P-consciousness is experience, or the 'what it is like' of being in a specific state. Here, we suggest to consider P consciousness, instead, as a necessary condition for consciousness.

Recurrent Processing Theory (RPT): claims that consciousness depends on recurrent processing in sensory areas. This theory suggests that access-related mechanisms are not necessary for consciousness itself, but for cognitive processes that often accompany it.

Sensory theories of consciousness: theories that focus on sensory mechanisms when explaining consciousness, typically targeting the phenomenal aspects of consciousness. For example, what characterizes contents that are consciously experienced, and what renders one experience different from another.

Theories of consciousness: neuroscientific accounts that try to explain the relations between the brain and conscious experience. Currently, there are at least two dozen such theories, and many more based on some classifications. They can be classified in many ways; one such classification, on which we focus here, contrasts between sensory and cognitive theories of consciousness.

reinforcing. This would be analogous to the relationship between the opening of voltage-gated ion channels and membrane potential in neurons. The membrane potential cannot significantly depolarize without the opening of many voltage-gated ion channels and, yet, the opening of many voltage-gated ion channels depends on the depolarization of the membrane potential. This kind of relationship might help to explain why the P and A conditions largely track each other and are difficult to isolate (which is implicit in some theories [11], explicit in others [62], but denied by others [60]).

To be clear, we do not claim that this is the case, but that our framework allows for the possibility that it is. For example, if information integration turns out to be a key part of the P condition, then an unfolding perceptual decision, happening over tens or hundreds of milliseconds, might start with the sharpening of some pattern of neural activity. In turn, this might engage attention (a putative part of the A condition), which would then sharpen the pattern further, thereby making its phenomenal character clearer. Another possibility is that the A condition adds a key component to the P condition, such as the subjective, first-person perspective aspect of phenomenal experience (as suggested previously by several authors; e.g., Table 1 and [54]). There is much that we do not yet know, and these are just two conceivable examples among several possible ways that the A and P conditions might interact. Of course, it may also turn out that the P and A conditions reflect two successive stages of processing necessary for consciousness, with the only interaction being their sequential dependency (similar to the abovementioned example of trichromatic and opponent-processing stages of color vision).

Implications of accepting P and A as two necessary conditions for consciousness

Accepting our framework not only resolves the ongoing debate around P and A consciousness; it has further implications for several key controversies in the field, as described below.

Theories of consciousness

Our proposal suggests that most (if not all) theories of consciousness are incomplete, since they have been primarily focused on one condition, while mostly neglecting the other. Sensory theories have mostly targeted the nature of phenomenal content (i.e., what differentiates content that can be experienced from content that cannot; for example, integration and differentiation, or perceptual organization), with some even denying the role of access for consciousness [69]. By contrast, cognitive theories have focused primarily on the specific kinds of access that might be needed for consciousness (e.g., global broadcasting, a higher order pointer/representation, or a schema of the focus of one's attention), mostly neglecting to account for phenomenal character. If our proposal is on the right track, a more comprehensive theory of consciousness will need to draw from both classes of theory to explain both the specific neural processes that organize the content in a way that renders it potentially phenomenal, and the neural processes that enable access (Box 2). In other words, they should explain both what makes certain content feel the way it does, and how this content makes a difference in terms of behavior, cognition, and so on [5].

Some might interpret our suggested framework as simply supporting cognitive theories (e.g., [60]) and challenging sensory theories for being incomplete. However, this would be a misinterpretation: we argue that both classes of theory are incomplete, as explained above. Notably, this incompleteness is not symmetric: while sensory theories are explicitly incomplete, by denying that access is needed for consciousness, cognitive theories are typically only implicitly incomplete in that most of them do not deny phenomenality, but tend to focus exclusively on explaining why there is an experience (or not) instead of why an experience feels like this rather than that (for attempts to do so, see [70,71]; also see further discussion in [54]). We accordingly suggest relying on existing theories as starting points while working toward a more comprehensive account that incorporates both access and phenomenology.

Importantly, this shift in thinking about P and A can serve as a strategic vantage point for empirically comparing theories. Some of the recent adversarial collaborations in consciousness research have attempted to pit a specific cognitive theory against a specific sensory theory (e.g., [19]). Perhaps it might be more productive to arbitrate between theories within each explanatory domain (phenomenal content or access), while unification might be called for between the two domains (Table 2, Box 2).

Brain regions involved in consciousness

Reconciling theories of consciousness has implications for the ongoing controversy over the neuroanatomical substrates of consciousness (i.e., the 'front versus back' debate [7,8,72]). Assuming that posterior areas mostly subserve the phenomenal content while anterior ones implement access, our suggestion implies that instead of 'either/or', we should accept an 'and' account, ascribing a necessary role to both areas. Naturally, more work is needed to identify the exact mechanisms that underlie phenomenality and access. Yet, we suggest that such work would be more productive if conducted under the assumption that the neural mechanisms of both conditions are needed, in line with the abovementioned findings, rather than debating which is the 'true' neural correlate of consciousness.

Timing of consciousness

Similarly, early and late correlates of consciousness (e.g., ~100–300 ms versus ~300–500 ms after stimulus onset [73–75]) have been claimed to implement P and A consciousness, respectively, evoking longstanding debates over the timing of consciousness. Instead, a more productive approach reframes the question by accepting that the processes leading to conscious percepts unfold over time [76,77]. Similar to the multi-stage model that was eventually accepted for color vision, we surmise that the establishment of phenomenal content and the subsequent (or concurrent) access of this content are two necessary conditions for conscious processing. This would again align with empirical evidence for both early and late neural correlates of consciousness [42].

Functions of consciousness

Another open question pertains to the functional role of consciousness: are there functions for which consciousness is necessary? Here too, theories of consciousness are divided, with some suggesting a functional role [e.g., GNWT, RPT, **Dendritic Integration Theory (DIT)**, **Attention Schema Theory (AST)**, and some versions of **Higher Order Theory (HOT)**] (Box 2), and some denying it (e.g., IIT and some versions of HOT). Interestingly, the divide here does not cut between access-based and phenomenal-based theories, because RPT, which explicitly focuses on P consciousness, makes some functional claims [78]; and some versions of HOT, which explicitly focus on A consciousness, do not [62].

Under our framework, since every conscious state comprises accessed phenomenal content, and because access allows for some functions (at the very least, the action of reporting), our proposal entails that consciousness has some functions (see Box 3 for further explanation).

Relationship between consciousness and attention

Another critical debate asks about the relationship between attention and consciousness [79,80]. Some theories hold that attention is needed for information to be consciously experienced (e.g., GNWT [66,81,82] and AST [39,63]), while others (e.g., RPT [59,69]) suggest that information is first P conscious, and only later does attention allow cognitive access for report and other task-related processing. In our view, both sides of this debate oversimplify the potential contributions that attentional mechanisms make to consciousness.

Box 2. A short primer about theories of consciousness

To say that there are 'many' theories of consciousness is an understatement, and new theories appear to emerge before we are able to evaluate and understand existing ones. Much has been written on 'theories of consciousness' [5,6], and a comprehensive treatment of them is beyond the scope of this article. However, it is instructive to look at how some of them fare in light of our suggestion. Some theories are more A-centric and some more P-centric, and accepting our argument suggests that some pairs of theories long thought to be at odds are, in fact, complementary.

One way to compare and contrast theories is to look at what they propose as mechanisms for establishing the 'right kind' of perceptual information encoding (i.e., phenomenal content) versus what they propose as mechanisms for 'access' to that information (Table 2). IIT, which is a more P-centric theory, proposes the integration and differentiation of information as the mechanism (or criterion) for encoding content [12]. The richness, or informativeness, of that content is given by the numerical value phi, which is computed based on the degree of integration and differentiation of information. The subset of that information that is 'present in' consciousness, is proposed to be that which belongs to the 'main complex', that is, the set of elements in a system that generates the maximum amount of integrated information.

By contrast, GNW is a more A-centric theory, where the mechanism for access is deemed to be the global 'broadcast' of information, heralded by an abrupt nonlinear global ignition event in the cerebral cortex [11]. GNW does not clearly specify what qualifies encoded perceptual information for a role in consciousness, other than being broadcast (but see section 6.2 in [81] for an early suggestion about integrating parts of IIT with GNW). Under the framework proposed here, and taken individually, neither IIT nor GNW fully account for subjective experience since each only accounts for one necessary condition. From this vantage point, we might conclude that the two theories could in fact be complementary.

Other modern theories, such as RPT, DIT, HOTs, and AST, offer their own proposed mechanisms (or criteria) for either content or access, in such various ways that some theories are deemed incommensurate [107]. The suggestion that different facets of all current theories can be combined into one general theory of consciousness may be overly optimistic, but a more selective integration may offer opportunities for progress in the scientific study of consciousness that have not been considered previously.

Table 2. Mechanisms of content and access suggested by core claims of different theories of consciousness

Theory	Mechanism for content	Mechanism for access
IIT	Integration and differentiation	?
GNWT	?	Global broadcasting
RPT	Perceptual organization, local recurrent processing	?
DIT	?	Integration into thalamocortical processing loop
AST	?	Attention schema
HOT	?	Second-order representation/indexing

Question marks denote unaccounted-for or underdeveloped domains. We suggest that, rather than comparing predictions across the domains (i.e., between columns), it might be more beneficial to contrast predictions within each domain (i.e., between rows).

Given that our argument considers both P and A conditions necessary for any conscious experience, attentional mechanisms could be needed for realizing one or both of these conditions. In this sense, our proposal does not decisively resolve this debate, but offers a solution that brings it into better alignment with cognitive neuroscience research on attention. The classic debate regarding whether attentional selection operates at early or late stages of sensory perceptual processing [83,84] has essentially been resolved, and the answer is both: attentional effects occur before, during, and after the processes involved in perceptual organization, and in different neuroanatomical locations within the sensory processing hierarchies [85–92].

Richness of consciousness

The attention-consciousness debate is often intertwined with the controversy about the richness of consciousness: whether it is rich or sparse [56,93] and whether perception overflows

Table 1. Responses to Block's articles [10,45] conveying similar, but not identical, ideas to those described in the main text

Source	Quote	Main claim
A is a necessary condition for consciousness		
Harman [111]	'Trivially, a self is conscious of something only if it accesses it'	A is necessary for consciousness
Clark and Kiverstein [112]	'The contents of conscious phenomenal experience…must be at least potentially available for use in the planning and selection of deliberate, stored-knowledge-exploiting, and goal-reflecting and goal-responsive, actions'	A is necessary for consciousness
A is a necessary condition for P		
Church [113]	'The concept of a phenomenal property is the concept of a property to which we have a special sort of access'	A is necessary for P (P entails A)
Rosenthal [114]	'There is reason to hold, contra Block, that phenomenology does always involve some cognitive access to the relevant experience'	A is necessary for P (P entails A)
Levine [115]	'The phenomenon of subjectivity, which is at the core of phenomenal experience, involves access essentially'	A is necessary for P (P entails A)
Harman [116]	'Not only are the objects of phenomenal experience cognitive accessible, they are ipso facto cognitively accessed'	A is necessary for P (P entails A)
Levine [117]	'One possibility…is that for a state to be phenomenally conscious it must be accessible to the subject in some sense, but not necessarily to the mechanisms responsible for report'	A is necessary for P (P entails A)
Balog [118]	'Access to phenomenality: A necessary condition of phenomenality?'	A (to phenomenality) is necessary for P (P entails A)
P is a necessary condition for A		
Natsoulas [119]	'A representation of the content of a phenomenal mental state is necessary for the latter state to be access-conscious'	P is necessary for A (A entails P)
P is a subtype of A		
O'Regan and Myin [120]	'The new form of phenomenal consciousness seems to be a poor-man's cognitive access	P is a weaker variant of A
Sergent and Rees [121]	"There is a clear distinction between two types of report: objective report (accessibility … probably via automatic stimulus-response routes) and subjective report (accessibility as defined in the term 'conscious access'). We propose that this latter form of accessibility is intrinsic to what Block calls phenomenal consciousness"	P is intrinsic to a special type of A
P and A are qualities/features of consciousness		
Dennett [122]	'The varieties of consciousness… can all be accommodated under the two rough quantitative headings of richness of content and degree of influence…. [Block] is inflating differences in degree into imaginary differences in kind'	P and A are qualities of consciousness, not two types of consciousness
A is equivalent to P		
Baars [123]	'…phenomenal consciousness is the same as access consciousness'	A is equivalent to subjective experience

In the righthand column, we extract the main claim made in each one of these commentaries to better highlight the similarities and differences between each claim and our own.

Key figure

Block's phenomenal (P) versus Access (A) distinction (left) and our revised version (right)

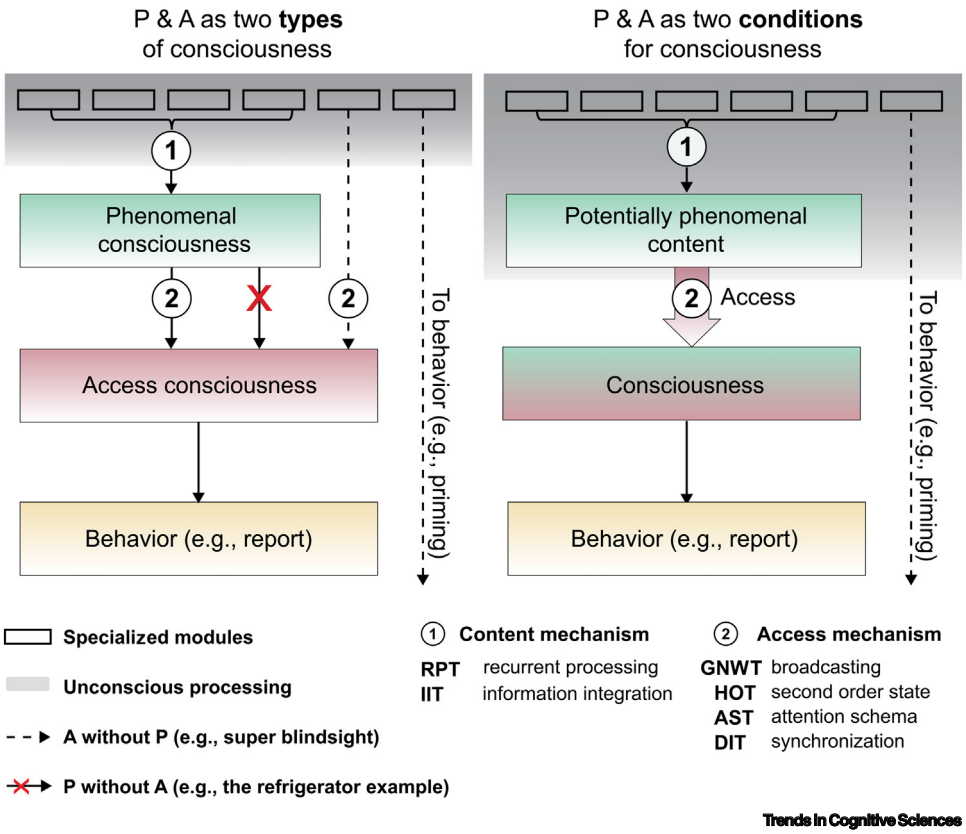

Figure 1. Unconscious processing (gray area) spans over specialized modules (blank boxes), which provide the background conditions for phenomenal content (green boxes). On the classic account, the latter already represents a type of consciousness (e.g., in the refrigerator example; see [53]), even if it is not accessible for the observer to report. In our account, this content remains unconsciously processed until an access mechanism (pink arrow) is applied to it, making it consciously perceived and poised for action/report (yellow boxes). This differs from the classic account, where access is another type of consciousness that can occur without having any phenomenal content (dashed arrow; super blindsight example [45] or a visual philosophers' zombie [124]). We further denote which theories of consciousness account for either the content and/or the access mechanisms, and how. Abbreviations: AST, Attention Schema Theory; DIT, Dendritic Integration Theory; GNWT, Global Neuronal Workspace Theory; HOT, Higher Order Theories; IIT, Integrated Information Theory; RPT, Recurrent Processing Theory.

report [48,50,94–97]. Under our account, conscious perception cannot overflow access because access is one of the preconditions for consciousness, although it can overflow report (see [54] in which a useful distinction is made between nonexplicit 'primary reports' versus explicit 'meta-reports'). The act of reporting is an extra step beyond access, which may involve additional cognitive constraints. For example, factors, such as memory and/or language, could limit report while leaving access untouched. Thus, one should be highly cautious when interpreting results of studies where participants fail to report some attribute or change that occurred (e.g., [98,99]). If consciousness always refers to accessed perceptual contents, we should specifically not focus on gaps between what one can report and what one can arguably

perceive, or between what one can perceive and what was present in the sensory input. Neither comparison is relevant to the richness question, because neither probes the richness of consciousness itself. Instead, a more fruitful avenue would be to take accessed content at face value, because this is the phenomenon of interest, and study how it is structured, and how rich it is (e.g., using microphenomenological approaches [100], similarity judgements [70,71], or other nonverbal, noncategorical types of report [93,101]).

Thus, if a participant fails to report perceiving a change or can only report a subset of items in a Sperling-like display [102], but insists that they had a rich conscious experience of the display or of the changed scene, the former fact cannot be used to challenge the latter: both are acts of report that are useful data points in need of explanation. Given that access and report are not the same thing, our view allows for richer access relative to the limits of report (verbal or otherwise). Furthermore, such investigations might benefit from examining ongoing experiences, rather than single snapshots, because conscious experiences evolve over time. Even if a single glance affords extraction of little detailed information [103], the crucial question is what happens when multiple glances are integrated (over the critical window of integration [104]). This would also bring us closer to understanding what the unique features of consciously experienced content are. The debate about the richness of conscious experience might then shift from P versus A to questions about the timing, duration, and temporal integration of successive cycles of P + A [105].

Concluding remarks

Despite making considerable progress over the past 30 years, the scientific study of consciousness has reached an impasse. Endless debates at both the empirical and conceptual levels [19,61,106], along with entrenched theoretical camps [43,44], threaten to hamper progress. Notwithstanding the complexity of these questions, which have been debated for decades, we argue here that many of these controversies could be resolved, or at least the debate might be more productive, by accepting that P and A are not types of consciousness but rather two necessary conditions for consciousness. Taking this stance provides several additional advantages. First, it resolves the widely criticized tension embedded in the claim that one can have a conscious experience of which one is not aware (P without A). Second, it unifies the concept of consciousness, providing one definition (comprising two necessary conditions), avoiding the need to assume the existence of three different types of consciousness (P only, A only, and P + A). Third, it dissolves one of the biggest challenges directed at the P versus A dissociation: how to differentiate between P-without-A and unconscious states. Under our account, both P-without-A and A-without-P are

Box 3. Functional role of consciousness

In the main text, we suggested that our definition of P and A as necessary conditions for any conscious experience implies that consciousness has some functions (at the very least, the function of enabling the act of reporting, including minimal self-reporting [54]). Two clarifications are in order here.

First, our position does not imply that the functions of consciousness are necessarily driven by the phenomenal aspect of experience. They might be fully determined by the access aspect of it. Second and consequently, our suggestion does not imply that a system that implements these functions would necessarily be conscious. That is, if a certain function only depends on the information being accessed by the system, and not on the fact that this information 'feels a particular way' to the system, it might be possible to have a non-conscious system (e.g., an artificial intelligence) that implements access mechanisms without having any phenomenal experiences. As we explained above, such a system would not be conscious.

Thus, we are not arguing here that every system that fulfills all the functions that are associated with consciousness (assuming we know what these are) is conscious; that would depend on whether **functionalism** (i.e., the claim that if system A is conscious, and system B is functionally equivalent to a system A, system B is also conscious) is true. Our argument here does not entail that it is (for discussions, see [64,125]). The immediate implication of our claim is that consciousness has some functions. Whether these functions only depend on the accessibility afforded by consciousness [65], or on the phenomenality of it [126], or both, is a matter of debate and in need of further research, much like whether functionalism is true.

Outstanding questions

What constitutes 'the right format' that renders information potentially phenomenally experienced?

What is the critical mechanism that provides access to a certain state?

Which experiments could pit proposed access mechanisms against each other? Which experiments could do the same for proposed mechanisms underlying potentially phenomenal content?

Which experiments could help us identify neural mechanisms for the most minimal form of access and/or phenomenal content?

How can theories of consciousness be integrated into a comprehensive account that explains both the P and A conditions to consciousness?

Are the A and P conditions independent or interdependent?

How do the sequential requirements of the P and A conditions influence the temporal dynamics of perceptual consciousness?

types of unconscious processing (which, in the former case, can retrospectively become conscious by gaining access [53]). Thus, we argue that the science of consciousness would benefit from replacing 'P consciousness' and 'A consciousness' with the P-condition and A-condition for consciousness, together defining two of the necessary conditions for consciousness. This conceptual shift would then pave the way for future efforts aimed at a selective unification of sensory and cognitive theories of consciousness (see Outstanding questions).

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Declaration of interests

The authors declare no competing interests.

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