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Review article

Three propositions about conscious experience and their implications for theories of consciousness

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ABSTRACT

The aim of this paper is to make and defend three simple propositions about what can and cannot be conscious in the human brain and to elucidate their implications for research and theory on consciousness. The first proposition is that the fact that some information is conscious should be, but often is not, distinguished from the information itself. The second proposition is that, treating the brain as an information processing system, information can be conscious (or not) but processes that operate on information cannot be conscious. This is illustrated with analysis of voluntary action generation, such as making a verbal report. The third proposition is that access consciousness is just access. Adding the word "consciousness" to it makes no difference to how it operates. An information processing system exactly like the human brain but in which no information was conscious would function in exactly the same way as human brains in which some information is conscious. Conscious experience must be explained by means of a generative mechanism; no such mechanism has yet been proposed.

1. Introduction

In recent decades there has been an immense proliferation of theories of consciousness, accompanied by vast numbers of experiments aimed at pinning down where (or when) consciousness is in the brain and what, if anything, it does, and a multiplicity of definitions of what consciousness is (Chis-Ciure, Melloni, & Northoff, 2024; Cogitate Consortium, 2024; Kuhn, 2024; Northoff & Lamme, 2020). This proliferation of theories and definitions has been largely unaccompanied by skeptical evaluation. The need for falsifiability criteria and attempts to disconfirm hypotheses has been noted by some (Chis-Ciure et al., 2024; Yaron et al., 2022) but no theory appears to have been disconfirmed by scientific research and it is not even clear how that could be done. Taking a skeptical stance does not mean being negative or destructive. The point of skepticism is to clarify matters of importance, to set challenges or standards or expectations for theories and hypotheses, to analyse how research evidence can or cannot be interpreted, to establish what would count as evidence for or against a particular hypothesis. The aim of the present paper is to make a contribution to that enterprise.

The premise for the present account is that the brain can be treated as an information processing system. Information processing systems process information, and the skeptical claim would be that they do that in the same way whether the word "consciousness" is attached to them or not. Then the challenge is to find something about consciousness, however defined, that information processing cannot account for. In other words, it should be possible to show that taking the word "consciousness" out of the explanatory account makes an identifiable difference. The challenge on top of that is to show how consciousness accounts for that difference, and the further challenge on top of that is to explain how consciousness is generated. It is not enough just to identify something that is associated with

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consciousness; it is necessary also to explain how that thing generates consciousness or makes things conscious.

The specific aim of this paper is to put forward and defend three simple propositions and to elucidate their implications for research. "Consciousness" is perhaps the most ambiguous term in all of science. There are almost as many definitions of "consciousness" as there are theories of consciousness. In this paper the main concern is with information that can be conscious and the preferred term is not "consciousness" but "conscious experience". That is conscious experience in the sense identified by Chalmers (1995, 1996) and it also relates to the term "phenomenal consciousness" (Block, 1995, 2014). However, both of those authors, in discussing their respective terms, make the same error, which is the concern of the first of the three propositions.

2. Information and the fact of information being conscious are different things

Chalmers (1995, 1996) made a distinction between the easy and hard problems of consciousness. The supposedly easy problems are mainly issues to do with information processing. To illustrate, one example in the list given by Chalmers (1995) is "the ability of a system to access its own internal states" (p. 200). That would probably be better expressed as the ability of one part of the system to access states in another part of the system and it could be argued that it is really a problem of information processing and not a problem of consciousness at all. But the main concern of this section is the hard problem. The hard problem is explaining the occurrence of conscious experience (his preferred term). But, in elucidating that problem, information and the fact of that information being conscious (in the conscious experience sense) are conflated. For example, in discussing the hard problem, Chalmers (1995) wrote, "we *experience* visual sensations: the felt quality of redness, the experience of dark and light, the quality of depth in a visual field" (p. 201). Actually there are two errors there. One is the implicit postulation of a "we" or "I" that has the experiences. Conscious experiences happen but it is not certain that there is an "I" that has them, and any attempt to specifiy what "I" is inevitably takes us away from conscious experience itself (Oakley & Halligan, 2017; White, 1993). But the other error is the main concern here.

The information itself should be distinguished from the fact that the information is conscious. In a conscious experience of red colour, the particular informational aspect of the colour, its redness, is something different from the mere fact that it is conscious. The error is pointing at the information when one is intending to point at the fact that it is conscious, in Chalmers' sense of conscious experience. No doubt there is a felt quality of redness, but the redness itself should be distinguished from the fact that it is conscious. The felt quality of redness is particular to redness, but the fact of being conscious is common to all that is in conscious experience. The failure to make that distinction also occurs in other papers on conscious experience and has significant implications for research on conscious experience, so a few more illustrative examples will be given.

Block (1995) has promoted a concept of phenomenal consciousness, which is similar in meaning to conscious experience in the sense used by Chalmers (1995, 1996). The same error is made, just with different examples. Block (1995) referred to "experiential properties of sensations, feelings, and perceptions" (p. 230) and gave pain as an example. He then said, "What it is like to hear a sound as coming from the left is different from what it is like to hear a sound as coming from the right" (p. 230). But there is the conflation. Hearing a sound as coming from the right is a reference to information, not to the fact that the information is conscious. The two sounds, from the left and from the right, are explicitly differentiated by the particular information, not by the fact that it is conscious. Statements about where a sound is heard as coming from are not intrinsically statements about conscious experience, they are statements about a certain kind of information in the brain. The fact (when it is one) that the information is conscious in the conscious experience sense is another matter.

Storm, Klink, Aru, Senn, Goebel, Pigorini, Avanzini, Vanduffel, Roelfsema, Massimini, Larkum, and Pennartz (2024) referred to Block's concept of phenomenal consciousness, describing it as "immediate, subjective experience, e.g., of seeing a blue sky" (p. 1533). "Blue sky" is particular information; the fact that it is conscious is something else, not to be identified with the particular information. A final example comes from the adversarial test of the global neuronal workspace theory and information integration theory by the Cogitate Consortium (2025): "viewing the Mona Lisa involves experiencing it as occupying a specific spatial location, categorizing it as a face, recognizing an identity and noting its leftward orientation, with this complex experience maintained over time" (p. 2). All that is referred to there is particular information, implicating extensive perceptual and post-perceptual processing. The information itself is again different from the fact, if it is one, that the information is conscious. Categorising the Mona Lisa as a face refers to the addition of semantic information to the surface visual information generated in early perceptual processing. That information might be conscious, in the conscious experience sense, but the information itself is distinct from the fact that it is conscious.

It is very difficult to point at conscious experience without pointing at the particular information that is conscious, but it is very important to distinguish between them. Information can have functional consequences in the brain; those consequences are consequences, not of the fact that the information is conscious, but just of the particular information that it is. That distinction is of critical importance to all that follows in this paper, and indeed to all attempts to make theories of either conscious experience or consciousness, however it may be defined.

Once the error of conflating information itself with the information being conscious has been made, it may have implications for reasoning about the functional significance of what is conscious. For example, Baars (2005) wrote, "More than a score of studies have shown that although unconscious visual words activate known word-processing regions of visual cortex, the same stimuli, when conscious, trigger widespread activity in frontoparietal regions" (p. 46). The error there is to conflate the particular information with the information in question being conscious and then to attribute a functional significance to the latter: to suppose that it is the being conscious of the information that triggers the activity, not the information processing mechanisms, nor the fact that the information is in a certain place in the system. One could say instead, visual word information can trigger widespread activity in frontoparietal regions when it is in one location (e.g., as relevant to the example, a global workspace or temporary information storage centre), but not when it is in another location (e.g. early perceptual processing). In that case it is the location of the information in the brain that makes the difference, not whether it is conscious or not.

As another example, from Baars (1998): "Mere consciousness of some event appears to help to store a recognizable memory of it" (p. 60). What helps to store a recognisable memory of some event is not whether it is conscious or not, but whether the information can be transferred to memory or not. That is a function of where the information is in the system and what processes may operate on it while it is there. It might not be possible to store a recognisable memory of the same information when it is in a different place in the system. It might also be the case that the information in question can be conscious when it is in one place and cannot be conscious when it is in another place. But, if that association is there, it is incidental. It is the location of the information in the system that determines whether it can be stored in memory or not, not whether it is conscious or not.

In summary, if the fact of some information being conscious is not distinguished from the information itself, then it may seem as though the information being conscious subserves or enables some function or other, when in fact it is the particular information (and its location in the system) that does that. That is not to say that conscious experience has no function, only that functions should not be ascribed to it when they are in fact functions of information, or of information processing. That is why it matters to distinguish between information itself and information being conscious, in the conscious experience sense. Putting it as simply as possible, there is something about something being conscious that is general to all that is conscious, and there is something about redness (for example) that is specific to redness and not shared by any other thing that is conscious. Discussions of conscious experience or phenomenal consciousness have tended to conflate those two things.

Reference to redness information being conscious could be taken as implying that there can be redness information that is not conscious. Whether that can be the case or not is a separate issue from the main point of this section, in the sense that whatever the answer to it might be has no implications for the distinction being made here, but it is a legitimate question and worthy of brief consideration. The question can be addressed in either philosophy or psychology/neuroscience but only the latter can be addressed here because the author is not a philosopher. Redness will be used as an example.

Perceptual processing is a complex, multi-stage activity much of which is not conscious. Colour information is processed in the early feedforward sweep of perceptual processing, before different kinds of information are integrated into object representations. The earliest cortical responses specific to colour occur about 60 ms after stimulus onset (Anllo-Vento, Luck, & Hilgard, 1998; Retter, Gao, Jiang, Rossion, & Webster, 2023; Teichmann, Grootswagers, Carlson, & Rich, 2019). That activity is local and pre-attentive (Anllo-Vento et al., 1998) and precedes integration of colour with other object information in feature binding (Moutoussis & Zeki, 1997). It is also long before conscious perception of the colour occurs, which is approximately 150–200 ms after the onset of a stimulus (Dembski, Koch, & Pitts, 2021; Förster, Koivisto, & Revonsuo, 2020; Koivisto & Revonsuo, 2010; Lamme, 2006).

If perceptual processing in the brain can be regarded as a kind of information processing, then redness in early perceptual processing is specifically the neural activity that embodies redness information. Redness, in other words, is neurally embodied information. It is almost impossible to think about what redness is like without thinking about what it is like in conscious experience, but it should not be imagined that there is a mini-experience of redness occurring in early perceptual processing. The redness is just the information that is represented by the neural activity that is occurring in the cells that encode redness. Clearly something changes when the redness information becomes conscious but, whatever that change might be, that does not alter the fact that the redness itself is still neurally embodied information.

It is likely that most if not all information in perceptual processing is encoded by the firing rate of neurons, the number of spikes that occur in a given time window (Rolls & Treves, 2011). Neurons in early perceptual processing are specialised for analysing or representing particular features (Rolls, Treves, & Tovee, 1997). Number of spikes functions as a code that can be read by neurons further along the processing chain that take inputs from multiple neurons. In that way information can be processed and transmitted through the perceptual processing system. Rolls and Treves (2011) concluded from their analysis of the research evidence that "the exponential rise in the number of stimuli that can be decoded when the firing rates of different numbers of neurons are analyzed indicates that the encoding of information using firing rates (in practice the number of spikes emitted by each of a large population of neurons in a short time period) is a very powerful coding scheme used by the cerebral cortex" (p. 485). Thus, the neural firing rate of neurons that encode for redness feeds into the decoding cells and in that way redness information is maintained and transmitted through the system to the point where it becomes conscious (if it does). There is much still to be learned about the basic representation of information in perceptual processing but there is a strong likelihood that the neurophysiological basis of redness (and all other perceptual information) lies in firing rates of detector neurons and transmission to subsequent decoding neurons (Rolls & Treves, 2011). That is what redness information is when it is not conscious. What it is for information to become conscious is not understood but, fundamentally, conscious or not, information is encoded in neurophysiological activity.

3. Information can be conscious, processes cannot be conscious

The proposition to be defended in this section is that information in the brain can be conscious in the conscious experience sense, and the processes that operate on information cannot be conscious. That proposition, expressed in different ways, has a long history in psychology (Elsabbagh, Wright-Wilson, Brauer, & Morsella, 2023; Miller, 1962; Neisser, 1967; Nisbett & Wilson, 1977; Rich, 1979; Sklar, Kardosh, & Hassin, 2021; White, 1988) but there is still a lack of clarity about its implications.

The general framework for the proposition is the assumption that the brain can be modelled as an information processing system. Under that assumption there are processes or mechanisms that operate on information (for example, integrating items of perceptual information into a coherent perceptual object, transforming information from one representational form to another, generating some kind of inference from it, actively maintaining it, as in rehearsal processes acting on information in working memory, or transferring it from one place to another, such as activating information from long-term memory into working memory). Information is a general term for what can be operated on by those and other processes. Many processes may be complex and have multiple stages, with multiple transformations of information as a result of that, but that does not in principle prevent or invalidate use of a basic distinction between information and the processes that act on it.

One area of brain activity that some would want to argue is not compatible with the proposition being defended here is the generation of voluntary actions. Under normal circumstances we feel as though we execute many actions both voluntarily and consciously; that is, the process of generating the action seems to us to be conscious. In ordinary belief there is a strong association between something being voluntary or intentional and that thing being conscious, and that association marks our understanding of how we generate our own actions (White, 1991, 1993). One important function of supposedly voluntary, conscious action is to convey information to others about what is conscious at that moment, for example in the form of verbal reports. That common belief seems to be generally shared by psychologists and neuroscientists and underpins some of the methodology involved in research on consciousness. Lamme (2006) surveyed a number of cognitive psychologists, asking them to rank various behavioural measures according to the weight they carried "as evidence for the subject having a conscious experience" (p. 497). Verbal report was ranked at the top, followed by "detection in Yes/No task". Verbal reports and key presses (or functionally equivalent detection measures) would be regarded as conscious, voluntary actions, therefore they are regarded as conveying explicit information about what the participant is conscious of.

It might be true that only information that is conscious can be reported, though that is far from certain and it is not clear how it could be proved or disproved. But, if it is true, it is not the fact that the information is conscious that makes it true. The distinction between particular information and that information being conscious, elucidated in the previous section, is important here. What makes information reportable in an information processing system is a conduit for that information from wherever it is in the system to the mechanism that generates the verbal report. Whether that information is conscious or not is not relevant to that.

Some verbal reports are not simply reports of a stimulus (e.g. a red patch) but specifically reports that the stimulus was conscious. On the face of it, that would seem to be strong evidence that the stimulus was indeed conscious, and that it was the fact of it being conscious that enabled it to be reported as being conscious. It is a possibility that a stimulus may only be reportable as conscious if in fact it was conscious, though again it is not clear how that possibility could be tested. Lamme's (2006) informal survey indicates that that is generally believed by scientists working in that area, but that belief is based not on evidence but on the common sense theory that verbal reporting is a conscious, voluntary process (Nisbett & Wilson, 1977; White, 1991, 1993). But, even if it is the case that only information that is conscious can be reported as being conscious, the information processing requirement is not changed by that. Information that a patch of red colour was conscious still has to be transmitted through the system to the verbal reporting mechanism, and being conscious is not the means by which that happens. It is a matter of information and the capacity of the system to transmit that information to the verbal reporting process. Fundamentally it is mediated by neural activity.

If only information is conscious and processes themselves cannot be conscious, then the process or mechanism involved in generating a verbal report is not conscious. That is evident in the fact that people cannot give informative reports about how they generate verbal reports. Any reader can try this: speak any sentence aloud and then ask yourself how you did it. Speech is a complex motor activity involving fine control and co-ordination of many muscles, including the vibration of the vocal cords, movements of mouth, lips, and tongue, with fine temporal co-ordination. For example, "[d]etermining the order of segments that constitute a lexical item (such as the difference between 'pets' and 'pest') requires information encoded in temporal windows of ~20–50 ms" (Hickok & Poeppel, 2007). Nobody can say exactly what movements they are making during the course of speaking a sentence, never mind how they are making them.

It could still be argued that the initiation of an action is voluntary and conscious, and that the effect of that initiation is to activate automatic mechanisms that control the muscles and generate the action. But even that is not the case. People certainly can report occurrence of the will to act, suggesting that the initiation of voluntary action might be conscious. However, research evidence

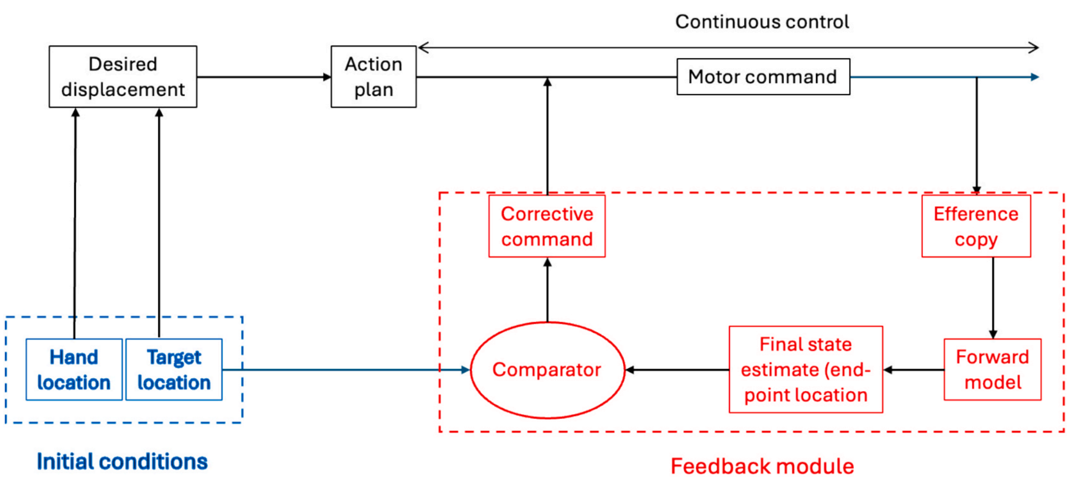

Fig. 1. Generic model of action generation and control (slightly adapted from Desmurget & Grafton (2000). See main text for further explanation.

indicates that the reported will to act is not the actual initiation of action. The belief that it is is an error or an illusion. Here a rather brief survey of the relevant literature must suffice.

Numerous studies have asked participants to carry out simple voluntary actions at times of their own choosing, and to report the time at which they felt the urge or will to act. There is a consensus in the results of those studies that the event that is reported as the will to act occurs approximately 200 ms before the action itself commences, as measured by detectors in the effector (usually a finger) involved in the action (Fried, Mukamel, & Kreiman, 2011; Haggard & Eimer, 1999; Libet, Gleason, Wright, & Pearl, 1983; Libet, Wright, & Gleason, 1982; Moretto, Schwingenschuh, Katschnig, Bhatia, & Haggard, 2011; Sirigu, Daprati, Ciancia, Giraux, Nighoghossian, Posada, and Haggard, 2004; Trevena & Miller, 2002, 2010.

To ascertain what the experienced will to act is and how, if at all, it is involved in the generation of action, it is necessary to take a brief look at research on action generation and control. There is general agreement now that feedback control of action generation involves both sensory feedback and a faster system that utilises a copy of the ongoing motor command, usually called a forward model (Bard, Turrell, Fleury, Teasdale, Lamarre, & Martin, 1999; Blakemore, Wolpert, & Frith, 2002; Desmurget & Grafton, 2000; Frith, Blakemore, & Wolpert, 2000; Grush, 2004; Haar & Donchin, 2020; Kim, Avraham, & Ivry, 2021; Medendorp & Heed, 2019; Shadmehr & Krakauer, 2008; Shadmehr, Smith, & Krakauer, 2010). Models based on that idea have a family resemblance; for illustrative purposes a model described by Desmurget and Grafton (2000) will be used. Their paper was concerned with arm and hand movements but the model generalises to all goal-directed action.

The model is illustrated in Fig. 1, which is a slightly modified version of figure 2 in Desmurget and Grafton (2000). Information about the current locations and orientations of effector and target is used to specify an action goal ("desired displacement"), which leads to formulation of an action plan. The action plan is the proximal cause of action. There may be antecedents to that such as formulation of goals, but they are outside the scope of the model and not directly relevant here. The action plan generates an ongoing stream of motor commands that result in execution of the entire planned action. That part of the model is also simplified and omits much information about forces and kinematics that are specified in the motor commands (e.g., Flanagan & Wing, 1997; Proske & Gandevia, 2012). The phrase "continuous control" in the figure refers to the fact that the execution of the plan is not fully automatic but can be monitored and adjusted. The feedback loop identified in Fig. 1 as involving the feedback module (red box) is the main component of the monitoring and adjustment mechanism. Before leaving the brain, a copy of the motor command is created and is fed into the feedback module. That copy is labelled in the figure as the efference copy (von Holst & Mittelstaedt, 1950). The efference copy is a component in the ongoing monitoring of action and error correction, as shown in the figure.

Initial appearance of the efference copy feeds into an error correction mechanism which compares the efference copy with a representation of the planned action. If no error is detected then the action is initiated by means of a release on inhibition of the action (Frith, 2005). That is the last moment at which the action can be inhibited. Studies in which participants have been asked to report the time of onset of the action find that the mean reported time is close to the actual time of action onset, in other words later than the

Box 1
Global workspace theories.

Global workspace theory was originally proposed by Baars (1988). The core of the theory is a hypothesised store of information with "a fleeting memory capacity in which only one consistent content can be dominant at any givenmoment" (Baars, 2002, p. 47). Information in the workspace is distributed or available to a large number of specialised processing mechanisms. Baars (2002) argued that "consciousness is the primary agent of such a global access function in humans and other animals" (p. 47). That claim is best understood in relation to what non-conscious processing can do. According to Baars (2002), "unconscious input processing is limited to sensory regions" (p. 47), meaning that it does not enable access to (or by) other processing mechanisms. Under that argument, consciousness enables many kinds of post-perceptual processing, such as comprehension of novel information. The global workspace also supports integration of different input networks (Baars & Franklin, 2003). The properties of the global workspace differ from those of working memory (Baars & Franklin, 2003): working memory typically has a capacity of a few items rather than just one, comprises possibly multiple specialised stores rather than just one (Baddeley, 2000; Baddeley & Hitch, 1974; Martin & Romani, 1994; Schulze & Koelsch, 2012), and is supported by transiently accessible storage in long-term memory (Norris, 2017).

Global neuronal workspace theory, originally proposed by Dehaene and Naccache (2001), postulates a similar central information exchange but incorporates postulates about the brain areas and networks involved, specifically "long-range connections (cortico-cortical and thalamo-cortical) that connect a broad network of brain regions, particularly in the prefrontal cortex, posterior parietal cortex, and associated areas" (Storms et al., 2024, p. 1535). Thus, information in the global neuronal workspace can be subject to integrated processing across a wide range of networks. This supports complex post-perceptual processing. A key concept in the global neuronal workspace theory is ignition: when activity crosses a threshold for entry to the global neuronal workspace, the information entered there is rapidly amplified and broadcast through the system (Dehaene & Changeux, 2011; Dehaene et al., 2014; van Vugt et al., 2018). Information in the global neuronal workspace is hypothesised to be conscious and ignition is hypothesised to be the means by which conscious information is made available to other processors. Evidence consistent with the occurrence of ignition has been found in several studies (Mashour et al., 2020; Noy et al., 2015; van Vugt et al., 2018); however the Cogitate Consortium (2025) failed to find ignition at stimulus offset and argued that that posed a serious challenge for the ignition hypothesis.

reported will to act (Haggard & Clark, 2003; Haggard, Clark, & Kalogeras, 2002; Haggard & Cole, 2007; Lau, Rogers, & Passingham, 2006, 2007; Moretto et al., 2011; Sirigu et al., 2004; Tsakiris & Haggard, 2003). So what appears to be the will to act is in fact the emergence of the efference copy or the forward model, and the actual initiation of the action is a release from inhibition of the action commands that follows detection of a match between planned action and forward model in the comparator.

The efference copy is a by-product of the action generation mechanism: it does not itself generate action. Instead, the information in it is fed into the comparator mechanism. It is the outcome of the error detection process that determines the initiation of action, and action continues to be guided by error monitoring as it unfolds, utilising both the efference copy and sensory feedback of action and outcome information. The model in Fig. 1 is illustrative of a general class of models and the last word on that subject has yet to be written, but it suffices for the issues under discussion here.

The experience we have of generating our own actions is, therefore, incorrect, and that shows that the generation of action is not conscious. The reported experience of the will to act is not the actual initiation of action, but just the emergence of the efference copy or the forward model. It is a set of information that tells the comparator mechanism what the planned action is and that it is ready to go. For the sake of clarity it should be noted again that a verbal report of the experience of the will to act depends on information being transferred from the action generation system to the verbal report generation system: as with everything else, it is information processing that determines whether something can be verbally reported or not, not the fact (if it is one) that the will to act was conscious. We do not have any experience that corresponds to the action generation and monitoring system as outlined here. If all of that was conscious, there would be no need for research for find out about it. If the justification offered for regarding verbal reports and detection judgments as indicating what is conscious is the assumption that those actions are done consciously, then that justification is not valid.

It could still be argued that only information that is conscious (in the conscious experience sense) can be conveyed in a verbal report or by a voluntary key press. The implicit justification for that in terms of the belief that verbal reporting is a conscious and voluntary action is not valid, but that is not enough to prove the claim to be false. In an information processing system, what determines whether information can be conveyed in a verbal report or not depends on whether there is a route from where the information is to the verbal reporting mechanism. That is, reportability is a function of the operating characteristics of the system. Thus, if it is true that only information that is conscious can be transmitted from wherever it is to the verbal reporting mechanism, then it is true that only information that is conscious can be reported. For example, in global workspace theories (Baars, 1988; Dehaene & Naccache, 2001; see Box 1) it would be argued that information in the global workspace is conscious, and that verbal reporting mechanisms are among a number of mechanisms that can access that information. It is not known whether that is correct or not. But it is the location of the information, not whether the information is conscious or not, that determines whether it can be conveyed in a verbal report or not. And, to restore the focus on the main proposition in this section, the processes involved are not conscious. In that respect action generation is an example of a general truth about the brain as an information processing system. Only the information handled by the processes can be conscious, in the conscious experience sense.

Let us suppose (hypothetically) that there is a global workspace and that only information in the global workspace can be conscious. If there is some information in the global workspace then that information can be conveyed in a verbal report. But it is not the case that the verbal reporting mechanism somehow looks at the information in the global workspace and sees that it is there and sees that it is conscious. That would be analogous to the naive belief that vision involves actually seeing what is out there in the world (Winer, Cottrell, Gregg, Fournier, & Bica, 2003), instead of the truth that vision constructs a model of the world based on information coming to it. So a verbal reporting mechanism depends not just on information in the global workspace being conscious, but also on that information being transmitted to it from the global workspace. That being so, is the information still conscious when it is in the verbal reporting mechanism, or does the verbal reporting mechanism just have (non-conscious) information about what was conscious in the global workspace? If the former is the case then the information is conscious in two different and temporally successive locations in the system, one in the global workspace and one in the verbal reporting mechanism. If the latter is the case then the information in the verbal reporting mechanism is not conscious but simply registers the fact that information was conscious when it was in the global workspace. (It might still be conscious if it is still in the global workspace at the time, but it is not necessarily the case that it is still there: it could have decayed or been erased). Whatever kind of information is or was in the global workspace, it has to be transmuted into the representational format used by the reporting mechanism, such as words or a choice of which key to press. Is it conscious when it is transmuted?

The questions in the previous paragraph are not rhetorical. There is a real issue of scientific importance concerning information being or not being conscious in different places in the system. Not enough is known about that. At the very least, a map of the system is required, a map that specifies the kinds of processes that are operating on information at each location in the system. When we have that, the next requirement is to find out where in the system information can be conscious. For example, if information in the hypothetical global workspace is conscious, that does not necessarily mean that it is still conscious when it has been transferred to a verbal reporting mechanism and transmuted into verbal form. Verbal reports are trusted by researchers as indicators of what is conscious (Lamme, 2006) but in fact it is not known whether information in the verbal reporting mechanism is conscious or not (in the conscious experience sense), let alone whether it is a valid guide to whether the information from which it was derived was conscious or not. That brings us to the third proposition.

4. Access consciousness is just a kind of information processing

In several papers, Block (1995, 2007, 2011, 2014) has proposed and defended a distinction between phenomenal consciousness and access consciousness. Block (1995) stated that “phenomenal consciousness is experience; what makes a state phenomenally conscious is that there is something ”it is like“ (Nagel, 1974) to be in that state” (p. 228). The use of the phrase “something it is like” by Nagel (1974) has been influential but is not in fact informative about consciousness. There is something it is like to be a stone, and that is to be another stone. So at best the phrase is unclear and at worst it just denotes relations of resemblance. It is better to focus on the definition of phenomenal consciousness as experience, which makes it close to, if not identical with, the meaning of the term “conscious experience” in Chalmers (1995, 1996). Block used illustrations of phenomenally conscious states (his term is “P-conscious states”) that are similar to those used by Chalmers (1995, 1996; see section 2): “we have P-conscious states when we see, hear, smell, taste, and have pains. P-conscious properties include the experiential properties of sensations, feeling, and perceptions, but I would also include thoughts, desires, and emotions” (Block, 1995, p. 230). With a reminder that the particular information must be distinguished from the fact that it is conscious, we can proceed to the difference between P-consciousness and access consciousness or A-consciousness (Block, 1995).

Block (1995) argued for three differences between P-consciousness and A-consciousness. One is that “P-conscious content is phenomenal, whereas A-conscious content is representational” (p. 232). “Representational” means roughly that there is something the information is about. The second difference is that “A-consciousness is a functional notion…: what makes a state A-conscious is what a representation of its content does in a system” (p. 232). That involves relations between components of the system. The third difference is that every phenomenally conscious state must have the same feel every time or all the time, whereas “any particular thought that is A-conscious at a given time could fail to be accessible at some other time” (p. 232). And in summary, “The paradigm P-conscious states are sensations, whereas the paradigm A-conscious states are ”propositional attitude“ states such as thoughts, beliefs, and desires, states with representational content expressed by ”that“ clauses (e.g., the thought that grass is green)” (p. 232). In a nutshell, A-consciousness is a particular kind of information, specifically having reference to something else (intentionality or aboutness), and it has a functional role in a system.

In writing all that, Block was not thinking about global workspace theories, nor indeed any particular theory of information processing in the human brain. The account was meant to be more general than that. Since then, however, the distinction between P-consciousness and A-consciousness has featured in a debate about where conscious information occurs in the brain. Some authors have argued that P-consciousness is located in iconic memory[1] and A-consciousness in later processing, notably in the global workspace, or indeed that information is only conscious (in any sense) in the global workspace (Bronfman, Brezis, Jacobson, & Usher, 2014; Dehaene & Changeux, 2011; Frässle, Sommer, Jansen, Naber, & Einhäuser, 2014; Koivisto & Revonsuo, 2010; Railo, Koivisto, & Revonsuo, 2011; Rutiku, Aru, & Bachmann, 2016; Sergent, Baillet, & Dehaene, 2005). In other words, P-consciousness and A-consciousness have been treated as if they were two forms of consciousness differentiated by being located in different processing stages in the brain. That is not correct. As Kouider, de Gardelle, Sackur, and Dupoux (2010) pointed out, “phenomenal consciousness” refers just to the phenomenal nature of consciousness, whereas A-consciousness refers to propositional attitudes as representations; that is, it refers to certain kinds of information, not to the fact (if it is one) that they are conscious. It is possible that information in both iconic memory and the global workspace could be P-conscious, to use Block's (1995) term.

The examples of conscious states (in the conscious experience or P-conscious sense) given by Chalmers (1995, 1996) and Block (1995) are mainly in perception: e.g. “the taste of peppermint” (Chalmers, 1996, p. 4), or pain (both authors). It is, therefore, odd that the debate over where P-conscious states occur has been concerned only with two post-perceptual stores, iconic memory and the global workspace. In principle, information could be conscious (P-conscious) anywhere in the system. Information could, for example, be P-conscious in any or all of perception, iconic memory, and the global workspace. It is not clear what it takes for information to be conscious in the P-conscious sense. For example, a case has been made that perceptual information becomes conscious only when re-entrant processing occurs late in perceptual processing, around 200 ms after stimulus onset (Lamme, 2018; see Box 2 for more on supposed neural correlates of consciousness and box 3 for more on re-entrant processing). However, re-entrant processing at that stage adds a particular kind of information to perceptual input, namely semantic or categorical information that supplements surface visual information with meaning. That is, it is concerned with certain kinds of information in perception, not with whether that information is conscious or not. Again, the information itself must be distinguished from whether it is conscious or not. So, even if it is true that perceptual information becomes conscious at that late stage of processing, re-entrant processing does not explain how that happens.

Nevertheless, the claim made by some is that access consciousness is located in the global workspace (Baars, 2002, 2005; Baars & Franklin, 2003) or global neuronal workspace (Dehaene & Naccache, 2001; Mashour et al., 2020; Changeux, & Dehaene, 2020). That does not fit well with the characterisation of A-consciousness given by Block (1995) as summarised above. However the fit between Block's concept and global workspace theories is not the main concern here. It is possible that information in the global workspace is conscious in the P-conscious or conscious experience sense; and that does not exclude the possibility of information being conscious elsewhere in the system as well. But, if information in the global workspace is P-conscious, that has no relevance to the functions of the global workspace. In fact, global workspace theories are not theories of P-consciousness or conscious experience at all. Nor are they theories of access consciousness. They are theories of access. Everything the global workspace does can be described without using the words “conscious” and “consciousness”. Taking those words out of the account does not alter the functional properties of the models in any respect.

Global workspace theories are essentially theories about the distribution of information in the brain. The claim is that there is a central repository for post-perceptual information that can be accessed by numerous specialised processing mechanisms. There are

[1] The term "iconic memory" was first used by Neisser (1967) and refers to a brief high-capacity store in which sensory information persists, subject to rapid decay, for some hundreds of milliseconds (Coltheart, 1980; Öğmen & Herzog, 2016; Sligte, Vandenbroucke, Scholte, & Lamme, 2010; Sperling, 1960).

Box 2
Neural correlates of consciousness.

When a novel stimulus is perceptually processed, EEG recordings reveal a characteristic series of positive and negative deflections (Koivisto & Revonsuo, 2010). Arguments have been made that some of those waveforms mark the emergence of conscious information. In global neuronal workspace theory it is argued that information becomes conscious when it enters the global neuronal workspace and that the marker of that event is a deflection called the P300 or P3 or P3b, a positive deflection occurring ~300 ms after stimulus onset (ASO) (Dehaene & Changeux, 2011; Mashour et al., 2020; Sergent et al., 2005). There is also a negative deflection occurring around 200 ms ASO, termed the N2 or N200 (Koivisto & Revonsuo, 2010), and now also commonly known as the perceptual awareness negativity (PAN) or, in vision, the visual awareness negativity (VAN) (Auksztulewicz & Blankenberge, 2013; Filimonov, Lenkkeri, Koivisto, & Revonsuo, 2025; Wiens, Andersson, & Gravenfors, 2023). That event coincides in time with the occurrence of re-entrant processing in late perceptual processing (see Box 3), and for that reason it has been argued that it marks the emergence of conscious perception (Lamme, 2018) or entry to iconic memory (Bronfman et al., 2014).

The debate over those two waveforms as indicators of the emergence of conscious information has a long and complex history (see, e.g., Wiens et al., 2023). There is now strong disconfirmatory evidence for the P3 hypothesis. Studies have shown that the P3 does not always occur in processing of novel stimuli. It occurs when participants are asked to make a report about the stimulus, such as a detection judgment, but does not occur when they are not asked to do that (Cohen, Dembski, Ortego, Steinhibler, & Pitts, 2024; Cohen, Ortego, Kyroudis, & Pitts, 2020; Dembski et al., 2021). When some stimuli are presented frequently and others infrequently, there is usually a strong P3 to the infrequent stimuli and little or none to the frequent stimuli (Dembski et al., 2021; Verleger, 2020). Several studies have found that the P3b occurs when the stimulus is task-relevant and does not occur when the stimulus is not task-relevant regardless of whether the stimulus was conscious (reportable) or not (Koivisto, Salminen-Vaparanta, Grassini, & Revonsuo, 2016; Pitts, Metzler, & Hillyard, 2014; Schlossmacher, Dellert, Bruchmann, & Straube, 2021; Schröder et al., 2021; Shafto & Pitts, 2015). In all three cases there is no reason to think that the stimuli were not conscious, so there is a clear dissociation between conscious information and the waveform.

On the other hand, it is not clear what the PAN indicates. It could be emergence of a conscious percept due to re-entrant processing (Lamme, 2018) or entry of perceptual information into iconic memory (Bronfman et al. 2014). It has also been argued that the VAN indicates detection, not identification, of a stimulus (Koivisto, Grassini, Salminen-Vaparanta, & Revonsuo, 2017; Wiens et al., 2023). That would suggest that it is not an indicator of late re-entrant processing because re-entrant processing is involved in identification. Interpretation of such indirect evidence is always problematic and it is far from clear that any physical event marks information being or becoming conscious in the conscious experience sense, as opposed to a stage in information processing (see main paper for more on this).

long-range connections covering a broad network of brain regions and those connections mediate the distribution of information from the central repository. That is a rather simple characterisation and fuller accounts can be found in numerous publications (Baars, 1988; Baars, 2005; Baars & Franklin, 2003; Dehaene & Naccache, 2001; Dehaene, Charles, King, & Marti, 2014; Dehaene et al., 2003; Mashour et al., 2020; Seth & Bayne, 2022; Storm et al., 2024; van Vugt et al., 2018 see also Box 1). But a simple characterisation suffices for present purposes. The purpose is not to criticise the theories. It is just to argue that taking the word "consciousness" (and "conscious", etc) out of them makes no difference to them. It is possible, and might even be correct, to talk about the storage and distribution of information in the brain without referring to consciousness in any sense of the term.

The distinction between P-conscious and A-conscious led to a debate about whether or not more things can be P-conscious than can be A-conscious. The positive hypothesis about that has come to be known as the overflow hypothesis, which originated with Block (2011). The summary of that hypothesis by Cova, Gaillard, and Kammerer (2021) is most useful and succinct for present purposes. "(1) *Some contents are phenomenally conscious but not access conscious*. This is the *overflow thesis*, which amounts to saying that the content of phenomenal consciousness *overflows* the content of access consciousness. However, (2) *if phenomenal consciousness were not empirically distinct from access consciousness, no content would be phenomenally conscious without being access conscious*. Therefore, (3) *phenomenal consciousness is empirically distinct from access consciousness*" (p. 3). The argument is incorrect: the possibility of P-consciousness being distinct from A-consciousness does not depend on overflow. For example, P-consciousness might occur both in the products of perceptual processing and in information in the global workspace, which is post-perceptual, and A-consciousness might occur only in the latter. That is not an overflow. It is just a matter of different kinds of consciousness, so defined, occurring in different locations in the system. A-consciousness is confined to the global workspace. P-consciousness might occur anywhere: in iconic memory and in the global workspace and in non-perceptual events such as imagery and emotions. Overflow does not speak to that possibility.

That is not quite all that needs to be said. Block's use of the term "access consciousness" might be taken as legitimising the use of the term "consciousness" in application to theories such as global workspace theories. The key to that is Block's (1995) statement that "A-consciousness states are "propositional attitude" states" (p. 232), with the example of a thought that grass is green. That example can be analysed in terms of information processing in the brain. For instance, one might look at some grass, and the percept of that grass, with its green colour, is information in the system. That information may be transferred to working memory or the global workspace, and from there it can be distributed to or accessed by a processing mechanism that analyses the colour information and generates a verbal thought about it. All of that can be described without reference to consciousness or conscious experience. There is no reason to

Box 3
Re-entrant processing.

On presentation of a visual stimulus, a rapid progression of activation through a series of processing stages occurs, often called the feedforward sweep (Fahrenfort, Scholte, & Lamme, 2008; Lamme & Roelfsema, 2000; Mohsenzadeh, Qin, Cichy, & Pantazis, 2018; Motlagh, Joanisse, Wang, & Mohsenzadeh, 2024). There is now abundant evidence that the feedforward sweep is accompanied by activations of connections from higher to lower areas, variously called re-entrant, recurrent, or feedback processing. Such pathways are now known to be widespread in the brain, and indeed re-entrant or descending connections outnumber ascending ones (Mumford, 1992; Spalek, Unnikrishnan, & Di Lollo, 2024).

There are at least three time scales on which re-entrant processing occurs. There is evidence for local re-entrant processing in the first 100 ms ASO, which may be associated with the progressive refinement of initial low spatial frequency information (Bar, 2003; Bar et al., 2006) or a general coarse-to-fine progression of perceptual processing (Ahissar, Nahum, Nelken, & Hochstein, 2009; Hansen, Greene, & Field, 2021; Hochstein & Ahissar, 2002).

Re-entrant processing also occurs toward the end of the initial feedforward sequence, beginning around 150–200 ms ASO, peaking in the range 200–300 ms and associated with incorporation of categorical or semantic information into the developing object construct (Clarke, 2019; Clarke et al., 2013; Fahrenfort et al. 2008; Mohsenzadeh et al., 2018; von Seth, Nicholls, Tyler, & Clarke, 2023; Wyatte, Jilk, & O'Reilly, 2014). There is evidence that this stage of processing is necessary for the occurrence of reportable visual percepts (Enns & Di Lollo, 2000; Fahrenfort et al., 2008; Lamme & Roelfsema, 2000; Motlagh et al., 2024; Spalek et al., 2024; Tapia & Beck, 2014).

Several studies have found evidence for re-entrant processing occurring or continuing for hundreds of milliseconds ASO (Akrami, Liu, Treves, & Jagadeesh, 2009; Brandman & Peelen, 2017; Gwilliams & King, 2020; Rajaei, Mohsenzadeh, Ebrahimpour, & Khaligh-Razavi, 2019; Wu et al., 2023). Those studies show perceptual processing continuing when there is ambiguity or uncertainty or incompleteness in the stimulus information, and the function of extended re-entrant processing is to resolve the uncertainty and generate a definite perceptual interpretation, if possible.

Lamme (2018) has argued that perceptual information becomes conscious at the middle re-entrant processing stage, partly because the latency of that stage (~200 ms) roughly coincides with the visual awareness negativity that has been interpreted as evidence for the earliest emergence of conscious perception (see Box 2). Clearly re-entrant processing is not sufficient for the occurrence of conscious perception because there is no evidence for that in early re-entrant processing. So the relationship between re-entrant processing and conscious information in perceptual processing, although suggestive, remains unclear at present.

think that whether the information is conscious or not (either in perception or in the verbal thought) makes any difference to how all of that works.

The term “propositional attitude” implicates higher-order theories of awareness (Lau & Rosenthal, 2011; Naccache, 2018; Natsoulas, 1981; Rosenthal, 2005, 2008; Seth & Bayne, 2022; Seth et al., 2008). The fundamental claim of those theories is that something is conscious when there is some kind of further thought, cognition, or information about that thing. As Seth and Bayne (2022) put it: “The core claim that unites all [higher-order theories] is that a mental state is conscious in virtue of being the target of a certain kind of meta-representational state. Meta-representations are… representations that have as their targets other representations” (p. 442). That is the case in the example of the thought that grass is green: the claim would be that the percept of the grass as green is conscious in the sense that there is a further thought embodying the proposition that the grass is green, or more broadly expressing awareness that it is. In the present account, meta-representation is again a matter of information processing. Whether any of the information is conscious or not (in the conscious experience sense) makes no difference to whether that kind of meta-representation can occur or not. But that is something that global workspace theories are designed to deal with: information is entered into the global workspace and from there it can prompt further processing using specialised processing mechanisms such as internal thought generation. That is awareness, in the sense of higher-order theories of awareness: some further cognition that is about the information in the global workspace. Lau and Rosenthal (2011) argued that global workspace theory and higher-order awareness theories are not the same and generate different predictions. That debate lies outside the remit of this paper. What they have in common is that they both describe certain kinds of information processing that operate on some kind of informational input to a holding area where it is available to that processing. Using the term “conscious awareness” for that, as Lau and Rosenthal (2011) did, confuses the issue because it is not certain that information has to be conscious, in the conscious experience sense, for that higher-order kind of processing to operate on it. Again, the information itself must be distinguished from whether it is conscious or not, and it is the information itself that subserves whatever function is involved. In a meta-representation of a percept of grass as green, the greenness of the grass in perception is information (and might or might not be conscious in the conscious experience sense), the proposition that the grass is green in the meta-representation is also information (and might or might not be conscious in the conscious experience sense). The perceptual information and the meta-representational information stand in a relation to each other that can be defined in terms of the operating characteristics of the system. That has nothing to do with whether either kind of information is conscious in the sense of conscious experience or not.

In summary, there is a distinction between information and that information being conscious (in the conscious experience or P-conscious sense). The analysis of global workspace models exemplifies an argument that applies to any information processing model, and it should not be taken as restricted in application to global workspace models. All such models are models of the operation of processing mechanisms on information in the system, optionally coupled with models of storage locations where information can be held. They are not models of the being conscious of information, in the conscious experience sense; that is something fundamentally different. Whatever model one has of information processing systems in the brain, the functioning of those systems, what they do to information, and the information content that is handled by them, can all be described without reference to whether any of the information is conscious (in the conscious experience or P-conscious sense). They do not explain what it is for information to be conscious in that sense. They do not explain how conscious experience occurs or what difference it makes.

This section has focussed on access consciousness, particularly in its association with global workspace theories. The same arguments can be made about many current theories or models of consciousness (see table 1 in Seth & Bayne, 2022, for a useful but far from exhaustive list). It needs to be shown that adding the word "conscious" to anything in any model, or supposing that something or other is conscious, in the conscious experience sense, makes a difference; or that taking the word "conscious" out of it makes a difference. No theory that is at bottom an information processing theory does that. A non-conscious mechanism could function in exactly the same way as any such mechanism that is proposed as a theory of consciousness.

5. The need for a generative model

There is a fundamental error in theorising about the conscious experience or P-consciousness sense of being conscious. It is to argue that conscious experience occurs somewhere in the brain and then to argue that that location or some kind of processing that is going on there is an explanation for conscious experience. In their table of theories of consciousness, Seth and Bayne (2022) repeatedly used the phrase "depends on" to express that. For example, for neuro-representationalism, "Consciousness *depends on* multilevel neurally encoded predictive representation" (p. 441, italics added). Just proposing that conscious experience depends on something or occurs in some location, even if that is correct, does not suffice to explain how conscious experience occurs. For that, a generative mechanism is needed. That is, it is necessary to have an account of the part of the brain, the processing mechanism, the functional properties of the mechanism, the underlying neurophysiology, or anything else that is concerned with the physical nature of the brain, that explains how conscious experience is generated by it. No existing theory does that. All of them take a putative association between conscious experience and some mechanism, function, neurophysiology, etc., and suppose that that association means that the mechanism, function, neurophysiology, etc. is the explanation for conscious experience. That is not enough. There must be an account of a generative mechanism that convincingly demonstrates how conscious experience is made to happen. The word "convincingly" sets a high standard of proof. Mere speculation does not meet that standard. Mere association does not meet that standard. There is no hope of establishing whether conscious experience occurs in other animal species, in computers, or in AI, without a convincing account of a generative mechanism for conscious experience.[2] We do not have one, and we do not have any idea what one would look like. It is an extraordinary conundrum that the one thing with which we are all most intimately familar should be perhaps the most difficult and impenetrable problem in all of science.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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[2] A reviewer of an earlier version of this manuscript suggested that the quantum theory of consciousness developed by Penrose and Hameroff (Hameroff & Penrose, 2014, 2021; Penrose, 1999; Wiest, 2025; see also Sarfatti and Shimansky, 2018) did offer a generative mechanism. The basic ingredient of that theory is microtubules, which "are cylindrical polymers of the protein tubule capable of information processing, with fundamental units being states of a billion tubules per neuron" (Kuhn, 2024, p. 90). The key is collapses of quantum states, that is from superposition of states into a single state. In their theory these collapses are orchestrated, which means that many collapses occur in a globally organised way. Microtubules are the loci of organised reduction of quantum superpositions. An entangled system can support phenomenal consciousness because it is not local in the way that particles are (Wiest, 2025). It is questionable whether the theory is a theory of conscious experience at all, however. The theory seems to be mainly concerned with differences between the waking state and non-waking states such as unconsciousness induced by anaesthesia. Brain function in the waking state is different from brain function in unconsciousness in many ways, and presence versus absence of conscious experience is only one of them (assuming that conscious experiences do not occur when one is unconscious). Also, since tubules are proposed to be ubiquitous in the brain, they are present in areas where conscious experience does not occur as well as in areas where it does occur. For example, they would be present in neurons involved in early perceptual processing, where information is not conscious. So they do not appear to be exclusively associated with conscious experience. In the present context, the key question is how organised decoherence generates conscious experience. Just claiming that it does is not sufficient. The generative mechanism is still lacking.

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