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What is a global state of consciousness?

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Abstract
The notion of a global state (or level) of consciousness is an increasingly important construct in the science of consciousness. However, exactly what a global state of consciousness is remains poorly understood. In this paper I offer an account of global states of consciousness as consciousness-related capacity modulations. On this view global states are not themselves phenomenal states – they are not occurring experiences. Rather, they are states that specify which of a creature's overall consciousness-related capacities are currently online. I argue that a mature mechanistic science of consciousness needs to account for global states of consciousness and that doing so requires moving beyond the current focus on occurrent experiences and integrating consciousness research with research in other areas of cognitive neuroscience.

Keywords
Consciousness · Disorders of consciousness · Global state · Level of consciousness · NCC

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1 Introduction

Consciousness is a multifaceted phenomenon. Most research into the neural basis of consciousness focusses on occurring conscious experiences: the visual experience of a face, the taste of pineapple, the feeling of pain, and so on. With regard to occurrent experiences there are two questions that researchers are interested in. By virtue of what is a conscious experience of a face *of a face*? And by virtue of what is a conscious experience of a face *conscious*? To answer the first question researchers seek neural representational systems with states that systematically correlate with the contents of consciousness (Chalmers, 2000; Crick & Koch, 2003; Koch et al., 2016). Given that the brain harbours both conscious and unconscious representations, revealing these neural representational systems does not immediately answer the second question. To answer the second question, researchers seek

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the "difference makers that transform unconscious content into conscious content" (Michel & Morales, 2020). They seek the neural mechanism, perhaps common to all conscious experiences, by virtue of which conscious contents are conscious (Bayne, 2007; Hohwy, 2007, 2009; Hohwy & Bayne, 2015).

In this paper I focus on another feature of consciousness that has variously been referred to as "global states" (Bayne et al., 2016), "background states" (Chalmers, 2000), "levels" (Boly et al., 2013; Laureys, 2005), "modes" (Bayne & Hohwy, 2016), "global modes" (Fortier-Davy & Millière, 2020), and "aspects" (Klein, 2017) of consciousness. As is often the case with features of consciousness, global states of consciousness are best introduced by way of example. Alert wakefulness, dreaming, dreamless sleep, mild anaesthesia, and coma are all examples of global states of consciousness. They are ways in which a creature may be conscious (or unconscious). In addition to answering the two questions above pertaining to occurrent experiences, we might also ask, 'By virtue of what is a creature in one global state rather than another?' However, before we can answer that question we first need to know what a global state of consciousness is. Perhaps the closest we have to a definition of global states is that offered by Bayne, Hohwy and Owen when they state that global states are "states of consciousness that characterize an organism's overall conscious condition" (Bayne et al., 2016). But this definition cries out for elaboration. In what sense are global states *states of consciousness*? And in what ways do they characterize an organism's overall conscious condition?

There are a wide range of suggested answers to these questions in the literature. In sections 2 and 3, I argue that none of them adequately capture the concept of a global state of consciousness. The absence of an adequate, agreed upon analysis of global states of consciousness might lead one to think that the concept doesn't really refer to anything interesting or substantive and that we should eliminate global states of consciousness from our taxonomy of phenomena that the science of consciousness must contend with. However, to do so on the grounds that no suitable analysis *currently* exists would be premature. For it may be that a suitable analysis *can* be given. My objective in this paper is to provide one.

Section 2 discusses the problems with the widespread convention of thinking of global states in terms of 'conscious level'. Section 3 considers three ways in which one might try to reduce global states of consciousness to occurrent experiences and finds them all unsatisfactory. Section 4 provides a positive account of global states as states that regulate which of a creature's consciousness-related capacities are currently online. And section 5 serves as a reminder that we want more from a mature mechanistic science of consciousness than just an account of occurrent experiences. Accounting for global states of consciousness requires integrating research into the mechanisms supporting occurrent experiences with research into the mechanisms supporting attention, working memory, expectation, and so on.

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

2 Are global states levels of consciousness?

In the scientific literature it is common practice for researchers to characterize the difference between alert wakefulness, dreaming, anaesthesia, coma and so on in terms of 'conscious level' (Aru et al., 2019; Boly et al., 2013; Koch et al., 2016; Laureys, 2005). The notion of 'conscious level' stems from clinical tools for gauging the conscious capacities of brain damage patients. In the Glasgow Coma Scale subjects are scored on a number of separate behavioural tests: eye opening, motor response, verbal response, and pupil reactivity (Brennan et al., 2018; Teasdale et al., 2014). For example, a patient who can move their limbs (give a thumbs up) in response to command scores higher on the motor response test than a subject who can only be coaxed to move in response to a painful stimulus. And a patient who spontaneously opens her eyes scores higher than one who only opens her eyes to command, or painful stimulus, or not at all. The scores for each test are tallied, and used to determine the conscious level – coma, vegetative state, minimally conscious state, normal wakefulness – of the patient. The thought is that the higher the score, the 'more conscious' the subject.

There is something intuitively appealing about the idea that some global states are more conscious than others. In some sense, a creature is more conscious when alert and awake than when sleeping or in a coma. But what sense of consciousness is at play here? An initial suggestion might be that a creature is more 'generically conscious' when alert and awake than when dreaming. As I use the term, 'generic consciousness' is just the most general property of 'being conscious'. A creature is generically conscious when it has a subjective perspective from which it is like something to be.[1] This interpretation of 'conscious level' as 'degree of generic consciousness' is common throughout the literature. For example, Tononi and Koch introduce the notion of 'conscious level' by suggesting that "when you fall asleep [...] the degree to which you are conscious (of anything) becomes less and less" (Tononi & Koch, 2008). But interpreting 'conscious level' as 'degree of generic consciousness' is ultimately untenable. Generic consciousness isn't the sort of property that can come in degrees. This is a point that has been recently stressed by a number of philosophers (Bayne et al., 2016; Carruthers, 2019). To see why generic consciousness can't come in degrees it will be helpful to introduce some metaphysics: the determinate-determinable relation (Funkhouser, 2006; Wilson, 2017).

The determinate-determinable relation describes the relationship between a certain class of abstract entities and their less-abstract manifestations. A paradigm example is the relationship between being coloured, being red, and being fire engine red. Being coloured is an abstract (determinable) property. An entity can't be coloured simpliciter. In order to be coloured an entity has to be a particular colour:

[1] Others have referred to this notion as 'creature consciousness' (Bayne, 2007, 2010; Chalmers, 2000). I avoid that term here since 'creature consciousness' is also used to refer to a creature being awake rather than asleep (Carruthers, 2019; Rosenthal, 2005).

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

red, or green, or blue, or some other determinate colour. Of course, an entity can't be red simpliciter either, but must be red by being a particular shade of red: fire engine red for example. Maximally specific shades of colour, such as fire engine red, are super-determinates. At the other end of the specificity spectrum is the super-determinable property, *being coloured*. Super-determinable properties are maximally abstract. Knowing that an entity is coloured tells us nothing specific about the way in which it is coloured. It merely specifies that it is coloured in some determinate way or other.

Following Bayne (2007) we can think of generic consciousness as the super-determinable property associated with being conscious. Knowing that a creature is generically conscious tells us nothing about what it is like to be that creature. It merely specifies that it is like something to be that creature. Specific conscious experiences, such as the visual experience of a face, the taste of pineapple, and so on are determinate ways of being generically conscious. Intuitively, just as an entity can't be coloured simpliciter but must be coloured in a determinate way, so too an entity can't be generically conscious simpliciter but must be generically conscious in a determinate way.

The reason this is relevant here is that the super-determinable property of being coloured, is not the sort of property that can come in degrees. Although we often speak of colourfulness as if it comes in degrees – Bob's shirt is more colourful than Jane's – what we mean here is that Bob's shirt is brighter, or more saturated, or a more vibrant hue. We don't mean that the colour of Jane's shirt is somehow less of a determinate of being coloured than the colour of Bob's. Even the drabbest of colours is a determinate of being coloured. Generic consciousness, like being coloured, is a super-determinable property that does not come in degrees. An entity either instantiates a determinate experience and is generically conscious, or does not and it is not generically conscious. It seems that 'conscious level' can't be as simple as 'degree of generic consciousness'.

Others have used 'conscious level' to refer to 'level of wakefulness' or 'level of arousal' (Laureys, 2005; Pal et al., 2018, 2020). However, if conscious level just means level of wakefulness/arousal then it is not an adequate analysis of global states of consciousness. The issue here is that level of wakefulness/arousal dissociates from consciousness in interesting ways. Dreaming subjects are asleep but certainly conscious (Revonsuo, 2006). And vegetative state patients exhibit a relatively normal sleep/wake cycle but are typically thought to be unconscious (Stender et al., 2017). Indeed, this is precisely why Laureys takes level of wakefulness to be only one of the components of global states of consciousness; the other being level of awareness/conscious contents.

A third suggestion is that 'conscious level' refers to the range of conscious contents a subject is currently experiencing. This appears to be what Melanie Boly and colleagues have in mind in places (Boly et al., 2013, see especially the y-axis of their figure 1). But, as they recognize, this analysis is not entirely satisfactory. The problem, as they put it, is that:

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

> Typically, high conscious levels are associated with an increased range of conscious contents. Whether or not high level of consciousness without any conscious contents is possible remains unclear. (Boly et al., 2013, p. 2)

What I take the authors to be grappling with here is the thought that it may be possible for a creature to be in a high global state of consciousness without experiencing much in the way of conscious contents. The states reached by experienced meditators might be an example here (Thompson, 2014). But if it is an open question whether global states dissociate from range of conscious contents, and conscious level just means range of conscious contents, then conscious level is not a suitable analysis of global states of consciousness.

Rather than appealing to the range of contents currently being experienced, one might try to unpack 'conscious level' in terms of the range of contents a creature is *capable* of experiencing. Anil Seth suggests something along these lines when he notes that "conscious level and content are related inasmuch as the range of possible contents increases with increasing conscious level" (Seth, 2009, p. 51). However, note that Seth is careful not to say that 'conscious level' *is* 'range of possible contents'. Rather he just points out that the range of contents a creature is capable of experiencing tends to be correlated with its conscious level.

Of course, one could go further and stipulate that 'conscious level' just is 'range of possible contents'. However, doing so would undermine its utility for analysing global states of consciousness – coma, vegetative state, dreaming, alert wakefulness, and so on. The consciousness-related differences between a patient in a minimally conscious state and an alert awake subject cannot be captured purely in terms of the range of contents each is capable of experiencing. While it is true that an alert neurotypical subject is capable of experiencing more content, they are also capable of endogenously directing the focus of their attention onto specific conscious contents and using these conscious contents to guide their intentional actions in ways that a vegetative state patient cannot. By manifesting these capacities, the alert neurotypical subject plays an active role in how their stream of consciousness unfolds over time. A subject in a minimally conscious state arguably lacks these capacities. Moreover, it is also possible that two subjects may have the same range of possible conscious contents, but differ in terms of their capacity to endogenously direct attention and their capacity to use their conscious contents to guide intentional action. In this case, while they have the same range of possible contents, only one would play an active role in orchestrating how their conscious life unfolds over time.

One might wonder whether these intentional capacities are really relevant to global states of consciousness. That they are becomes clear when we consider the objectives that clinicians have when treating disordered global states of consciousness. They want to do more than just restore to a subject her capacity for a wide range of possible conscious contents. A treatment that restored to a patient the full range of conscious contents, but left them incapable of guiding their intentional

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

actions and engaging in everyday conscious life would not be entirely satisfactory. Indeed, one might question whether such a treatment is worth doing at all.

Similar points can be made regarding other areas of research in which the concept of a global state of consciousness can be applied. A central distinction within dream research is between lucid and non-lucid dream states. The main dimension of difference here is not the range of possible contents dreamers can experience, but the degree to which they have intentional control over their actions in the dream world (Windt, 2015a). Moreover, it is not just intentional capacities that are relevant. Cognitive capacities such as the ability to lay down new long-term memories, as well as connectedness to the environment are also relevant. For example, in evaluating cases of interoperative awareness – conscious awareness during surgery – researchers are interested not only in the range of contents subjects experience while anaesthetised, but also their 'connectedness' to the environment, and the degree to which their experiences are remembered (Mashour & Avidan, 2015; Sanders et al., 2012). The really distressing cases of interoperative awareness are those in which subjects have explicit recall of events that took place during the surgery. It is these cases that tend to have a higher instance of long-term negative effects such as post-traumatic stress disorder. As a result, if 'conscious level' means 'range of possible contents' then it is not a suitable analysis of global states of consciousness as it is applied in many areas of research into global states of consciousness.

A final suggestion is that level of consciousness can be cashed out in terms of the quality or vividness of conscious content (Aru et al., 2019; Bachmann & Hudetz, 2014; Overgaard & Overgaard, 2010). For example, Aru et al suggest that sleep, vegetative state, and the minimally conscious state are "intermediate states" between fully conscious and fully unconscious "with varying levels of clarity or degrees of experience" (Aru et al., 2019, p. 2).

Here we need to distinguish the application of the term 'level of consciousness' to the investigation of conscious contents, with its application in research on global states of consciousness. In content-based research researchers are interested in what is required for a mental representation to be conscious. One of the questions that researchers are currently grappling with is how best to explain the fact that some of our conscious contents are clear and vivid while others we only glimpse. One view is that there are two more or less independent variables here: richness of representational content, and degree of awareness of that content (Fazekas & Overgaard, 2018; but see Michel, 2019; Rosenthal, 2019 for challenges to this view). In this discussion, degrees of awareness are sometimes referred to as 'levels of consciousness'. However, we need to be careful to distinguish 'conscious level' as it applies to degrees of awareness of a content, and 'conscious level' as it applies to global states of conscious creatures. These are not the same construct. One applies to mental states. The other applies to whole creatures. And they can vary independently. For example, in masking experiments, researchers seek to manipulate the degree to which subjects are conscious of a stimulus. But doing so

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does not change their global state. Subjects remain alert and awake throughout the experiment. What is manipulated is the degree to which they are conscious of the stimulus.

One attempt to bridge the gap between conscious level as it applies to conscious contents and conscious level as it applies to whole creatures is to define a creature's level of consciousness in terms of its "most clearly experienced contents" (Overgaard & Overgaard, 2010, p. 3). On this view a vegetative state patient with one crystal clear experience of pain would be just as conscious as an alert awake subject. But if this is what 'level of consciousness' means when applied to whole creatures, then it is not an appropriate analysis of global states of consciousness. Even if a patient in a vegetative state did have a conscious experience that was as clear as an alert awake neurotypical subject, there are consciousness-related differences between these two subjects that go beyond the quality of their most vivid conscious content. Not only do we assume that the alert neurotypical subject has a much wider range of conscious contents available to her than the vegetative state patient, she can endogenously direct the focus of her attention onto specific conscious contents and use these conscious contents to guide her intentional actions in ways that the vegetative state patient cannot.

To recapitulate, 'conscious level' can't mean 'degree of generic consciousness' since, as I have argued, generic consciousness does not come in degrees. If 'conscious level' means 'level of wakefulness/arousal' then it is not an adequate analysis of global states since wakefulness/arousal dissociate from global states of consciousness. If 'conscious level' means 'range of conscious contents' then it is not a suitable analysis of global states since it is an open question whether global state and range of conscious contents dissociate. And if 'conscious level' just means 'range of possible contents' or 'vividness of conscious content' then it is not an adequate analysis of global states of consciousness since there is more to global states of consciousness than just range and vividness of conscious contents. So, while there is something intuitively appealing about the idea that some global states are *more conscious* than others, by *more conscious* we can't mean *more generically conscious*, or *more awake/arousable*, or *conscious of more* content, or *capable of being conscious of more content,* or *experiencing more vivid conscious contents.*

3 Are global states phenomenal states?

According to Bayne, Hohwy and Owen, global states are "*states of consciousness* that characterise an organism's overall conscious condition" (Bayne et al., 2016). How should we understand 'states of consciousness' in this context? Perhaps the most natural way to think about states of consciousness is that they are phenomenal states: experiential states that are characterized in terms of *what it is like* to be in them. On this reading, global states are occurrent experiences that characterise an organism's overall conscious condition. This appears to be how Chalmers thinks of global states. He maintains that the set of global states form a "phe-

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

nomenal family" – which is "a set of mutually exclusive *phenomenal properties*" (Chalmers, 2000, p. 22). On this view, global states of consciousness are states with characteristic phenomenal properties. Bayne, Hohwy and Owen also suggest that this is the right way to think about some (but not all) global states. Dreaming is an example of what they call an "occurrent global state" a global state "defined in terms of the individual's current conscious experiences" (Bayne et al., 2016, p. 412).

There are a number of ways one might try to characterize global states in terms of current experiences. One might try to account for global states in terms of the unified totality of fine-grained conscious contents that a creature has at a time. On this view global states are to be characterized in terms of the totality of what it is like to be a creature at a time. Alternatively, one might follow Chalmers in thinking that while global states are phenomenal states, they will "not be defined in terms of specific contents" (Chalmers, 2000, p. 18). There are two ways one might go here. Global states might have distinct residual phenomenal signatures even once all the conscious content is subtracted away. Alternatively, one might appeal to the structural relations between conscious contents in order to account for global states of consciousness. In this section, I argue that none of these options is satisfactory.

3.1 Are global states total states?

For the purposes of investigating consciousness, it is often useful to focus on local states of consciousness that are characterized in terms of conscious content: states such as the visual experience of a face, the taste of pineapple or the feeling of pain. At any given time, conscious creatures are conscious of a wide range of contents, and these contents are bound together (or at least appear to be bound together which may amount to the same thing) into a unified conscious experience. Following Bayne we can call this unified conscious experience a "total state" of consciousness (Bayne, 2010).

An initially appealing thought is that we might be able to account for global states in terms of total states. However, there are two problems here. First, one and the same global state can give rise to radically different total states. Second, it is conceivable that two distinct global states can give rise to indistinguishable total states. I'll elaborate on these in turn.

To motivate the idea that one and the same global state can give rise to radically different total states, contrast the totality of what it is like to snorkel around a coral reef with the totality of what it is like to wait in line at the department of motor vehicles. In the first instance you experience a rich visual scene with vibrant colours and intricate shading due to the motion of the waves above. You feel the cool of the water and the familiar weightlessness that accompanies swimming. If you are not a frequent snorkeler, you may experience a mix of excitement and anxiety about breathing through your mouth while your face is submerged. In the

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second instance your visual experience is drab by comparison. Your body heavy and feet sore from standing stationary for too long. And in place of excitement, frustration colours your affective experience. In terms of their phenomenal character, these two total states are strikingly different. And yet, they are both cases of a single global state: alert wakefulness. One problem with attempting to account for global states in terms of total states is that total states are much too finely specified. It is not clear what principle could be appealed to in order to account for why these two strikingly different total states are both instances of the same kind of global state.

The second issue is that there is reason to think that distinct global states might yield indistinguishable total states. False awakenings – in which you dream that you have woken up – might be an example here. False awakenings are often very convincing. In many cases, the dream experiences during false awakenings appear to be subjectively indistinguishable from waking experience (Windt, 2015a). Further, it may be that certain dream experiences in neurotypical subjects are indistinguishable from the waking experience of subjects in a minimally conscious state. The problem here is that the totality of what it is like to be a subject at a time may be incapable of distinguishing between distinct global states.

The problems that arise when trying to account for global states in terms of the totality of what it is like to be a creature in that state do not have obvious solutions. A more plausible approach could be to follow Chalmers' suggestion that while global states are phenomenal states, they will "not be defined in terms of specific contents" (Chalmers, 2000, p. 18). As mentioned earlier, there are two ways in which this might go. It might be that global states have a distinctive phenomenological signature in addition to specific contents. Or, it might be that global states structure a subject's phenomenal field in distinctive ways. I will address these in turn.

3.2 Do global states have residual phenomenal signatures?

According to the view that global states of consciousness have residual phenomenal signatures it would still be like something to be alert and awake, or to dream, or to have a seizure, even if all the specific contents had been *subtracted* away. And that this 'phenomenal residue' is how we should think about global states of consciousness.

At first pass, evidence from sleep research might be taken to support this view. Upon waking from sleep, subjects are sometimes able to confirm that they were dreaming even though they are unable to recall any of the details of the dream: so-called "white dreams" (Fazekas et al., 2019; Strauch & Meier, 1996). A natural interpretation of white dreams is that subjects had normal, contentful dreams but failed to encode these dream contents into memory or are unable to retrieve them (Cohen, 1974; Goodenough, 1991). An alternative interpretation that has recently sparked considerable interest is that subjects are accurately reporting "contentless"

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

or "*imageless*" dream experiences (Windt, 2015b; Windt et al., 2016). On this view, during white dreams,"subjects experience only a minimal form of conscious presence with no [...] specific percepts, bodily sensations or thoughts occurring during such experiences" (Fazekas et al., 2019, p. 85).

It is tempting to infer from this that there is some phenomenal signature to dreaming independent of conscious contents. After all, subjects are able to report that they were dreaming even though they are not able to report any dream contents. However, such an inference would be a mistake. For one thing there is an argument to be made that white dreams are not in fact contentless. Rather they are dreams with "low-quality" contents (Fazekas et al., 2019). But even if genuinely contentless dreams do occur, this would not support the idea that global states can be accounted for by subtracting conscious content and revealing some residual phenomenal signature distinct to those states. Supposedly, all that remains of a dream state once all the conscious content is subtracted away is a "minimal form of conscious presence" (Fazekas et al., 2019, p. 85). But it is not clear how this 'minimal form of conscious presence' could be used to distinguish one global state from another. Presumably, all that is left of any global state once all the conscious content is subtracted away will be a minimal form of conscious presence. So even if there is a residual phenomenal experience once all conscious content is subtracted away, it is far from obvious that global states should have distinct residual phenomenal signatures. If they don't then the subtraction method is not capable of differentiating between global states of consciousness.

3.3 Are global states distinct phenomenal structures?

This leaves the view that global states are distinct ways a subject's phenomenal field can be structured. Here the operation is not subtraction but abstraction. Rather than subtracting away conscious content and seeing what is left, we abstract away from the specific details concerning the contents of consciousness and focus on structural features that characterise the relations between conscious contents.

Perhaps what first comes to mind when we think about the structure of a phenomenal field are the relations between conscious contents at a time. If we abstract away the specific content of a total state – recall the total state is the totality of what it's like to be a creature at a time – we reveal that these contents are unified (Bayne, 2010) into a seemingly 3-dimensional field (Revonsuo, 2006, pp. 265–281), with a distinctive centre and periphery (Watzl, 2017). But when analysing global states, it's also important to consider temporal structure as well. For example, a structural feature of certain dream states is that they lack narrative coherence. At one stage in a dream you may be at dinner with your family, the very next base-jumping off the Eiffel Tower. In fact, dreams can be so disjointed that researchers are typically unable to distinguish genuine dream reports from artificial reports constructed by splicing together segments of distinct dream reports (Stickgold et

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al., 1994).[2] Narrative coherence characterizes the relationship between conscious contents across time. So, we should think of phenomenal structure here as encompassing both the relations between conscious contents at a time and the relations between conscious contents across time.

Can phenomenal structure provide a way of characterizing global states? While it is plausible that global states do determine phenomenal structure, it is a mistake to think that global states *are* distinct phenomenal structures. There are two problems. First, what we take to be a single global state can, at different times, structure the phenomenal field in different ways. Second, it is conceivable that distinct global states can nonetheless give rise to phenomenal fields with indistinguishable phenomenal structure. I will address these in turn.

Consider the following scenario. It's evening and you are watching a thriller on TV. The suspense generated by the film has your undivided attention. The movie cuts to a commercial break and your attention dissolves away from what's happening on the screen into features of the surrounding environment. You notice the faint sound of a truck passing outside, remember that you had boiled the kettle to make tea during the previous commercial break, and feel guilty about the neglected pile of ironing on the couch.

The structure of your phenomenal field is strikingly different at the end of this scenario than at the beginning. At the beginning, your attention is acutely focussed on what is happening on the screen, resulting in a sharp center-periphery structure to your phenomenal field (Watzl, 2017). You have vivid, high-quality contents at the centre of your phenomenal field, but only faint experiences of what is in your phenomenal periphery. At the end, your attention is much more diffusely distributed and the contrast between center and periphery is much less acute. If we identify global states with distinct phenomenal structures, then despite the fact that you are alert and awake the whole time, it looks like we are committed to saying that these are distinct global states.

Second, I argued earlier that it is conceivable that paradigmatically distinct global states can nonetheless give rise to indistinguishable total states of consciousness. It is also conceivable that two distinct global states could nonetheless give rise to phenomenal fields with indistinguishable phenomenal structure. Again, false awakenings – where dream experience appears to replicate waking experience – may provide an example (Windt, 2015a). In order to avoid these issues, we need to consider not just the experiences that a subject actually has and the relations between them, but the set of possible experiences that the subject can have while in that state. This reveals perhaps the most convincing reason for abandoning the project of trying to account for global states in terms of occurring experi-

[2]Moreover, there are candidate explanations for this lack of narrative coherence. Lateral prefrontal inactivity may result in diminished capacity for working memory, which in turn "may prevent reflection upon immediately past events leading to an unquestioned, forward progression of the plot as well as frequent narrative divergence" (Pace-Schott, 2013, p. 2).

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

ences: global states of consciousness and occurring experiences belong to different ontological categories.

Global states are complex capacities. Part of what it is for me to be alert and awake is for me to be able to experience semantically-rich content. I can see faces and recognise them *as faces* not merely as bundles of shape, colour, and texture. But I don't need to be currently experiencing semantically-rich content in order to be alert and awake. Similarly, part of what it is to be alert and awake is to be able to make use of conscious contents to guide intentional action and provide verbal reports. But I don't need to be currently guiding my intentional actions and providing verbal reports in order to be alert and awake. What matters is that I *can* do these things.[3] Phenomenal states – occurring experiences – are not capacities. They are occurrents. To illuminate the difference here compare 'being in pain' with 'having the capacity to be in pain'. The former hurts. The latter doesn't. In the next section I provide an account of global states in terms of consciousness-related capacities.

4 The capacities account of global states

Before explicating the capacities account of global states, it will be helpful to introduce another distinction: the distinction between 'a system' and 'a system in a state.'[4] My washing machine has a range of settings: cottons, quick wash, delicates, off. Common sense tells us that the washing machine that is currently making a racket during its final spin cycle of a *cottons* wash is the same washing machine that was quietly sitting in *off* two hours ago. Here, the distinction that I want to draw out is that between 'my washing machine' (a system) and 'my washing machine in the final spin cycle of a *cottons* wash' (a system in a state). Creatures, like washing machines, are systems. They persist beyond the current states they are in. The alert awake (and highly caffeinated) creature currently writing these sentences is the same creature that was asleep in bed three hours ago.

There are a number of ways in which a creature (a system) may be said to have, or fail to have, a capacity. Consider the capacity to speak a language. A creature may lack the capacity to speak a language because it has never learned one (as is the case with infants). A creature may lack the capacity to speak a language because it lacks the capacity to learn one (as is the case with most non-human animals). Alternatively, a creature may lack the capacity to speak a language because

[3] The idea that global states of consciousness are sets of capacities is not new. In his account of waking consciousness as "capacitation", Crowther (2018) traces the idea back to Aristotle. More recently, Fortier-Davy & Millière (2020) also discuss global states in terms of capacities.

[4] In the philosophical literature the distinction is more commonly put as continuants and occurrences, or things and events (Lowe, 2005). I opt for 'system' and 'state' here as it is likely to be more intuitive to non-philosophical readers and it is less likely to get us bogged down in long standing metaphysical issues about how to unpack this distinction that are tangential to the current project.

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

its capacity to speak a language is currently off-line (as is the case with anaesthetized adult humans). It is the third sense that I am interested in here. In order to understand the capacities account of global states we need to appreciate the distinction between the total set of capacities that a creature (a system) has, and the set of capacities that creature has while in a particular global state.

An example can help to make this more intuitive. Take my capacity to bake cookies. I am not always able to manifest this capacity (I can't bake cookies in my sleep I am sorry to say). So, while 'Andy' (a system) has the capacity to bake cookies, 'sleeping Andy' (a system in a particular state) does not have the capacity to bake cookies. While Andy is asleep, his capacity to bake cookies is off-line. According to the capacities account of global states, global states of consciousness are states of creatures that characterize the range of consciousness-related capacities that are currently online.

In order for this account of global states of consciousness to be informative we need to know what makes a capacity a consciousness-related capacity. How are we to distinguish consciousness-related capacities from capacities that are not consciousness-related? At first glance, given that consciousness is realized in biological organisms, many of the capacities involved in maintaining biological organisms are related to consciousness in some way or other. In some sense, being able to breathe is a capacity that is related to consciousness. If you can't breathe you will quickly lose consciousness. But being able to breathe is not a consciousness-related capacity as I am using that term. Rather, being able to breathe is a background condition that enables the possibility of consciousness. We might call it a consciousness-enabling capacity. I reserve the term 'consciousness-related capacity' to refer to those capacities that cannot be specified without reference to consciousness.[5]

Consider once more the capacity to breathe. In order to specify what it is to have this capacity we don't need to refer to consciousness. You can breathe when you have the capacity to control the muscles in your chest in such a way that it draws air into your lungs. As such, the capacity to breathe is not a consciousness-related capacity. By contrast, the capacity to visually experience colour cannot be specified without reference to consciousness. Here it is important to point out that the capacity to visually *experience* colour is not just the capacity to perform better than chance on forced choice tests. It is the capacity to have phenomenally conscious mental states with colours as their content. Similarly, the capacity to verbally report your conscious experience of colour cannot be specified without reference to consciousness. Some aspects of attention offer another example. The capacity to focus one's attention on the colour of an object so as to bring a vivid conscious experience of colour into the center of one's phenomenal field cannot be specified without reference to consciousness. Each of the above count as consciousness-related capacities.

[5]Thanks to Tim Bayne for this suggestion.

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

Specifying the full range of consciousness-related capacities is beyond the scope of this paper, but we might begin with the three mentioned above. Following Bayne, Hohwy and Owen we can construct a multi-dimensional account of global states with capacities along three dimensions (or sets of dimensions): a content dimension, an attentional dimension, and a cognitive dimension (Bayne et al., 2016; Bayne & Hohwy, 2016). The content dimension specifies the range and quality of contents a subject is capable of being conscious of while in that state. The attentional dimension specifies the extent to which attentional resources can be focussed on a particular target and whether or not that focus can be endogenously directed as well as exogenously captured. The cognitive dimension specifies the range of cognitive systems into which the contents of consciousness can be mobilized.

The capacities account of global states of consciousness is as follows:

> **Global states of consciousness:** states of creatures (systems) that regulate (i) the range and quality of conscious contents the creature is capable of experiencing while in that state, (ii) the range of cognitive systems into which those contents can be mobilized while in that state, and (iii) the range of attentional capacities the creature has while in that state.

Contrasting alert wakefulness with dreaming can shed light on what this might look like. While alert and awake, the full range of a creature's consciousness-related-capacities are online. Alert awake adults can be conscious of a wide range of high-quality, semantically-rich content in addition to low-level features. They can see faces as particular people, not merely as bundles of shape, colour and texture. They can hear speech as meaningful, not merely as sounds, and so on. Those conscious contents can be mobilized into a wide range of cognitive systems. Alert awake adults can make use of conscious contents to guide intentional action, provide verbal reports, consolidate memories, and so on. And, alert awake adults have a wide range of attentional capacities. In addition to having their attention exogenously captured by features of the environment they can endogenously direct their attention to particular items, and by modulating the intensity with which they direct the focus of their attention they have the capacity to modulate the centre/periphery structure of their phenomenal field.

When dreaming some of these consciousness-related capacities are offline. Although dreaming subjects are still capable of experiencing a wide range of semantically-rich contents, these may be lower-quality. Dreams often involve vague contents: contents "whose identity or precise nature is indeterminate, unknown, or obscure in a way which does not occur in waking life" (Revonsuo & Salmivalli, 1995, p. 174). This may be because the low-level features (colour, shape, and texture) that typically accompany semantically rich conscious content in alert wakefulness are less vivid (Fazekas et al., 2019). In some cases, high-level content may even dissociate entirely from low-level features. It is not uncommon

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

for subjects in dream studies to report "just knowing" that the person that they were "seeing" in their dream was their mother, even though they cannot provide specific information about low-level features (Windt, 2015a, p. 267). While dreaming attentional capacities may also be substantially limited. In most cases dreaming subjects lack the endogenous control of attention that they have while awake – lucid dreams, where dreamers are aware they are dreaming and have a degree of dream control being the notable exception (Voss & Hobson, 2014). And there also tends to be limitations to the range of cognitive systems into which the contents of consciousness can be mobilized. Conscious contents may be available for memory consolidation, but they are typically not available for reasoning and guiding intentional action.

There is a question as to whether global states can be characterised as fixed sets of capacities or need to be indexed to individual subjects. Disorders of consciousness – minimally conscious state, vegetative state, and coma – tend to be characterised in absolute terms. However, for some global states, alert wakefulness for example, it seems more appropriate to index global states to specific subjects. Both infants and adults can be alert and awake, but their consciousness-related capacities are very different. Alert wakefulness may be best characterized as a state in which a subject's full range of consciousness-related capacities are online – to be "fully switched on", as Crowther (2018) puts it. This may have considerable implications for taxonomies of global states. However, my primary goal here is not taxonomic, so I will leave this issue for another time.

There are a number of advantages of the capacities view of global states. First, it can make sense of the idea that global states admit of some degree of ordering. Roughly, the more consciousness-related capacities a creature has the more conscious that creature is. However, a few qualifications are in order. We need to be clear that the notion of consciousness at play here is not generic consciousness. Moreover, as Bayne et al. (2016) stress, this approach will not admit of a strict ordering. Two global states may have the same number of consciousness-related capacities online but be very different in terms of which consciousness-related capacities are online. There may be no fact of the matter as to which is the 'higher' global state of consciousness.

Second, this framework provides the conceptual tools to make sense of a number of claims about consciousness that at first glance appear to be conceptual contradictions. I mentioned earlier that it is an open question whether or not high level of consciousness without conscious content is possible. If conscious level is thought of as generic consciousness – the property of having a subjective perspective from which it is like something to be – it is not obvious how to make sense of this claim. A creature's being generically conscious entails that there is something it is like to be that creature. A creature's having no conscious contents appears to entail that there is nothing it is like to be that creature. This looks like a contradiction. The capacities account of global states can make sense of this claim. A creature might be in a high level of consciousness by virtue of having a wide range

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

of consciousness-related capacities online, and yet have no conscious contents by virtue of failing to manifest any of its content-related capacities.

The capacities account of global states can also account for certain meditative states such as "witness consciousness" (Albahari, 2009) or "pure awareness" (Thompson, 2014) as well as contentless dream states (Windt, 2015a) in which there is conscious awareness or presence in the absence of any conscious contents. In such states, subjects might have the full range of attentional capacities online, but none of their content-related capacities online.

While the capacities account has the resources to make sense of these states, it is not committed to thinking that these are states that ever actually occur. It may be that the mechanisms underlying a creature's consciousness-related capacities are such that attentional capacities are only ever online when at least some range of cognitive capacities and content-related capacities are also online.

5 Implications for the science of consciousness

Although a number of researchers have recently begun to explore global states of consciousness as I have presented them here (Bayne & Carter, 2018; Bonhomme et al., 2019), for much of the past 30 years they have seen relatively little attention from consciousness scientists.

Theories of consciousness have said little about global states of consciousness. The Integrated information theory of consciousness (IIT) has focussed exclusively on conscious contents and the structural relationships between them. In its current form, it appears to lack the resources to account for global states of consciousness as conceived under the capacities account (Tononi et al., 2016). Cognitive theories of consciousness appear better equipped in this regard. However, they have primarily been developed in the context of investigating what is required for a mental representation to be conscious. As a result, they have said little about the global states of conscious creatures. For example, according to the global neuronal workspace theory, in order for a neural representation to be conscious, its content needs to be mobilized into a global workspace rendering it available for a wide range of cognitive systems (Baars, 2005; Dehaene et al., 2011). Here we should take care not to confuse the contents of the global workspace with a creature's global state of consciousness. Rather, a creature's global state of consciousness might be taken to correspond to the current state of the perceptual, cognitive, and attentional systems that are connected to the workspace, and the ways in which these connections are gated. Perhaps the closest any theory of consciousness has come to addressing global states of consciousness is the REF-CON model proposed by Mogensen and Overgaard (Mogensen & Overgaard, 2017). According to this theory it is only when the content of a perceptual representation is integrated into a "dynamic network" combining elements from sensory areas with "a broad spectrum of other dimensions relevant to the current status of the individual" that it become available for cognitive access, behavioural control and conscious aware-

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

ness (Mogensen & Overgaard, 2017, p. 17). While there may be some overlap here between this "dynamic network" and a creature's global state of consciousness, it remains unclear exactly what these authors have in mind. Considerable work remains to be done in clarifying how and indeed whether the various theories of consciousness can accommodate global states of consciousness.

Moreover, the central project in the science of consciousness – the search for the NCCs – has been explicitly defined as the search for the minimal set of neural mechanisms that are jointly sufficient for the occurrence of a conscious experience (Chalmers, 2000; Fink, 2016; Koch, 2004). Revealing the minimal mechanisms supporting occurrent experiences is an important task for the science of consciousness. Doing so will go some way towards extending our ability to make reliable inferences about (1) which creatures and systems are conscious and (2) what they are conscious of. Though it is worth noting some complications here. For the most part, NCCs are defined as minimally sufficient in the context of a conscious neurotypical adult rather than minimally sufficient simpliciter (Block, 2005; Chalmers, 2000; Koch, 2004). If this is the case then revealing the NCC won't straightforwardly extend our ability to make inferences about which creatures/systems are conscious and which not.

It is within the context of investigating the minimal neural correlates of consciousness in alert neurotypical adults that current debates between cognitive and sensory theories of consciousness are situated (Aru et al., 2012; Block, 2007, 2019; Boly et al., 2017; Cohen & Dennett, 2011; Koch & Tsuchiya, 2007; Odegaard et al., 2017; Phillips, 2018). Cognitive theorists argue that the processes in prefrontal cortex that support attention and cognition are part of the minimal neural correlates of consciousness in alert neuro typical adults. Sensory theorists argue that they are confounds that need to be screened-off. This final section serves as a reminder that we want a mature mechanistic science of consciousness to do more than just reveal the minimal mechanisms that support consciousness. We want it to account for the full suite of capacities that consciousness imbues us with. And in the context of this broader project the neural mechanism supporting attention and cognition are clearly relevant. I will briefly consider two cases to motivate this.

First, consider the use of anaesthesia as a tool for controlling consciousness for surgical purposes. What anaesthetists want to ensure is that patients don't experience the surgery. In order to achieve this it is not essential that patients are rendered completely unconscious. All that is required is that their consciousness be disconnected from the environment. Dissociative anaesthetics such as ketamine work in just this way (Sanders et al., 2012). Under dissociative anaesthetics, subjects remain conscious, but the capacities that enable them to experience the external world are off-line. It is reasonable to expect that a mature mechanistic science of consciousness facilitate prediction, explanation, and fine-grained control over conscious creatures' connectedness to the environment. This goes beyond revealing the minimal mechanisms that support occurrent experiences.

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

A second example comes from considering disorders of consciousness. Compare the conscious life of a creature who has the capacity to endogenously direct her attention with that of a creature who lacks that capacity. There is a very real sense in which the conscious experiences of the former are "part of her own making" (Watzl, 2017, p. 44). By actively directing her attention to the sound of the wind through the trees or the feeling of grass under her feet, she can bring those contents to the center of her conscious field and thereby ensure that she enjoys high-quality representations of those conscious contents. Similarly, by intentionally moving her body, she can alter the sensory input she receives and by virtue of doing so, play an active role in the production of her future experiences. By contrast, in disordered states of consciousness such as the minimally conscious state subjects lack, or have greatly diminished capacities to orchestrate the unfolding of their conscious life. Even if it turns out that attentional and cognitive consciousness-related capacities are not necessary constituents of the minimal mechanisms sufficient for supporting conscious experiences, they are central to the endogenous formation of intentions, goals, and desires by virtue of which conscious creatures play an active causal role in orchestrating their conscious life.

The take home message here is that a mature mechanistic science of consciousness needs to account for more than just occurring experiences. It also needs to account for (i) the ways in which conscious experiences unfold over time, (ii) the active role the subject of those experiences plays in how they unfold, and (iii) the ways in which these can be compromised in disordered global states of consciousness. In order to achieve these goals, research into the neural mechanisms underlying occurrent experiences needs to be integrated with the research from other areas of cognitive neuroscience such as attention, working memory, and so on. To be clear, the idea is not that occurrent experiences should be reduced to these other constructs. Rather, the idea is that a mature mechanistic science of consciousness needs to make explicit the causal/constitutive relationships between them. It needs to reveal how changes in attention, working memory, expectation and so on effect consciousness, and it needs to reveal how changes in consciousness can in turn effect these cognitive processes.

6 Conclusion

In this paper I have argued that global states of consciousness cannot be fruitfully understood in terms of 'conscious level', nor can they be reduced to occurring experiences. I have offered an account of global states of consciousness as states of creatures that characterize the range of consciousness-related capacities that are currently online. I have finished with a reminder that a mature mechanistic science of consciousness needs to do more than reveal the minimal neural mechanisms that support consciousness. It needs to integrate these findings with cognitive neuroscience more broadly in order to account for the full suite of consciousness-related capacities that determine a creature's global state of con-

McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58

sciousness. Considerable work remains to be done in considering the implications that the capacities account of global states has for our taxonomy of global states of consciousness and for extending consciousness research so as to investigate the full range of consciousness-related capacities.

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