The Conscious Brain: How attention engenders experience, by Jesse Prinz. New York: Oxford University Press, 2013. Pp. xiii + 397. H/b £27.50.

Jesse Prinz's *The Conscious Brain* is a book of big ideas, tackling the problem of consciousness through a wide-ranging examination of cognitive science. Prinz ambitiously aims 'to synthesize two decades of empirical exploration' of consciousness (xi-xii) and the vividness of the book's discussion is mirrored in the striking cover drawn by the author. Prinz's coverage of interesting experiments is a major highlight, impressive in scope and dizzying in details. There is much to learn from and admire in the book, and I strongly recommend it to empirically minded theorists of consciousness.

Chapter 1 provides desiderata for a theory of consciousness and critically comments on extant theories. Part 1 then presents the core of the book, Prinz's AIR (*A*ttention to *I*ntermediate *R*epresentations) theory of consciousness: Chapter 2 ties visual consciousness to brain regions serving *intermediate vision* while Chapter 3 presents and defends the AIR theory: consciousness arises when and only when attention modulates intermediate vision; Chapter 4 then discusses the neural correlates of intermediate vision and of attention, combining them to yield the neural correlates of AIR and consciousness, what Prinz calls *gamma vectorwaves*, the synchronized neural activity of populations of neurons over time. As Prinz ties consciousness to perception, Part 2 responds to challenges to AIR from putative cases of non-perceptual phenomenology: cognitive phenomenology (Chapter 5); action as the basis of consciousness (Chapter 6); and the phenomenology of the self (Chapter 7). Part 3 then applies AIR to traditional philosophical issues and provides interesting proposals on the unity (Chapter 8), ontology

(Chapter 9), and self-knowledge of consciousness (Chapter 10). I will focus on the foundations of AIR, first on intermediate vision, then on attention.

Like many scientists of consciousness, Prinz assumes that neural content, namely information transmitted by neurons, determines conscious content. In Chapter 2, he identifies the realizer of visual consciousness in intermediate level vision, vision that carries *viewpoint-specific* information. This level best reflects the content of experience: 'We consciously experience a world of surface and shapes oriented in specific ways at various distances from us' (52). In Chapter 4, Prinz presents four criteria for identifying intermediate visual areas including an *anatomical* criterion emphasizing connectivity to primary visual areas and a *viewpoint* criterion that takes the necessary representations as being from a specific vantage. This yields a concrete map of intermediate visual regions (figure 3, p. 54). I admire Prinz's specificity in linking neuroanatomy to consciousness and find his emphasis of intermediate level vision plausible (note: Prinz's theory is not restricted to visual consciousness).

Let me raise two questions. First, what exactly is a 'viewpoint' as definitive of intermediate visual representations? I am not fully clear on this, but I surmise that egocentric visual representations, namely representations of a stimulus in relation to a part of the subject's body, should be sufficient for intermediate visual representations. After all, Prinz emphasizes that visible items are represented 'at various distances from us' (52). Now all representations by visually responsive neurons are egocentric in the sense that the neurons have receptive fields tied to the retina (a visual neuron's spatial

receptive field can be understood as that part of the retina stimulation of which drives the neuron's activity). The relevant egocentric representations, however, cannot be retina-centered otherwise *all* visual neurons will be intermediate, encoding information from the viewpoint of the retina. Rather, egocentric representatons must be body-centered, say head-centered. Yet the best evidence that we have for body-centered representations in cortical vision are for those in areas Prinz labels as high-level such as the ventral intraparietal area (VIP) where we have head-centered reference frames (Duhamel, J. R., Colby, C. and Goldberg, M. E. 'Ventral intraparietal area of the macaque: congruent visual and somatic response properties' 1998, *Journal of Neurophysiology,* 79: 126–136). Indeed, VIP is in the dorsal visual stream, a stream that is often taken to be unconscious (D. Milner and M. Goodale, 1995 *The Visual Brain in Action,* Oxford University Press). The question then is whether certain dorsal stream high-level areas are in fact intermediate visual areas and whether they contribute to consciousness.

Second, might viewpoint independent representations have correlates in consciousness? The well-studied visual agnosic patient, D.F., has defective visual experience of objects and shapes though preserved texture and colour experience. Neuroimaging has localized the bulk of her brain lesions to the lateral occipital complex (LOC), an area thought to be important in object and shape processing (T. W. James et al. 'Ventral occipital lesions impair object recognition but not object‐directed grasping: an fMRI study' *Brain,* 2003, 126: 2563-75). Prinz locates LOC in high-level vision, but the evidence from D.F. suggests that LOC plays an important role in visual consciousness, supporting consciousness of shape. It is not clear to me, then, that Prinz's map of intermediate level

vision draws the boundaries in exactly the right place or that consciousness is restricted to intermediate level vision. I suspect Prinz would agree that some fine-tuning of the map of the neural correlates of visual consciousness is necessary.

Let us now move to attention. As Prinz notes, a theory of consciousness should tell us when consciousness arises. His answer is the following:

> **[Attention Formulation of AIR]**: Consciousness arises when and only when intermediate-level representations are modulated by attention (89).

AIR is later unpacked as follows

> **[Working Memory Formulation of AIR]**: Consciousness arises when and only when intermediate-level representations undergo changes that allow them to become available to working memory (97).

Unlike many discussion that invoke attention, Prinz provides a clear statement of what attention is, namely a process that makes information available for working memory. AIR is motivated by a large body of empirical work that Prinz details, a highlight of the book. I think, however, that there are compelling reasons that speak against AIR in its attention formulation. Let me consider one compelling example.

Robert Kentridge and colleagues have provided a case against AIR's sufficiency claim that attention implies consciousness (Kentridge, R. W. et al. 'Attention without awareness in blindsight.' *Proceedings of the Royal Society of London. Series B: Biological Sciences,* 1999*,* 266: 1805-1811). Working with the blindsight patient G.Y., Kentridge et al. use the Posner spatial cueing paradigm to demonstrate that G.Y. directs spatial attention in his blind field. The essential feature of spatial cueing is that a cue is used to direct or misdirect attention with respect to a target stimulus. When attention is cued to the actual location of the target, there is a benefit in reaction time for target detection while there is a cost in reaction time when attention is miscued and directed to an incorrect location (both times are compared relative to performance with a neutral cue). One can think of the cost as due to relocating incorrectly cued attention to the correct position and the benefit as due to preparing attention. Kentridge et al. observed cueing benefits when G.Y.'s attention was directed in his blindfield. This suggests attention without consciousness. I find this and similar experiments to make a compelling case against AIR.

Prinz has interesting responses. He notes that the cueing paradigm is a test of spatial attention, but the relevant form of consciousness is of an object. Thus, the relevant sufficiency claim is:

(S) if S attends to object O, then S is conscious of O.

Prinz notes that the cueing paradigm only establishes attention to a location, not to an object. Posner cueing, however, involves object attention as well. After all, to perform the task, the subject must issue a report about a specific object and not a location. To my mind, it is a strange position to allow that attention gets pulled by the cue but then simply leaves the scene when the target to be reported on appears. Rather, attention is also needed to selecting the target to inform the subject's report, as the task requires. In many cases, such selection for task suffices for attention. In reporting on the presence of a target, G.Y. thus attends to an object that he cannot consciously see. Prinz is correct that spatial cueing is deployed as a test for spatial attention, but the standard construal of the paradigm misses the essential involvement of object attention (for recent work suggesting object-based attention without consciousness, see L.J. Norman et al. 'Object-based attention without awareness', *Psychological Science, 2013,* 24: 836-43).

Prinz's central response is to distinguish *orienting* from attention and to argue that putative counterexamples are due to orienting. But what is orienting? Prinz writes that 'orienting alters what information gets in and attention alters where it flows' (p. 113). In vision, *overt* orienting aims to allow a target of interest to stimulate the fovea, the retinal area of highest visual acuity. Thus, Prinz ties overt orienting to what is typically called 'overt attention', attention linked to movement of the sensory organ. He also allows for two forms of *covert* orienting: (a) when the subject forms an intention to overtly orient or (b) when there is 'shrinking of receptive fields' (p. 114).

Can invoking covert or overt orienting provide an adequate defense in response to the experiments with G.Y.? I do not think overt orienting can. Prinz suggests that G.Y. might be making *microsaccades,* smaller saccadic (ballistic) movements of the eye. Since saccades result in foveation, namely allowing a target to stimulate the fovea, Prinz's idea must be that microsaccades provide enhancement of visual processing in the direction of foveation. While I agree this is possible, I think physiological parameters speak against it. While the upper bound of microsaccades is often taken to be one perhaps even two visual degrees, microsaccades are typically much smaller, say less than 30 arcminutes (1/2 of a visual degree; M. Rolfs, 'Microsaccades: Small Steps on a Long Way', 2009, *Vision Research,* 49: 2415-2441). In G.Y.s case, however, the target was located six visual degrees from fixation, and experimenters could detect if GY made eye-movements of two to three degrees. I presume that they threw out any trials in which such visible movements were made. Prinz would then need to explain how microsaccades can explain enhanced performance of a target likely located three and more likely at least six times the distance of the eye movement. I do not think microsaccades explain GY's performance.

What of covert orienting? On visual field remapping (or shrinking), Prinz is referring to work of J. Moran and R. Desimone showing that when two objects are present in a neuron's receptive field, attention to one of them, results in remapping the receptive field to the attended object, almost as if the receptive field shrinks around it ('Selective attention gates visual processing in the extrastriate cortex' 1985, *Science* 229: 78204). The effect was observed in visual area V4, one of Prinz's intermediate areas, and the

experimental task used to induce the effect required the use of working memory: Animals were tasked with matching a stimulus with an earlier sample. Moran and Desimone suggest that the observed effect is a kind of neuronal filtering of irrelevant stimuli that supports working memory (cf. Donald Broadbent's conception of attention as a filter, *Perception and Communication,* Pergamon Press, 1958). Even by Prinz's own characterization of attention, I think receptive field remapping is plausibly tied to attention. Remapping looks to serve availability to working memory.

Finally, what of covert orienting as intention, say an intention or at least preparation to move the eye (saccade)? This is the most promising defense. Prinz's argument would be that (1) covert orienting as an intention to move the eye is not the same as attention and that (2) the intention modifies processing sufficient to enhance G.Y.'s performance. Neuroscientists have long debated the precise relation between orienting qua intention to move and attention. For example, at the beginning of electrophysiological recordings with awake behaving monkeys, there was a heated debate whether one can even distinguish intention from attention in neural activity (P. Glimcher, *Decision, Uncertainty and the Brain,* MIT Press, 2003, chp. 10). Indeed, while attention has been characterized as a supramodal capacity separate from sensory and motor systems, the influential *Premotor Theory of Attention* proposed a constitutive link between the preparation of eye movement and attention (G. Rizzolatti et al. 1994, 'Spatial and Selective Attention' in C. Ulmità ed. Attention and Performance XV, MIT Press, pp. 231-65).

I think that there are compelling reasons to reject strong versions of the Premotor Theory and thus to endorse (1), but my sense is that many scientists would allow that preparation of an eye movement (or an intention to so move) towards X often causes attention-based enhancements of processing at X (see section 3, D. T. Smith and T. Schenk 'The Premotor Theory: Time to move on?', 2012, *Neuropsychologia,* 50: 1104-1114 and K. Armstrong 'Covert Spatial Attention and Saccade Planning' in C. Mole, D. Smithies, and W. Wu eds., *Attention: Philosophical and Psychological Essays,* 2012, Oxford University Press, pp. 78-96). Indeed, it is arguable that any intention to move the eye to location X requires prior attention to X to make possible an intention with that very content. In other words, covert attention is needed to provide the targeting needed for orienting. The point then is that the relevant intention to move the eye might both cause and depend on attention. While I think Prinz's appeal to intention is interesting, the fact that intentions are closely tied to attention suggests that attention is at least as likely, and to my mind more likely, an explanation of G.Y.'s performance as intention.

In the end, I think there is a body of compelling evidence against the sufficient condition of AIR, and Chapter 3 provides a nice summary of other troublesome cases for the theory. Prinz defends his view with relish, and I have no doubt that he will have deft responses to new challenges. Still, I wonder why he should bother. Why not drop the *essential* link between consciousness and attention? None of the counterexamples he considers targets his working memory formulation of AIR since none disconnect consciousness from the intermediate level modulations Prinz associates with availability

to working memory. For Prinz, these modulations are 'gamma vectorwaves' as per his 'fully unpacked' version of AIR:

> **[AIR fully unpacked]**: Consciousness arises when and only when vectorwaves that realize intermediate-level representations fire in the gamma [frequency] range and thereby become available to working memory (292).

Attention has disappeared from this formulation ('gamma frequency' has been postulated to be a mechanism of attention though this remains an open question; see T. Womelsdorf and P. Fries. 'The role of neuronal synchronization in selective attention.' *Current opinion in neurobiology,* 2007, 17: 154-160). AIR fully unpacked presents an interesting empirical proposal about the neural correlates of consciousness that can be disconnected from an intrinsic connection to attention. It deserves further scrutiny. By dropping attention as essentially connected to consciousness, Prinz could eliminate most of the proposed counterexamples to his theory while retaining its core in one deft stroke.

William James once noted that consciousness is of the essence of attention. The Kentridge work Prinz discusses as well as experiments on visually guided action have convinced me that consciousness is not. Attention can be, and often is, unconscious. Recent empirical work has also suggested that attention is of the essence of consciousness, and Prinz is a notable proponent of that view. We can, however, also reject that link even as we acknowledge that the two phenomena are often deeply

intertwined. On this, Prinz is to my mind surely right and the subtitle of the book expresses a truth: attention engenders consciousness. This is in fact how it often goes.

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