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**Perception, Action, and Consciousness: Sensorimotor Dynamics and Two Visual Systems.** Nivedita Gangopadhyay, Michael Madary, and Finn Spicer (Eds.). Oxford: Oxford University Press, 2010, 372 pages, £49.99 hard.

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*Perception, Action, and Consciousness: Sensorimotor Dynamics and Two Visual Systems* is a state-of-the-art collection whose main goal is to explore, from an interdisciplinary perspective, the relationship between action and perception. A second goal of the volume is to investigate how perception and action interact specifically in the production of phenomenal awareness. In presenting and contrasting the major perspectives on the field, this volume marks a good sign of the progress being made on the nature of phenomenally conscious visual experience. By combining theoretical and empirical approaches it also contributes to the debate in key domains of the cognitive sciences (such as perceptual psychology, cognitive neuroscience, and philosophy of mind).

The book contains a useful editorial introduction written by the Editors (Nivedita Gangopadhyay, Michael Madary, and Finn Spicer) and six sections further divided into fifteen chapters. In the first part of this review I briefly summarize the content of each section. Having offered an outline of the volume, I then turn my attention to the main theme of the collection, which is the dichotomy between action-oriented theories of perception and the two visual systems hypothesis and look at the dialectic underlying this debate.

### *Book Summary*

Part one of the book is constituted by a series of three essays written by J. Kevin O'Regan, Andy Clark, and Dana H. Ballard. It addresses methodological issues in the scientific study of phenomenal awareness and focuses on the sensorimotor theory of

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perception. The sensorimotor theory of perception is a theory that explains perception as an achievement of an agent acting in a complex environment.<sup>1</sup> Advocates of this theory affirm that sensorimotor contingencies (specific patterns of dependencies that hold between the movements the perceivers make and what they are able to perceive) are necessary ingredients for phenomenal awareness, and maintain that the perceptual content of one's conscious experience is always a function of the implicit sensorimotor knowledge acquired by the perceiver through her active engagement with the world. In his contribution, O'Regan mounts a defense of this idea on the grounds of empirical evidence derived from studies on sensory substitution (p. 42), colour perception (p. 43), and change blindness (p. 45). He then claims that analogous sensorimotor considerations can be drawn for consciousness, which rather than being understood as driven exclusively by sub-personal neural mechanisms should instead be described as arising from the individual's direct and unmediated engagement with her own environment (p. 47). Clark disagrees with this take and denies that action can enter the content of phenomenal experience in a direct and unmediated way. Contra the understanding that describes consciousness as a unitary entity in which perception, action, and experience twines all together to form a "golden braid" (p. 51), he proposes to explore the validity of the two visual systems hypothesis (on which more below) but concludes his essay by arguing that a decisive solution to the elusive questions concerning the nature and the neural underpinnings of conscious visual experience hasn't yet been formulated. Ballard, rather than focusing on the elusive question of where to locate consciousness (either internally or externally), prefers to address the problem of what components are necessary for it. He concentrates on finding a mechanistic and purely computational explanation of what it feels like to be conscious and argues that this feeling "must be handled at a high level of abstraction, a level that incorporates a bookkeeping strategy of tagging" (p. 30).

Part two of the book is devoted to the analysis of the two visual systems hypothesis, with contributions from A. David Milner and Melvyn A. Goodale, and from Dean R. Melmoth, Marc S. Tibber, and Michael J. Morgan. In a series of pioneering studies conducted in the early 1990s, Milner and Goodale (1995) suggested that humans possess two functionally distinct cortically-based visual systems, which they labeled as the ventral and the dorsal pathways. The former (also known as the "what pathway") is a potentially conscious vision-for-perception system situated in the ventral stream, which protrudes from the primary visual cortex to the inferior temporal cortex and is generally associated with experiential awareness and with a kind of indirect control of action. It is also reported to be responsible for object and color recognition. The latter (also known as the "where pathway") is instead an unconscious vision-for-action system that is located in the dorsal stream. It projects from the primary visual cortex to the posterior parietal cortex and it is fundamentally devoted to governing body movements by exercising direct control of visually informed action. In their contribution to this volume, Milner and Goodale survey the evidence that has accumulated to support their hypothesis and use it to sharpen their distinction and further refine their model. Milner and Goodale reckon that the available data on double dissociations are partly contradictory and somehow incomplete. They nevertheless defend their dichotomous account of perception and action against critics and argue that even if results across patients suffering from visual agnosia and optic ataxia do not decisively indicate the emergence of double dissociations, this does not necessarily entail that the function of

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<sup>1</sup>See Hurley (1998) and O'Regan and Noë (2001); for antecedents in psychology see Gibson (1979); for precursors in developmental psychology see Piaget (1972).

the ventral and the dorsal streams cannot be strongly dissociated (p. 89). Substantial disagreement with this claim is expressed by Melmoth, Tibber, and Morgan, who in analyzing the role that illusory stimuli (such as the Poggendorff illusion) come to play for visuo-motor actions, defend the conjecture that a single unified representation of spatial position is used for both perceptual and motor tasks and therefore attack the idea that action and perception are functionally distinct (p. 95).<sup>2</sup>

Part three investigates agency and the problem of perceptual experience in relation to the nature of visuo-motor actions with a triptych of ground-breaking essays. Mohan Matthen focuses on the notion of “feeling of presence” distinguishing between “motion-guiding vision” and “descriptive vision” (p. 107). The former, he argues, is used in the control of motor movements and is a key element for the cognitive feeling of presence that accompanies our perception of real objects. The latter instead has to do with the capacity of the perceiver to store and recall information and is essentially (though not entirely) responsible for visual consciousness. Matthen uses this distinction to give an explanation of the problem of perceptual experience that isn’t merely based on the role of the perceiver’s actions (as in sensorimotor theories of perception) but more profoundly depends on the nature of the perceptual object and on the possibilities of interactions it offers. Pierre Jacob and Frédérique de Vignemont offer a solution to the problem of how we perceive that is fully consistent with the two visual systems hypothesis, and attribute the contents of conscious experience to the processing in the ventral stream. On the grounds of some experimental evidence they then defend a version of the two visual systems hypothesis and claim that it is unlikely that information at the service of action can participate in and constitute perceptual experiences. Susanna Schellenberg develops her account of perceptual experience by disentangling the perceptual content of one’s experience into what she calls “situation-dependent properties” and “intrinsic properties” (p. 145). In her view, the perceptual content of one’s experience is determined by both the perceiver’s capacity of self-location and the knowledge, gained through action, of how objects will look from different perspectives. So, Schellenberg argues that perception depends on the capacity to know what it would be to act in relation to given objects.

Part four further explores the relationship between action and perception and focuses on empirical evidence drawn from cognitive neuroscience (in particular from cases of optic ataxia and neglect syndrome) to substantiate and develop an experimentally driven defense of action-oriented theories of perception [see chapters by Yves Rossetti, Hisaaki Ota, Annabelle Blangero, Alain Vighetto, and Laure Pisella, and by Giuseppe Vallar and Flavia Mancini]. This fourth section also includes an essay from Yvonne Delevoeye–Turrell, Angela Bartolo, and Yonn Coello, in which the authors use transcranial magnetic stimulation to motor areas of the brain to show the importance of action-oriented processing in triggering spatial visual experiences. This work is important because it contributes to undermine the rigid and sharp distinction between the “what” and the “where” pathways that lies at the core of the two streams models.

Part five centers on the role of action and sensorimotor knowledge in sensorimotor theories of perception. Alva Noë offers a taxonomy of four distinct ways of relating action and perception and tries to accommodate and reconcile his actionism with the two visual systems hypothesis by showing the extent to which conscious perception can

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<sup>2</sup>The Poggendorff illusion is a geometrical-optical illusion that was first discovered by physicist J.C. Poggendorff in 1860. It is characterized by a misjudgment of the position of the two ends of a straight line segment passing behind an obscuring rectangle. The illusion consists in seeing the lines as distorted by their background when they are instead aligned.

impact upon visuo-motor behavior and perceptual experience. Julian Kiverstein defends Noë's understanding of perceptual experience but argues for the constitutive role of sub-personal sensorimotor expectations in perceptual content. In particular, he proposes to conceive the content of phenomenal awareness as egocentrically encoded and substantially determined by skillful practice. Finally, in part six of the book a self-standing contribution from Robert A. Wilson explores the boundaries of the agent: the author defends an externalist position about visual experience and offers a positive argument for the idea of extended vision which relies (quite heavily) on enactivist assumptions.

### *The Main Theme of the Book*

Having summarized the contents of this volume, I now briefly want to focus on what I believe is the major theme that characterizes this collection: namely the tension between action-oriented theories of perception and versions of the two visual systems hypothesis. Action-oriented theories typically emphasize the role of action in structuring (in non-trivial ways) perception. Versions of two visual systems hypothesis instead postulate the existence of a profound functional distinction between vision-for-perception and vision-for-action. Now, if the understanding endorsed by versions of the two streams model is right, then it seems we have to say that perception and action are independent, functionally distinct, and completely separated. If, on the contrary, action-oriented theories stand correct, then it seems we should describe perception and action as reciprocally coupled, deeply interwoven, and mutually interconnected. At this point a question naturally arises: are action-oriented theories of perception and versions of the two visual systems hypothesis necessarily opposed and inevitably in conflict (as it would appear at a superficial glance) or is there a way to reconcile them?

Noë intriguingly argues that action-oriented theories are not in opposition with empirical evidence supporting the dual streams model. He actually claims that the former are necessary for making sense of the latter. Action-oriented theories on his view offer a plausible and credible explanation of how ventral and dorsal streams can communicate, despite using alternative encodings of visual information. Milner and Goodale, and Jacob and de Vignemont suggest a close correspondence too, but of course, do not go all the way with Noë in asserting the instrumental dependence of perception on action. Jacob and Jeannerod (2003) have proposed an interesting way of thinking about the anatomical distinction between the ventral and the dorsal pathways. In particular, they have rejected "a simple dichotomy between vision-for-action and vision-for-perception in favor of a more nuanced model that takes into account, for example, the complexities of human pragmatic processing of objects — in particular the contribution of the parietal lobes (part of the dorsal pathway) to high-level pragmatic processing, including complex tool use and the perception of other people's actions" (Bermudez, 2007, pp. 1–2). Other authors (such as Norman, 2002) have claimed that in order to explain and fully understand the relation between action-oriented theories and dual stream models we ought to embrace an integrative dual process approach aimed at revealing their synergistic interactions.

Several PET studies have revealed that during motor imagery of grasping actions the posterior parietal cortex and premotor inferior parietal areas of our brain are vigorously activated (Decety et al., 1994; Grafton, Arbib, Fadiga, and Rizzolatti, 1996; Parsons et al., 1995). Another study conducted by Sirigu, Duhamel, Cohen, Pillon, Dubois, and Agid (1996) has further highlighted the involvement of the dorsal stream in cognitive tasks (Gallese, Craighero, Fadiga, and Fogassi, 1999). Van der Kamp, Rivas, van Doorn, and Savelsbergh (2008) have more recently demonstrated the crucial con-

tributions (in fast ball sports) of the ventral system in perceiving what action the situation affords and of the dorsal system in the visual guidance of that action (p. 101). Indeed, the idea of a major role played by action in building our perception has become increasingly popular (Gallese, 2007) and all these findings taken together seem to explicitly contradict the sharp distinction between an “acting brain” and a “knowing brain,” suggesting that perception can be properly accounted for only by considering the bidirectional relationship between the agent and her environment.

This volume doesn't (probably) resolve the tension between action-oriented theories and versions of the two visual systems hypothesis; but this wasn't its main goal. Nor does it unravel the mystery surrounding the concept of visual conscious experience, as an ambitious reader could have hoped. The book nevertheless succeeds in providing an up-to-date and coherent state-of-the-art treatment that is capable of both advancing the research and satisfying the curiosity of the most inquisitive reader.

*Perception, Action, and Consciousness: Sensorimotor Dynamics and Two Visual Systems* is, from an academic perspective at least, an intriguing book. Quite densely written and difficult to understand in places, it might not be suitable for lay people. Impressive both in scope and depth, the volume is vital reading for those (especially philosophers and cognitive scientists) who want to know more about the interdisciplinary study of perception and action. Philosophical rigor and scrupulous attention to empirical details make this collection of essays a complete, erudite, and authoritative contribution that will surely have a very long life as a definitive account of the subject.

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