CRITICAL NOTICE OF: BRAIN AND THE GAZE: ON THE ACTIVE BOUNDARIES OF VISION

Jan Lauwereyns (2012) *Brain and the Gaze: on the active boundaries of vision.* **Hardcover** **$40.00** | ISBN: 9780262017916 | 312 pp. | 7 x 9 in | 49 b&w illus.|

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***On the Active Boundaries of Vision***

***Introduction***

‘Vision is, first and foremost, an information processing task, but we cannot think of it just as a process. For if we are capable of knowing what is where in the world, our brain must somehow be capable of representing this information – in all its profusion of colour and form, beauty, motion, and detail’ (Marr 1982, p.3).

For Marr vision is a complex information processing task, whose main goal is to capture and represent the various aspects of the world that are of use to us (Poggio 1981). The work of David Marr has dramatically influenced vision research in the last 30 years: his book (1982) and the series of papers that preceded it (Marr and Poggio 1979, for instance) have had a lasting impact in both neuroscience and psychology. In the last 20 years, however, Marr’s computational approach to vision has been subject to intense criticism. In the wake of empirical findings obtained in neuroscience (see Wurtz and Goldberg 1972a, b; and Sokolov et al. 2002) and cognitive psychology (see Gregory 1966; Posner 1980); a numbers of philosophers [such as Hatfield (2003); Noë (2004); Clark (2012) just to mention recent works] have questioned the Marrian computational framework, emphasising the need to properly integrate an ecological perspective (Gibson 1979) in the study of perceptual awareness.

In ‘*Brain and the Gaze: on the active boundaries of vision*’, leading neuroscientist and acclaimed poet Jan Lauwereyns investigates the delicate interweaving of perception, thought, and action; proposes a substantial revision of the computational (Marrian) framework through a fascinating exploration of the active role of gaze in perceptual experience; and attacks radical externalist accounts of perception (on which more below) that have argued that the process of perceiving is merely ‘an activity of skillful exploration’ (Noë 2004, p. 164) that does not require the production of any mental content or internal representation. Building on his previous work on biases (2010), prediction (2002), and attention (1998), in which he explored the cognitive processes underlying perceptual sensitivity; Lauwereyns now bridges the gap between ‘motor side’ and ‘sensory side’ in neuroscience, by proposing an empirically-informed, highly interdisciplinary, non-reductionist framework for the study of vision that holds together a Bayesian account of perceiving and large swathes of recent works conducted in philosophy of cognitive science at the intersection between phenomenology (Merleau-Ponty 1945/2008) and embodied cognition (Clark 2008).

The book contains a  useful introduction in which Lauwereyns highlights the focal points of his project and seven chapters ( + a coda) in which he further develops his positive proposal (what he calls the intensive approach to perception, on which more below). In the first part of this critical notice I summarize the book’s content. I then turn my attention to the most important theoretical tension underlying it: the relationship between the classic computational model of vision (as endorsed by Marr 1982), the intensive approach (Lauwereyns’ own view), and radical externalist accounts of perception (such as Noë 2004, 2009). I investigate the dialectic between these three different accounts and argue that Lauwereyns’ intensive approach is to be preferred.

***Book Summary***

In chapter 1, ‘Free Viewing’, Lauwereyns demonstrates the action-oriented, expectation-based, and intrinsically dynamic nature of perception. The first half of the first chapter of the book therefore contains an interesting exploration of the ways in which brain, body, and world intermingle to forge perception. Lauwereyns in particular focuses on the special role of the gaze (combination of eye and head position) and of eye movements in information gathering and argues that biased viewing (observer-dependant perception) is our default mode of vision (p.18). In the second part of the chapter, Lauwereyens introduces the notion of informativeness (p.19) and looks at whether humans possess a hardwired desire for information (p.22). He then analyses the role of information in processes of exploration and distinguishes (based on Berlyne’s seminal work) between *diversive exploration* – open-ended, aimless search - and *specific exploration* -directed at particular objects, domains, or problems – (p.28). He argues that while these two modes of exploration can be entangled (the former normally unfolds into the latter following appropriate stimulation), it is still important to distinguish them theoretically ‘as they imply different computational demands and degrees of freedom for gaze control’ (p.29). The chapter ends with a fascinating discussion of Barthes’ distinction between *studium*, the general gist of the scene, and *punctum*, ‘what breaks the studium, rises from the scene, shoots out like an arrow, and pierces me grabbing my attention’ (Barthes 1981/1999, p.27). In Lauwereyns’ view, the dialectic between *studium* and *punctum* is instrumental to establish two of the main points of the chapter – the existence of biases in subject’s perception – and the idea that ‘perception must ultimately be understood as a personal experience, intensely subjective in nature’ (p.36).

In chapter 2, ‘A Sensorimotor System’, Lauwereyns refines his analysis of the active boundaries of vision by focusing on the biological role of the body in perception. Embodied cognition, he argues, has acknowledged the role that the body and psychological engagement with the environment play in perception but hasn’t displayed so much interest in the biology of the body that is supposed to be embodied. Lauwereyns accuses Noë (2004) of treating the body as a vague set of spatiotemporal coordinates, a moving point with no extension (p.41) and urges him to reconsider its role. When studying perception, Lauwereyns contends, we must study the body as a biological entity, with its mechanisms and characteristics, biases and sensitivities, needs and preferences. We must learn from its anatomy and concentrate on all the potential factors that can influence, define, and shape perceptual awareness. In chapter 2 Lauwereyns also reflects on the dichotomic nature of the brain’s visual system (Ungerleider and Miskin 1982; Goodale and Milner 1992) and provides a basic introduction to the neural circuits for eye movement control (Wurtz and Goldberg 1989; Buttner-Ennever 2006). Lauwereyns first distinguishes between two distinct cortically-based visual systems, the ventral and the dorsal pathways (p.54) but then goes on to argue that we should resist the temptation to dichotomize, or ‘line up pairs of antonyms in supposedly divisive ventral-dorsal (yin-yang) ways’, and rather look at how ‘the different types of visual analysis in the two streams together contribute to the inherently interactive and dynamic processes of perception and action’ (p.58). In the second part of the chapter Lauwereyns analyses the role that biases, sensory mechanisms, memory, and context play in processing visual information and guiding our gaze (p.67).The chapter ends with a critique of Noë’s account of perceptual experience (pp.71-74). Contra Noë, Lauwereyns argues that the sense of access to rich visual details is not only ‘virtual’ (existing –potentially- out there in the world) but rather ‘actual’ and ‘present’ in our brains. So, Lauwereyns believes that the sense of access to things (although driven by sensorimotor engagements) is ultimately a function of our brain (p.73) and that it reflects ‘the brain’s active and passive biases in perception and decision making’ (ibid.).

In chapter 3, ‘The Moving Retina’, Lauwereyns look at the visual system and tries to specify the systematic and peculiar features that characterise it. To do so, he investigates what happens in the brain when we perceive, and focuses on the mechanisms of active perception and on what he calls ‘the moving retina’ (p.77). Lauwereyns shows that the retina is a functionally promiscuous layered structure, which supports multiple computations and a variety of processes and mechanisms, but at the same time he also demonstrates that the retina is a sub-system of the visual system and that the visual system is an integral part of the mind (pp.84-85). ‘The upshot of taking the eye to be an integral part of the mind is that explaining the computations in the eye amounts to explaining some of the picture viewing that homunculi had to do in old theories of vision’ (p.87). Thus, Lauwereyns’ idea is to look at the retina and show that the mechanisms of active perception are fully at work already there. Contra Marr, Lauwereyns rejects the assumption that when we perceive we always perceive highly detailed pictorial representations, and rather explores the role that the ‘moving retina’ plays in active vision by focussing on the dichotomy between foveal and peripheral perception and on the study of saccadic movements in visual processing (Wurtz and Goldberg 1972). Other crucial topics of this chapter are: a) the extent of automaticity and autonomy in vision (p.104); b) the presence of visual modules devoted to specific categories of information, such as face recognition (p.106-107); and c) the existence of general biases toward meaning (pp.108-110).

In chapter 4, ‘Seeing as Grasping’, Lauwereyns assesses the merits and demerits of the common assumption that seeing is a way of grasping the visual presence of things in the world (pp.113-114) and focuses in particular on the idea that vision, in a very proactive sense, defines and delineates objects and events. Lauwereyns reflects on the role of the active observer in perception and critically reviews Zizek’s *The Parallax View* (2006/2009) and Bachelard’s The *Poetics of Space* (1954/1986). His critical appraisal of these volumes is then nicely framed within a set of empirical data, which involve discussion of: a) internally generated cognitive discharge - the idea that the brain compensates for the disruption of visual input by using advance knowledge of the impending saccade – (Sommer and Wurtz 2002), b) egocentric-versus allocentric coding (pp.140-141), and e) the coordination between visual selection and purposeful action (p. 142) as described in Posner’s location-cueing paradigm (1980). The chapter ends with a brief but useful analysis of Gibson’s (1979) ecological approach to perception (pp.144-146).

In chapter 5, ‘The Intensive Approach’, Lauwereyns continues his inquiry into the cognitive function of vision (p.148) and outlines his intensive approach to perception, according to which perceptual awareness possesses a deeply, intrinsically interactive nature but is always regulated by observer-dependent biases that combine motor and sensory processes to create meaningful understandings of things and objects. Lauwereyns chooses the word intense over intentional to characterise his approach because he wants to emphasise that his account not only tends towards meaning but also aims for concentration and force (p.154). Intensive, on his view, therefore means continuous, penetrating, purposeful and focussed. Furthermore, Lauwereyns declares that he uses the word ‘approach’ and not ‘stance’ because he believes that approach more clearly indicates ‘the deeply interactive, sensorimotor nature of perception’ (p.155). Having clarified the roots of his project and explained the labels he uses, Lauwereyns then goes on to praise philosophers of action (especially Noë) for having drawn the attention of neuroscientists to phenomenology and to the issue of values, of costs, and benefits in processing. Despite his appreciation for this work, he believes that the actual mechanisms that perform the processing in vision are to be found in the head[[1]](#footnote-1) (p.155) and that we need to study our biases in action to better understand how perception really works. The chapter also contains a discussion of the phenomenon of echo variations in the thalamus (MacAlonan et al. 2008). Lauwereyns shows that the thalamus is not just a relay station that passively transmits information to the cortex (Saalmann and Kaster 2011) and that perception lives in the distribution of different neural responses across various regions in the brain (p.162). ‘This implies a multiplicity of coding, with distinct populations of neurons contributing to different representations, or even single neurons contributing to different representations’ (p.163). The neural and cognitive mechanisms of intensive processing are subsequently discussed with examples of filling in (pp.166-170), and visual working memory (p.171). The chapter ends with an interesting discussion of Goethe’s (1810/2006) ever-fascinating theory of colours (pp.180-183).

In chapter 6, ‘The Gaze of Others’, the author explores the role of the gaze as object of perception and argues that there exists a natural connection between our own capacity for gaze control and our reading of other people’s gaze. Lauwereyns in particular shows how our gaze can lighten our cognitive workload by acting as a deictic pointer (p.190), how it can contribute to preference formation and decision making (p.191), and how it can increase the value attributed to an object or attach ratings of informativeness to items in the visual world (pp.192-193). Since our gaze is always public and intrinsically informative, Lauwereyns also looks at the ways in which our gaze can be read by others (p.196). So, he analyses the other’s ability to follow our gaze through a discussion of the mirror neuron system in humans and then focuses on how sometimes we deny access to our eyes to avoid contact, impose distance, or signal lack of esteem (p.213-214). Lauwereyns also shows how our gaze can be strategically deployed (cooperatively or competitively) to guide perception and how it can be used to forge profitable social (Hermann et al. 2007) and cognitive connections (Kovacs et al. 2010).

In chapter 7, ‘Seeing and Nothingness’, Lauwereyns reflects on the importance of the notion of presence for perceptual experience (pp.226-227). Lauwereyns acknowledges that presence – the state or fact of existing, occurring, or being available in a place or thing - consistently increases the vividness of information being transmitted, by giving the things a material form onto which our mind can latch (p.229). The chapter also contains an interesting analysis of how taboos and transgressions affect our gaze (pp. 233-236), how prohibitions determine trance stare –staring but not seeing- (p.241), and a scientific reflection on how sometimes looking at nothing can be beneficial for a specific cognitive function (e.g., reactivate memory – see Ferreira et al. 2008). The monograph ends with a *coda* (pp.251-258) in which the author summarises the gist of the volume while reaffirming its crucial idea: that vision is characterized by the combination of behavioural patterns (sensorimotor engagements) and the dynamics of internal processing (movements of the gaze).

***Computation, Sensorimotor Knowledge, and the Intensive Approach to Vision***

Having described the contents of the monograph, I now briefly turn to what I believe is the most interesting theoretical tension underlying it; the relationship between the classic computational model of vision as endorsed by Marr (1982), the intensive approach as proposed by Lauwereyns in this book, and radical externalist accounts of perception a la Noë (2004,2009).

In *Vision* (1982), Marr proposes a three-level approach for the study of perceptual experience. This approach distinguishes between 1) the computational level that determines what is being computed and why; 2) the algorithmic level that specifies the class of representations that is deployed at a certain time and the algorithm required for the transformation from input to output; and 3) the implementation level that determines how the particular class of representations used at a particular time and the algorithm are combined and materially implemented (Shagrir 2010). On the grounds of this three-level approach to visual perception Marr attempted to formulate a representational framework for the study of vision as a whole. In particular, he claimed that vision goes through a series of stages (*raw primal sketch*, *complete primal sketch, 2.5D sketch*, and *3D model*), each corresponding to a specific representation (from low-level retinal images, involving the extraction of information regarding edges and intensity changes, to a full 3D hierarchical and modular description of our spatial environment involving the identification of the structure of objects and materials in our visual field). In essence, Marr attempted to describe vision as process of engineering towards highly detailed pictorial representations. His computational model of perception has also led to many important advances in our understanding of biological visual processing and Marr himself is still widely regarded as one of the founding fathers and most prominent figures in contemporary neuro-psychology.

Today, we appreciate Marr’s work for his conceptual clarity and for the useful distinction of different level of analysis in perception; but we are also aware of the many problems that affect his account. First, in his analysis of perceptual experience Marr did not consider the dynamic between foveal and peripheral vision and focused only on the role that the visual cortex play in perceptual processing– that is, he failed to acknowledge the importance of saccadic eye movements in visual perception. Second, as Lauwereyns sharply notices in his book (p.88), Marr ignored the massive series of papers on ‘Activity of Superior Colliculus in Behaving Monkey’ by Wurtz and Goldberg (1972a,b), which show – among other things- that the visual responses of superior colliculus neurons depended on what the monkey intended to do. So, Marr failed to acknowledge the crucial role that intentions and gaze play in visual processes, the significance of sensorimotor engagements, and more generally, the importance of action in perception, objects recognition, and navigation.

By the time Marr had formulated his computational approach to vision, an influential psychologist (James Gibson 1979) had proposed a fascinating but rather controversial *direct theory* of perception that strongly challenged the idea that vision involves top-down processing and internal computation. Gibson had in fact argued that perception is a direct (bottom-up) process that exploits the information in our environment to make sense of the world. The most radical contribution of Gibson’s theory of perception is probably the notion of affordance. Affordance refers to ‘an action possibility available in the environment to an individual, independent of the individual's ability to perceive this possibility" (McGrenere and Ho 2000, p.179) or, more clearly, to ‘whatever it is about the environment that contributes to the kind of interaction that occurs’ (Greeno 1994, p.338). Gibson’s account of perception, which partially draws on Reid’s direct realism-, infuriated his contemporaries and was bitterly criticized by both psychologists and philosophers (Ullman 1980; Fodor and Pylyshyn 1981). In recent years, however, Gibson’s ideas have gained increasing influence, and a number of theorists (Varela, Thompson, and Rosch 1991, for instance) have emphasised the importance of including an ecological approach in the study of perception and cognition.

Philosopher Alva Noë (2004, 2009) has probably been the most successful in promoting an enactivist approach to visual perception, according to which, perception is not something that happens to us, but rather something we do; something we act (or better enact) out. To be a perceiver, on Noë’s view, is to be able to grope and grasp the effects of movements on sensory stimulation, to comprehend and understand the patterns of dependencies, the ‘sensorimotor dynamics’ (Hurley and Noë 2003), that hold between the movements the perceivers make and what they are able to perceive. An implication of this bold claim is that our ability to perceive things and objects in the world depends, in a constitutive way, on the possession of appropriate sensorimotor knowledge. Another implication is the idea that perception is not a process that occurs in the brain, but rather a kind of skilful activity that is performed through the body in the environment. As Noë puts it: ‘the process of perceiving, of finding out how things are, is a process of meeting the world’ [Noë (2004), p.164]. So, perception, for Noë, is not a computational activity regulated by specific brain mechanisms, but rather a way of keeping track with things through sensorimotor interactions with them. As such it does not require the existence of any internal representation or mental content; because these are determined by the things we perceive in the world through our interactions with them.

As I mentioned at the beginning of this section, the main goal of the monograph is to formulate a new (empirically informed and theoretically rich) theory of visual perception, what Lauwereyns calls the ‘intensive approach to vision’. How does the author define this new approach and what are his most important characteristics?

The intensive approach to vision is a smart and reasonable combination of classic computational theories of perception (a la Marr) that say that vision is essentially a top-down process, and less conservative accounts (a la Noë) that emphasise the pervasive sensorimotor nature of perceptual experience and the role that (bottom-up) sensorimotor engagements play in visual processes. The intensive approach to vision is therefore a (top-down, bottom-up) approach that highlights the deeply interactive nature of perceptual awareness, while assigning ‘a fundamental role to observer-dependent biases and to internal mechanisms in the processing of perceptual experience’ (p.155). Lauwereyns’ model closely resembles Bayesian approaches to visual perception (see Rao and Ballard 1999; Lee and Mumford 2003; Friston 2009). It in fact embraces the idea that vision emerges via a recurrent cascade of predictions (mostly biases driven) that involve (predominantly sub-personal) expectations, spanning multiple spatial and temporal timescales (Clark forthcoming). In accepting these rich, full-blooded, neo-computationalist views of visual experience, and by taking into account much of the Gibsonian’s lesson about proactive agent-environment interactions, the intensive approach to vision aims to combine phenomenology and philosophy with functional taxonomy and computational cognitive neuroscience, by focusing on the active role that gaze and intentions play in perception, and by explaining information processing in terms of responses to biases, predictions, expectations, and sensitivities.

So, in which ways does the intensive approach differ from radical enactivist accounts of perceptual experience and how does it overcome the limitations that affect classic computational theories of perception as traditionally presented in neuroscience? The intensive approach differs from traditional computational accounts of perception because it recognises the importance of sensorimotor knowledge, subjective experience, intentions and engagements with the world in processes of perceiving. But the intensive approach also differs from radical enactivist accounts that deny the existence of internal representations and mental contents in visual processing because (unlike them) it concentrates on the construction and maintenance of representations in relation to our knowledge of the world (our biases, our memory). So the main difference between Lauwereyns’ approach and radical enactivist views is that the latter choose to remain silent about the role of gaze, memory, biases, expectations and mechanisms of recognition in processes of perceiving, whereas the former aims at studying and integrating them within its theoretical framework.

So, why should we prefer the intensive approach to vision to the understandings sketched above? Well, by integrating ideas from both accounts, Lauwereyns formulates a richly multidimensional framework for the study of vision that is better able to explore and explain the more extended and varied regions or corners of perceptual experience; an understanding that is capable of dealing with differently-relevant causal factors and processes (both at the internal and at the external level), while not necessarily appealing to an ultimate (privileged) source of explanation (either the brain or the world on its own) for phenomena of visual processing. So, it is the opinion of the reviewer that the intensive approach to vision has be preferred to both purely computational accounts and radical externalist positions on the grounds that it provides a more reasonable and better informed scientific framework for the study of visual experience.

***Conclusions***

*Brain and The Gaze* has one major goal and two secondary objectives. The major goal of the monograph is to formulate a new empirical framework for understanding perceptual awareness. The two secondary objectives are: 1. the proposed revision of the standard neuroscientific understanding of vision that has dominated traditional neuroscience in the last 30 years; and 2. the attack of radical externalist accounts of perception a la Noë (2004, 2009) that deny the existence of internal representations and affirm that vision is a mere activity of skilful exploration that does not require the existence of any mental (internal) content. As far as this reviewer is concerned, the volume succeeds in both its primary goal and secondary objectives. It in fact convincingly makes the case for the intensive approach to visual perception by undermining competitive and more radical accounts of perceptual awareness.  
  
The volume is thorough and does not at all shy away from conceptual complexity – quite the opposite. As the author puts it in the coda: ‘*I never promised this would be an easy book...my aim is not to popularize science but to do science*’ (p. 253). Lucidly but densely written, this essay is therefore recommended to professional academics or postgraduate students with advanced knowledge of the topic. The impressive sheer of wealth and breadth of information presented in this tome combined with a charming and engaging prose style (each chapter contains a digression into a piece of poetry that somehow relates to the main theme being discussed), makes the volume worthwhile. The seasoned reader will surely find the book uplifting and inspirational, Lauwereyns’ style intriguing and his intellectual playfulness quite solacing.

This is an illuminating and very much needed contribution that will set the benchmark for the neuroscientific study of perceptual experience for the next few years. A must read for cognitive scientists, philosophers, neuroscientists, psychologists, and more generally, for all those who are interested in understanding the delicate weave of perception and its relationship with brain, body, and action.

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1. Here I would like to raise a minor point of criticism. It seems as if Lauwereyns is assuming that drawing attention to phenomenology and to values in processing is to go externalist: but that’s not so, lots of analytic philosophers of action deal with phenomenology and with values, costs, and benefits, but remain internalist. This is a curiously partial picture. Thanks to John Sutton for drawing my attention to this point. [↑](#footnote-ref-1)