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Reviews the book, "Eye movements: A window on mind and brain" edited by Roger P. G. van Gompel, Martin H. Fischer, Wayne S. Murray, and Robin L. Hill (see record 2007-07810-000). Although the reviewers believe that this book is a bit outdated (by about four years, with some sections receiving insufficient coverage), their overall impression was favorable. The book illustrates the progress that the study of complex cognitive processes via the measurement and analysis of eye movement has made over the last three decades. The content is wide in scope and touches on many important areas. Covering history, theory, and new findings, this collection is an excellent source for the dissemination of knowledge related to many aspects of eye-movement research. (PsycINFO Database Record (c) 2009 APA, all rights reserved)

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Using Eye Movements to Elucidate Human Behavior

Review By: Amir Raz
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Review of: Eye Movements: A Window on Mind and Brain
By: Roger P. G. van Gompel, Martin H. Fischer, Wayne S. Murray, and Robin L. Hill (Eds.), Oxford, England: Elsevier, 2007. 720 pp. ISBN 978-0-0804-4980-7. $150.00

Unraveling the relationship between eye movement patterns and human actions constitutes an important pillar of behavioral science. As intuition suggests, the eyes and their movements may provide an index to the mind and the neural correlates of behavior. In addition to unlocking the behavior of healthy individuals, investigation of eye movements is especially meaningful in the study of preverbal populations, nonverbal populations, and paralyzed persons and in ecological contexts. With the advent of increasingly sophisticated eye-tracking technology, it is possible to adumbrate the general impact of this noninvasive technique on behavioral and clinical science.

Eye movements dovetail with aspects of attention. We usually foveate, or look at, the precise location we are interested in, thus generally relating our attention to where we fixate. It is easy to dissociate the two, but we can cue people to attend to some location in space other than the center of gaze and then show that they are very sensitive (i.e., have a low threshold or fast response time) to information that occurs at the cued location and relatively slow to respond or insensitive to information at the fovea. We believe that these covert shifts select the part of the visual field to which one usually wants to move the eyes. Typically, covert shifts of attention precede an eye movement. The superior parietal lobe participates in voluntary, covert shifts of attention (Corbetta, Kincade, Ollinger, McAvoy, & Shulman, 2000), whereas the frontal eye fields and superior colliculus may be primarily involved in the participation of overt eye movements in attentional shift (Corbetta, 1998).

Although the idea that the eyes, not just eye movements, may provide a window to the mind and brain has been scantily explored, a few scientists have attempted to capture the world inside the eye. These researchers have conducted an analysis of the visual information that is embedded within a single image of an eye (Nishino & Nayar, 2004). The cornea of an eye and a camera viewing the eye form a catadioptric (i.e., lens + mirror) imaging system. Unlike a typical catadioptric imaging system, however, a corneal one is flexible in that the reflector (cornea) is not rigidly attached to the camera. When dealing with two eyes, each foveated retinal image reveals what the person is looking at and allows detailed analysis of the epipolar geometry of this stereo system, showing how it can compute the three-dimensional structures of objects located around the person. This approach to interpreting eye images is passive and noninvasive, and it holds direct implications for several fields, including visual recognition, human–machine interfaces, computer graphics, and human affect studies (Nishino & Nayar, 2006).

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Eye movements, an undervalued yet central aspect of vision and action, reveal much about the underlying neural mechanisms of the mind and brain. The measurement and analysis of eye movements forge a link between diverse groups of researchers—psychologists, neurologists, psychiatrists, computer scientists, and other professionals. In 1981, the multidisciplinary interest in eye movements resulted in the formation of a series of interdisciplinary symposia sponsored by the European Conference on Eye Movements (ECEM). This biennial series brings together mostly European scientists who exchange information about current research, equipment, software, and innovations in the field. Conference presentations typically find their way into a collection of book chapters in edited volumes. A significant lag, however, separates the ECEM symposia and the publication of the meeting's proceedings. As a case in point, the published account of the 2003 ECEM meeting (in Dundee, Scotland) has been released only recently in the volume reviewed here, despite the fact that two ECEM meetings have taken place since (2005 in Bern, Switzerland, and 2007 in Potsdam, Germany). In the high-speed, constantly changing world of science and technology, a four-year delay between the conference and the publication of the book might render at least some of the information to be less cutting-edge.

We have a predilection for research accounts that place findings in historical contexts and provide readers with an overview of psychological and technological developments in the field. In this regard, we thoroughly enjoyed the first part of the book. From 17th-century experiments using afterimages to state-of-the-art functional magnetic resonance imaging (fMRI), this 720-page volume on eye movement research offers something for everyone. Whether you are a practitioner, a researcher, a graduate student, or interested laity, this capacious volume has something for you.

Even under natural viewing conditions involving everyday situations, eye movement data are easy to obtain. Ocular patterns are a valuable window to various cognitive processes exemplifying the putative relationship between eye movements and complex mental processes. The book features chapters describing eye movement data as means to localizing brain regions (e.g., those involved in the cognitive control of actions that require the suppression of an automatic response; Ford, Brown, and Everling) and as a context for common life situations (Land). In this regard, even a game of table tennis can illustrate the importance of anticipatory or preemptive ocular orienting: saccades that are not driven by a stimulus but by a player's estimation of the location wherein something is about to occur. Experimental findings from baseball suggest that successful performance results from the ability to suppress prepotent vestibulo-ocular responses and anticipatory saccades in favor of generating smooth eye movements. It is easy to see, therefore, how eye movements may be relevant to reading, spoken language processing, attention, and scene perception.

Eye-movement data are used by diverse groups of researchers as a tool for investigating multidisciplinary interests. Preceding the compilation of the 2003 ECEM volume, the editors sent out questionnaires to participants and conducted a citation count to determine the most influential publications in the field. They found that the developments of greatest interest involved the following:

computational modeling, new eye-tracking technologies, anatomical and physiological mapping of the visual-oculomotor system, eye movements during spoken language processing, the use of eye

movement methodology in combination with fMRI, and eye movements in naturalistic settings and tasks. (p. 27)

The editors solicited written accounts from more than 70 researchers and crafted 33 chapters divided into eight research sections to incorporate this ostensible interest into the present volume. The first section addresses the history of eye-movement research, and the following seven chapters capture disparate ways to construe eye movements as a tool for understanding cognition and perception.

Individual chapters vary in both quality and readability. While an abstract heralds the tenor of each chapter, the volume's sections lack such background material. A contextual paragraph, preceding each of the eight sections, would have enhanced this volume. Providing a thematic section overview of the chapters included therein affords an emerging rationale for the underlying specific research areas that aids readability and presents a more coherent learning experience.

Investigation of eye movements is central to the psychology of reading. One of the main pillars of this collection includes the five chapters that make up the Eye Movements and Reading section. These accounts dovetail nicely and summarize the present state of knowledge concerning eye movements during reading. Of special interest is a comprehensive chapter providing an excellent overview of the word identification factors that influence eye movements in reading, drawing on such parameters as morphological complexity, plausibility, and pragmatic factors (Cifton, Staub, and Rayner). One account investigating the differences in cognitive processing during the reading of languages other than those read from left to right compared readers of Finnish and Hebrew. Although Hebrew readers have a smaller span compared with that of English readers (Rayner, 1997), readers of Hebrew—a densely packed language—are unique in that they crack the morphological code parafoveally (Bertram and Hyona). In this regard, it would be interesting to explore eye-movement strategies in texts that naturally lack regular spacing between words, such as Chinese and Japanese script, wherein the eyes tend to land at the beginning, rather than the center, of the word (Kajii, Nazir, & Osaka, 2001).

The study of eye movements can aid our understanding of the processes underlying visual and cognitive performance in psychopathological populations. Although it is difficult to keep up with the agglomeration of research findings in this burgeoning field, the text devotes only three chapters to the Physiology and Clinical Studies section. We found this section, which follows a vigorous opening overview and a carefully crafted historical perspective, to be sparser than we had expected. Although one chapter addresses such issues directly (Munoz, Armstrong, and Coe), the role of eye movements in a variety of relevant neurological and psychiatric disorders was conspicuously absent. For example, evidence suggests that smooth pursuit, which refers to the ocular tracking of a moving target, is suboptimal in individuals with both Huntington's disease and schizotypal personality disorder. We expected to see more reports on eye movements in autism, amygdalae lesions, and other pathologies, such as the research of Ralph Adolphs of the California Institute of Technology.

Another lacuna concerns addressing topics shrouded in controversy (e.g., eye-movement desensitization and reprocessing; EMDR) and leveraging the debate into a constructive dialogue.

Although the chapter on eye movements in the context of magic could have qualified under this appellation, we found the title more enticing than the actual report (cf. Kuhn & Land, 2006). Controversial topics provide a great platform for fostering discussion and evaluating existing data. For example, on the one hand, EMDR has been claimed to treat posttraumatic stress disorder, panic disorder, and phobias by seemingly reducing anxiety through the practice and generation of rhythmic, multisaccadic eye movement during recall of trauma-related memories. On the other hand, multiple studies have raised serious concerns about EMDR's efficacy, suggesting that eye movement in EMDR is unnecessary for therapeutic gains (Davidson & Parker, 2001; Goldstein, de Beurs, Chambless, & Wilson, 2000).

Finally, reports of eye movements in young infants are essential to the understanding of the processes that underlie the developing brain. For example, studies of gaze-following behavior in 9-, 10-, and 11-month-old infants reveal that, whereas 9-month-old infants follow adult head-turn cues even when the adult's eyes are closed, 10- and 11-month-old infants follow adult head turns significantly more often when the adult's eyes are open—suggesting that infants of 10 months may begin to "visually connect" to the external world (Brooks & Meltzoff, 2005). We would have liked to see eye-movement researchers tap the context of developmental cognitive neuroscience more vigorously. We hope that this emerging area will be even more conspicuous in future ECEM publications.

This impressive compilation provides a representative snapshot of where the field was about four years ago. Although we can certainly find captious things to say about specific sections of the book and about particular topics that are either insufficiently covered or incoherently presented, our overall impression of this edited effort is a favorable one. The book clearly illustrates the considerable progress that the study of complex cognitive processes via the measurement and analysis of eye movement has made over the last three decades. The content is wide in scope and touches on many important areas. Covering history, theory, and new findings, this collection is an excellent source for the dissemination of knowledge related to many aspects of eye-movement research. Both the intelligent reader and the expert will surely find this volume hewing to the adage that eye movements are a window on mind and brain.

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