Memory for visual information is a fascinating topic. We effortlessly remember thousands of faces, or pictures presented only briefly, and retain such information for months, if not years. The Visual World in Memory deals with this intriguing area of cognitive psychology. The eight-chapter volume aims to cover a huge field, spanning from very short-term iconic memory to long-term memory, and from memory for basic object features to memory for complex visual scenes. It covers issues that are of interest primarily to the memory theorist, such as dissociations between and within memory systems, but also issues that are directly relevant to real-world application, such as spatial navigation and eyewitness testimony. In the following, I will briefly review each chapter, before I evaluate the book and note some points of critique.

The first chapter, by Logie and van der Meulen, deals with the components of visuospatial working memory (WM). They present an extension of the well-known Baddeley and Hitch WM model, and review behavioural and neuropsychological evidence for dissociations between WM systems. These include a dissociation between modality-specific verbal and visuospatial WM (VWM) systems, and—within VWM—between WM for static patterns and movement sequences, and also between visual imagery and VWM. In discussing the capacity of VWM and the types of codes that can be used to retain visual information the authors also point out the `Humpty-Dumpty problem': How are separate systems `put together again' to allow for integrated and flexible performance? For example, they conclude that phonological and visual codes can be used independently but in conjunction to retain visual information. Finally, they briefly touch on feature binding and WM capacity issues.

These are taken up by Jiang, Makovski, and Shim in chapter 2, focusing on WM for feature conjunctions. The authors discuss how the separation of object and location processing (ventral versus dorsal stream) in perception does not seem to transfer clearly to VWM. Behavioural studies, in contrast, have revealed more subtle dissociations, suggesting, for instance, that spatial but not nonspatial features of items are obligatorily encoded into VWM. They go on to review central discussions in the literature: (1) whether VWM is object-based (with a capacity of about four objects irrespective of the number of constituent features, but varying with complexity and/or similarity of to-be-remembered objects) or feature-based (with separate capacities for different features), or (2) if the capacity limit of WM is best described as a storage limit (defined by a limited number of WM slots or a limited resolution that decreases with increasing memory load) or an executive-control limit (meaning that low-capacity individuals may not have lower WM capacity per se, but may be less able to filter out irrelevant information).

The third chapter, by Bruce, is concerned with memory for faces and how this may be a `special' type of memory. Evidence is reviewed (including disproportionate effects of inversion and negation) that face identification unlike `standard' object recognition is strongly based on holistic analysis of feature configurations. Findings suggesting that face memory is not special are also reviewed. For instance, similar effects of inversion etc are also observed in experts' object identification (eg when a farmer identifies his sheep). Nonetheless, neuroimaging research suggests that, brain-wise, faces are special, with the fusiform face area specifically devoted to face processing, independently of expertise. Finally, Bruce discusses how the reproduction of faces by witnesses is extremely poor, and how this could be improved by novel techniques (eg morphing of several independent reproductions).

In chapter 4, Hollingworth highlights the fact that, unlike objects studied in the lab, objects in the real-world are typically embedded in complex scenes. Hence this chapter deals with how the coordination of component operations in memory supports real-world perception of (objects in) scenes. The functions of visual memory in scene perception are fundamental: iconic memory allows for the integration of information across very short intervals. VWM bridges gaps in perception created, inter alia, by movement (of the eye and objects in the world) and hence
allows for scene continuity (based, in particular, on the mapping of pre- and post-saccadic object representations). Visual long-term memory allows for the accumulation and stable representation of object information in complex scenes (which easily exceeds the capacity of VWM), and integrates objects with their scene context. Finally, schematic scene knowledge can help guide attention to task-relevant objects.

Chapters 5 (Hayhoe) and 6 (Shelton and Yamamoto) discuss the importance of visual memory for action and navigation. Visuospatial memory makes the planning of eye-, hand-, and body-movements more efficient. For example, a spatial—not retinal—representation of the environment is essential in the planning of complex tasks with many eye movements and high demands on hand–eye coordination. In moving environments (traffic, sports), internal models of the dynamics of moving objects allow for anticipatory saccades, which in turn allow for higher speed and precision of action. In navigation, while spatial representations are fundamentally based on vision, there is some evidence for a supramodal navigation system. For example, spatial information can also be extracted from nonvisual modalities, and such representations will be modality-specific to a certain degree (eg a verbal description of object positions can be superior to visual encoding in some tasks). Also, while there is a clear role of visual memory in cue-guided landmark navigation, people can also rely on more supramodal, allocentric cognitive ‘maps’ that are not primarily visual.

In chapter 7, Davis and Loftus focus on how expectations, emotions, and beliefs lead to systematic distortions of visual memory. At encoding, expectations and activated schemas partly determine what is encoded (eg the false perception of a man holding a weapon is more likely when the man is dark-skinned). Likewise, storage and retrieval are strongly influenced by the belief of “what must be true”: labelling (eg of a suspect as ‘black’) will lead to memory for the suspect’s appearance being shifted towards prototypicality; suggestive post-event information will distort both what is remembered and the confidence it is remembered with. Expectations (eg that the culprit ‘must be’ in the line-up) and misattributions (eg that an innocent suspect is familiar from a crime scene when he is in fact familiar from a photo in the file) will increase the probability of false identifications. Finally, the review points out that the popular ‘tunnel-memory’ theory of the effects of emotion on memory—central aspects of emotional events are better remembered at the expense of peripheral detail—is far too simplistic; for example, emotions can generally impair memory by promoting automatic retrieval processes at the expense of more accurate controlled processes.

The final chapter, by Ganis, Thompson, and Kosslyn, discusses the overlap of brain regions associated with vision and imagery. While perception seems to engage more brain regions than imagery (presumably owing to functions needed in perception but not imagery, such as visual grouping), the overlap is striking, going down to the single-neuron level. Neuropsychological impairments affecting both imagery and perceptual identification can be object-specific, providing some evidence for reinstatement theory (ie similar brain regions support perception and long-term storage of specific object classes). Finally, the finding that the motor system is actively involved in mental rotation has paved the way for an exciting application, namely the successful use of mental practice to improve actual motor performance, not only in sports, but also in stroke recovery.

Overall, the book finds a nice balance between data and theory (although some chapters are a bit light on the theory side). A very positive aspect is that central topics of visual memory research—how the system deals with the severe capacity limitations imposed by VWM, how long-term representations influence perception and interpretation of visual information—are taken up in different chapters and are discussed from different angles. The book therefore has a nice flow to it, and there is appropriate cross-referencing. Hence, the book offers an integrated overview of research into human visual memory that in its breadth and depth will appeal to interested undergraduate students as well as memory researchers.

Given the book’s broad scope, it is obvious that not all potentially relevant data and theories could be discussed, and that some topics of visual memory had to be omitted altogether. In most chapters, literature reviews are encompassing and the main theoretical controversies are sufficiently discussed. I found that some authors, however, focused too much on their own work (to give one arbitrary example, I was surprised to find the work of Bar [eg Bar 2004] unmentioned). Also, readers with an interest in episodic recognition memory or implicit forms of memory should turn to other sources of information, as should readers primarily interested in
computational modelling or the neuroscience of visual memory (the reviewed data are mainly behavioural, augmented by neuroscientific evidence, contrary to what is suggested by the cover). Yet, this should not necessarily be seen as a weakness of the book, which offers a focused collection of first-class reviews and will be a valued repository for scientists fascinated with the visual world in memory.

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Fixing my gaze: A scientist’s journey into seeing in three dimensions by S R Barry; Basic Books, New York 2009, 272 pages, $26.00 cloth (Can$32.95, £15.99) ISBN 9780465009138

Fixing My Gaze: A Scientist’s Journey into Seeing in Three Dimensions prefaced by Oliver Sacks, written by the neurobiologist Suzan Barry, combines in an elegant way biography and science. The book describes Barry’s childhood strabismus, stereo-blindness, and the gain of stereovision at the age of 50 years after vision therapy. It focuses on active vision, the importance of eye movements for stereovision, and provides exceptional evidence for continuous plasticity in the adult human brain beyond critical periods. The book is pleasant to read, the style direct, touching. It renders accessible to a large audience some of the most complex concepts and tests in stereo- vision, eye movements, and brain plasticity. This is due to the author’s great knowledge of past and current research in all of these fields, and her critical view on laboratory results applied to human strabismus.

The book is structured in nine chapters. In the first chapter, called “Stereoblind”, Barry begins with describing how, as a college student, she is listening to a lecture on stereovision when the professor concludes that “most persons with misaligned eyes do not see in 3-D: they are virtually stereoblind” (page 3). After exposing the Greek etymology of the word stereovision and listing its multiple virtues, Barry builds the book on the notion of brain plasticity. She presents various examples of plasticity, including that of her husband, an astronaut, who, when returning from space flight, needed three days to regain his balance and a sense of up and down. She then points out that, despite full evidence of the adaptability of the adult brain, such plasticity is not yet applied to the concept of strabismus (page 15).

In chapter 2, called “Mixed up beginning”, one reads: “stop wondering stop wandering’ My parents whispered this to me over and over ... it was our coded message to tell me that my eyes were crossing” (page 17). The consequences of strabismus are far more dramatic than just for vision; strabismus influences relationships, social evaluation, and even perceived cognitive abilities. The author describes her multiple strabismus surgeries in a touching way. We see the child afraid of losing vision, but also enjoying compensation (a family pet). The need for multiple surgeries is still a reality for many children with strabismus; the missing opportunity to get vision therapy, early after the first surgery, that could have made Barry gain stereovision since childhood, is another important point.

Chapter 3 called “School crossing” makes important points for future research: the link between stereopsis and quality of reading (eg the author points out that about 20% of children show problems in focusing on the text during sustained periods); past eye-movement research concentrating on one eye only; and the need for binocular eye-movement research. False diagnosis of hyperactivity disorder in children with intermittent strabismus is another example of the complexity of strabismus and its consequences. Complexity culminates with the rude conclusion from an ophthalmologist, stating that “there was nothing wrong with her vision and perhaps she needed a psychiatrist” (page 46). Evaluation of vision cannot be reduced to visual acuity; ophthalmologists need to take this more into consideration.

The book acknowledges important contributions of physiologists, unknown optometrists or orthoptists developing clinical tests and methods to improve visual function probing brain plasticity. The historical overview on the links between ophthalmology, orthoptics, and optometry, still needing further development (pages 60 – 63), is very useful.
Other key scientific notions of the subsequent chapters are listed below:
“Sensing the word is not a passive process but require active exploration” (page 70)
“Balancing and aligning her body corresponded with balancing and aligning her eyes” (page 78)
“Even people with normal vision have different visual styles” (page 81)
“Stereopsis provides us with the ability to see the volume of space between objects and to see each object as occupying its own space” (chapter “The space between”)
“The sensation provided by stereopsis of empty space and things projecting or receding into the space is unique” (page 102)
Emotions triggered by stereovision, such as the pleasure of seeing depth but also the fear from unusually vivid 3-D perception, are beautifully described, as well as the creation of pictorial depth by painters.
Barry then highlights the resistance from other scientists in admitting her gain of stereovision at the age of 50. In the last two chapters, she develops the neural basis of brain plasticity allowing such a late gain of stereovision. Behind the biographic style, one finds a solid scientific construction with arguments, one after the other, driving the reader convincingly to the heart of brain plasticity.
Some particularly relevant notions about plasticity are: “it all comes down to timing” (page 10); or the importance of feedback, “knowing when your eyes are aligned”, as a prerequisite for plasticity to occur.
On page 127, Barry then emphasises the role of eye movements for 3-D perception; she mentions improvement of her pursuit eye movements, and describes her increased capacity to use both holistic and analytic vision (page 132). She stresses the correspondence between specific exercises during vision therapy and specific improvements that would be useful for vision therapists. Indeed, Barry almost succeeds to drive the reader in seeing the process of genesis of strabismus—an interplay between sensory and motor mechanisms, both under plasticity (good or bad).
In the last chapter, the concept of a critical period is questioned with humbleness, and Barry communicates her exchanges with Hubel and Wiesel on this matter. Inappropriate extrapolation by many clinicians and scientists from animal studies to human clinical problems, mistaken ideas about critical periods for development of binocular vision versus rehabilitation, and limitation of occlusion procedures in humans are all insightful points for neuroscience.
Barry observes with perspicacity the brain’s capacity to keep different modes of functioning, regressing back to flat vision under stress and emotions.
In sum, this is an excellent book, pleasant to read, uncovering the complexity of strabismus pathophysiology, the subtleties of human brain plasticity, rendering scientific knowledge accessible to a large audience and still being extremely accurate. I would certainly recommend this book to opthalmologists, orthoptists, optometrists, neuroscientists, special educators, and psychologists, but also to parents of strabismus children and artists.
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