

# The Visual World in Memory

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## Preface

Every morning at the same time (give or take 15 minutes depending on the speed with which my 2- and 5-year-olds decide to eat their cereal), I head off on a one-mile walk to the Psychology Department at the University of Edinburgh. The windswept Scottish rain aside, I thoroughly enjoy this walk—first among the eighteenth-century Georgian townhouses, then down the sixteenth-century streets, with the rocky crags of Holyrood Park and the majesty of Edinburgh Castle all the while framing my path (how could one not be in awe?). It was on these walks that the idea for this book slowly developed. I'd occasionally discover new and interesting *objects* in shop windows or aspects of the panoramic *scenes* I hadn't noticed before while standing on the bridges and hilltops overlooking the city. I started to realize that I was passing the same *faces* every morning coming down the hill from the city centre as I climbed up. When a traffic accident blocked my normal route home, I found that I was able to *navigate* home along a completely novel path (happily discovering quaint hidden pubs along the way). I'd come home and tell my wife about the interesting street performances and other *events* that I'd stumbled across. I constantly found myself captivated by the city's ancient buildings and tried to create *mental images* of what the city must have looked like centuries ago. In short, it struck me just how much of what I thoroughly enjoy about my walk to work depends on my ability to represent the visual world around me in memory. This book, in some sense, then, is a story of a one-mile stroll through Edinburgh and the amazing, striking, and at times desperately limited nature of memory for our visually based experiences, from simple patterns to highly complex, dynamic, and emotion-inspiring events.

How is the visual world represented in memory? The question has literally been asked for centuries, but the past decade has witnessed an explosion in scientific research on the question. With a recent PsycInfo search, I found 1,605 peer-reviewed journal articles that included “visual memory” as a key concept or major index term, dating as far back as 1897. Strikingly, 1,056 of these articles (66%) have been published in the last 10 years. It seemed, then, that the time was right to produce a volume that surveys the current issues confronting visual memory research and previews the challenges for researchers in the years ahead.

Although terms like “visual memory” sound as though they might be addressed by a unitary line of scientific enquiry, research on visual representation varies tremendously across the timescales, stimuli, and scenarios of interest. As will be apparent in this book, while some researchers are interested in memory for events in the distant past, other researchers’ investigations are restricted to memory for visual experiences that occurred no longer than a second ago. While some examine memory for simple visual features such as color or shape, others consider memory for entire scenes. While some are interested in memory for specific objects, places, or events, others are interested in how memory for those objects, places, and events can be mentally manipulated to support future action and reasoning. While some are interested in the veridicality of memory, others are interested in the susceptibility of memory to various errors and distortions.

Although all of these areas of study combine to characterize our visually based experiences and memories, because of these disparate interests, research in the field of visual representation is in practice rather compartmentalized and as such is disseminated across a range of nonoverlapping literatures. The purpose of this book, therefore, was to collect a series of chapters written by leaders in the field that concisely present the state-of-the-science in all the aforementioned areas of memory research. The chapters are written by researchers who have made influential and lasting contributions to the study of memory mechanisms involved in representing the visual world; when taken together, these contributions provide a single source of information that uniquely bridges the field.

In the first chapter, “Fragmenting and Integrating Visuospatial Working Memory,” Robert H. Logie and Marian van der Meulen introduce the concepts of visual and spatial working memory and analyze the major theories regarding working memory for visual information. They consider the question of whether a unique memory system exists for visual information, and, if so, how many visually and spatially based systems exist. The relationship between visual working memory and executive control, developmental aspects, and computational modeling of visuospatial working memory are also discussed.

The next three chapters are written by experts in the fields of object, face, and scene processing who have made highly influential and lasting contributions to the study of memory mechanisms involved in the processing of these stimuli. In their chapter, “Visual Memory for Features, Conjunctions, Objects, and Locations,” Yuhong V. Jiang, Tal Makovski, and Won Mok Shim pick up on the distinction between visual and spatial working memory outlined in chapter 1 and review the evidence for whether the neural division of labor for the perception of objects and their locations extends to working memory. Turning to a behavioral analysis, they then consider the determinants of the limits of visual working memory, including those related to capacity, resolution, and executive control. Finally, they consider the relationship between short- and long-term memory for objects and their locations by considering how each is used to coordinate visually guided behaviours such as visual search. In chapter 3, “Remembering Faces,” Vicki Bruce considers theories and models of face

recognition including the role of visual and visually derived semantic codes in face memory. In describing the factors that affect face recognition, she contrasts the known properties of face memory with those of object memory. In this discussion she reflects on the configural or holistic processes involved in face recognition and on how the methods used in the expertise and neuroscience literatures have been used recently to critically assess whether face memory is a special class of object memory. Also considered is the role that dynamic information, such as head movement while making expressions or while speaking, plays in facial memory and the recognition of faces, especially when other information is impoverished. In chapter 4, “Memory for Real-World Scenes,” Andrew Hollingworth analyzes the structure of scene representations and how elaborate those representations are. While considering how scene memory is constructed as participants view a natural scene and how both short- and long-term scene memory reciprocally influence scene perception, he considers the nature of change blindness, the spatial and schematic structure in scene memory, the influence of gist and context in scene perception, the effects of scene memory on object recognition, and the relationship between visual memory and conscious awareness.

Chapters 5–7 are written by very well-known researchers who consider the role of memory in natural real-world tasks in which the observer is an active player. These chapters discuss, in turn, the memory mechanisms involved in the motor planning and coordination of body movements, navigation, and witnessed events. In her chapter, “Visual Memory in Motor Planning and Action,” Mary M. Hayhoe addresses how memory representations are involved in the coordination of natural tasks such as making a sandwich, batting a ball, or driving. While previous chapters have considered visual memory in a single brief exposure or trial, here the focus is on the sequence of different visual operations, the selection and timing of which are controlled by the observer. With an analysis of eye, hand, and body movements in both real and virtual environments, she asks to what extent a current visual operation depends on memory for the output of a previous operation and what information from the world is actually needed in order to perform natural tasks. Next, Amy L. Shelton and Naohide Yamamoto consider the relationships between “Visual Memory, Spatial Representation, and Navigation.” They point out that memory for space and spatial relationships draws heavily, but not exclusively, on vision and discuss how auditory information and textual descriptions also lead to spatial representation. They further outline the nature of the memory representations by considering the importance of viewpoint, observer orientation, and landmarks on both the recognition of, and navigation through, the visual world. They describe how a veritable menagerie of spatial representations available to humans and animals—including egocentric and allocentric representations, cognitive maps, eidetic memory, and memory for movement velocity, acceleration, and optic flow—give rise to remarkable spatial reasoning abilities. Deborah Davis and Elizabeth F. Loftus round off this set of chapters with a discussion of “Expectancies, Emotion, and Memory Reports of Visual Events.” Drawing on their extensive research on the accuracy

of eyewitness testimony, they consider the quality of memory for objects and faces when they must be interpreted and remembered in the context of real-life events. They discuss the malleability of memory for visual events at all stages of memory generation, from what is originally encoded in memory to the multiple efforts to retrieve and report on the original events. These authors also consider how factors such as emotion and stress influence our memory of witnessed events and how this requires a reinterpretation of current theory regarding memory for visual events.

In the final chapter, “Visual Mental Imagery: More Than ‘Seeing with the Mind’s Eye’,” Giorgio Ganis, William L. Thompson, and Stephen M. Kosslyn discuss recent advances in the study and characterization of visual imagery. As many readers will be aware, an extensive debate surrounding the nature of imagery ensued in the late 1970s and 1980s without coming to any clear resolution. These authors turn to recent advances in noninvasive neuroimaging and neuropsychology in an effort to finally answer the question: How tightly linked are visual imagery and visual perception? Their focus in this discussion is on whether, and to what extent, visual mental imagery and visual perception recruit the same neural resources and whether there are different types of visual imagery, each relying on nonoverlapping brain networks. Although the authors argue that the study of mental imagery with these approaches is still in its early stages, the result of their analysis is the most up-to-date review of visual mental imagery available.

Throughout the chapters, readers will discover that many psychological constructs and research methods appear and reappear in discussion of wide-ranging lines of psychological investigation. For example, the building blocks of memory for objects constrain memory for scenes (collections of objects), which in turn influence memory for events (collections of dynamically changing scenes). Extensive cross-referencing of concepts among the chapters will highlight the myriad connections that exist between multiple lines of research. Readers will also see how advances in technology, including eyetracking, virtual reality, and neuroimaging, have caused a revolution in the research questions that can be addressed. With regard to the growing ubiquity of neural considerations in psychological research, all chapters include discussion of neuropsychology and/or neuroimaging findings.

In closing this short introduction, I would like to take the opportunity to thank the people that made this volume possible. First, of course, I would like to offer my sincere thanks to all of the authors whose outstanding chapters are presented here. Second, many thanks are owed to Lucy Kennedy, Tara Stebnicky, and Rebekah Waldron at Psychology Press for guiding this book from concept to reality. Third, I thank Chris Moulin and those anonymous reviewers who were kind enough to comment on previous drafts of this work; through their efforts this work has certainly been strengthened. Finally, I would like to thank my teachers and colleagues, especially Laura Carlson, John Henderson, David Irwin, and Frances Wang, who have stimulated my interest in visual cognition over the past 10 years and whose influences are apparent in the way I think

about the field. For my part, I would like to offer this work for Ellen and Owen, and all those who marvel at the visual world around them. I hope that the rigorous discussion and analysis included in each chapter will appeal to established researchers and that the breadth of the book will make it a useful companion for students learning about memory.

James R. Brockmole  
Edinburgh, September 2008