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Joseph B. Hopfinger
Frontmatter
More Information

# Neuroscience of Attention

Attention is critical to our daily lives, from simple acts of listening to a conversation or reading, to the more demanding situations of trying to concentrate in a noisy environment or driving on a busy roadway. This book offers a concise introduction to the science of attention, featuring real-world examples and fascinating studies of clinical disorders and brain injuries. It introduces cognitive neuroscience methods and covers the different types and core processes of attention. The links between attention, perception, and action are explained, along with exciting new insights into the brain mechanisms of attention revealed by cutting-edge research. Learning tools – including an extensive glossary, chapter reviews, and suggestions for further reading – highlight key points and provide a scaffolding for use in courses. This book is ideally suited for graduate or advanced undergraduate students as well as for anyone interested in the role attention plays in our lives.

**Joseph B. Hopfinger** is a Professor of Psychology and Neuroscience at the University of North Carolina at Chapel Hill and co-Editor-in-Chief of the journal *Cognitive Neuroscience*. He has also received the *Brain Research* Young Investigator Award.

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To

William, Michael, and Jenni

Thank you for all your support and for helping my attention always return to what matters most.

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Frontmatter
More Information

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Frontmatter
More Information





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More Information





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# Preface

Attention has been discussed for millennia, but only in the last few decades have the methods of cognitive neuroscience been able to probe into the human brain to reveal the neural mechanisms underlying this critical mental process. Current topics in the popular press, such as stories of distracted driving, the effects of video games on students' concentration, and the frustratingly long lines at airport security checkpoints, highlight a few real-world examples of the importance of attention. New industries have arisen over the past few years promising to enhance our attention through a variety of "brain training" techniques. Between the implementation of distracted driving laws, the treatment options for attention disorders, and the push to enhance our brains, understanding the brain mechanisms of attention is more important than ever.

This book is intended for audiences including graduate students, advanced undergraduate students, and laypeople or scientists interested in the history and current research into the neural mechanisms of attention. It starts with the historical background of early theories of attention, presents seminal cognitive neuroscience studies that have revealed core processes of attention, and discusses future directions of research into the brain mechanisms of attention that have real-world implications. This book is aimed to fill a gap between the broad but brief coverage of attention in most undergraduate cognitive psychology textbooks and the in-depth but narrow focus of research articles and books that address only a select aspect of attention.

## How to Use This Book

The first few chapters of this book provide a foundation for understanding current research on attention by explaining the history of attention research and the strengths and limitations of the many cognitive neuroscience methods that are used in the attempts to uncover the neural mechanisms of attention processes. The subsequent chapters are organized around major themes in attention research, such as voluntary versus involuntary influences on attention, the distinct process of controlling attention versus the effects of that control, and the role of neural rhythms in the allocation of attention across time. The different deficits and disorders of attention are compared, and research into the plasticity and training of attention systems is discussed, along with the presentation of new models of perception and attention. Each chapter can be read as a standalone account of an area of attention research, but the chapters also contain cross-references to related material in other chapters, thus serving to extend and reinforce each other in an integrated way.

Since many different techniques and types of equipment are used to probe into the brain basis of attention, a full chapter is dedicated to explaining the various methods of cognitive



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neuroscience. As will become clear, there is no single perfect method, as each has strengths as well as critical limitations. Thus, an understanding of neural mechanisms can only come by integrating findings from across these varied methods. A critical goal of this book is to help readers understand how each method works, so that experimental findings can be evaluated in terms of what each result can or cannot tell us about the processes of attention.

Each chapter starts out with a list of learning objectives and ends with a summary of key points and review questions. Boxes within each chapter highlight controversies or recent trends in the research being done on the topic of that chapter, and a short list of suggested "Further Readings" is provided for readers wanting to dive deeper into seminal papers or in-depth reviews of the topic. A Glossary is also included to provide quick access to definitions and explanations of important terms. The chapters are written to be accessible to those without expert knowledge, but they also present some of the most critical research findings on each topic and provide extensive citations. Even in a book dedicated just to attention there is not room to describe all the exciting research being done, but the citations and suggested readings provide recommendations for where interested readers can obtain further knowledge of specific areas of research. Thus, this book could be used as a standalone textbook in upper-level undergraduate courses, as part of advanced graduate seminars focused on attention or cognitive neuroscience, or simply as a means for anyone interested in this topic to gain a deep understanding of how the brain enables the multifaceted processes of attention.

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