
Preface

Attention played a vital role in the historical development of the field of psychology. Early psychologists pondered the nature of attention and attempted to characterize its phenomenology and constituent processes. Attention was considered to be a fundamental and inescapable aspect of human experience by Wilhelm Wundt, William James, and other founders of modern psychology. Yet, for much of the early twentieth century, psychologists avoided the construct of attention, and relatively little experimental study of attention took place before the 1960s. Because attention has an intangible quality and cannot be specified as a unitary process, many behavioral scientists considered the construct of attention to be metaphysical or at the very least theoretically incoherent. Some of their concerns regarding the nature of attentional phenomena were clearly justified. Yet, it was also apparent to most psychologists that explanations of behavior and cognition that failed to account for attention were phenomenologically and conceptually incomplete.

In the 1970s, there was a major shift in zeitgeist, as cognition increasingly became an accepted topic of scientific inquiry. This shift corresponded with the onset of the information age and rapid developments in computer science. Cognitive scientists increasingly incorporated concepts arising out of information-processing theory to explain cognitive phenomena, such as how people selectively attend to particular information in their environment. Humans clearly cannot handle an infinite amount of simultaneous information. Cognitive processes must exist which serve to reduce the information derived from sensory input to manageable levels, to select particular stimuli and responses from the vast universe of alternatives, while eliminating other less relevant information from immediate consideration, and to direct optimal focus on information that is most salient. While the specific mechanisms and functional brain systems underlying these processes were not well understood, it was apparent to early cognitive scientists that accounting for and explaining the occurrence of phenomena normally labeled as attention and consciousness was essential to a complete understanding of cognition.

The necessity of studying attentional phenomena is particularly evident within neuropsychology. Patients with brain disorders frequently do not perform at optimal levels, even when task variables are held constant. They may fail to detect an object in the environment, even though it can be demonstrated that they have adequate perceptual capability. Inconsistent performance is often attributed to attentional factors. Yet, even today, attention is not comprehensively assessed as part of most routine neuropsychological

evaluations, even though disorders of attention are now recognized as being very common. Historically, few systematic clinical approaches existed for assessing attention. Over the past two decades, considerable effort has been directed at developing neuropsychological tests of attention. Furthermore, consideration of underlying attentional mechanisms and impairments arising from disruption of these mechanisms is now much more central to neuropsychological inquiry. While many of the concepts, models, theories, and methods for studying attention were beginning to emerge during the late 1980s prior to the first edition of this book, there was a clear lack of coherence in the neuropsychology of attention. This is no longer the case. While debate continues over whether certain processes are best considered as aspects of attention, memory, or other cognitive processes, there is now much greater agreement over what constitutes attention, how it relates to other cognitive processes, and also regarding the underlying brain systems and physiological mechanisms responsible for attending. The necessity of studying attentional phenomena is particularly evident within neuropsychology. Patients with brain disorders frequently do not perform at optimal levels, even when task variables are held constant. They may fail to detect an object in the environment, even though it can be demonstrated that they have adequate perceptual capability. Inconsistent performance is often attributed to attentional factors. Yet, even today, attention is not comprehensively assessed as part of most routine neuropsychological evaluations, even though disorders of attention are now recognized as being very common. Historically, few systematic clinical approaches existed for assessing attention. Over the past two decades, considerable effort has been directed at developing neuropsychological tests of attention. Furthermore, consideration of underlying attentional mechanisms and impairments arising from disruption of these mechanisms is now much more central to neuropsychological inquiry. While many of the concepts, models, theories, and methods for studying attention were beginning to emerge during the late 1980s prior to the first edition of this book, there was a clear lack of coherence in the neuropsychology of attention. This is no longer the case. While debate continues over whether certain processes are best considered as aspects of attention, memory, or other cognitive processes, there is now much greater agreement over what constitutes attention, how it relates to other cognitive processes, and also regarding the underlying brain systems and physiological mechanisms responsible for attending.

These considerations motivated the first edition of this book in the late 1980s. The first edition of the *Neuropsychology of Attention* was a comprehensive overview of the field. It included three major parts. The first part presented information about the history of attention within psychology, the cognitive science of attention, behavioral approaches, and psychophysiological approaches. Part II provided a review of the neuropsychological manifestations of disorders affecting attention, with chapters on neurological and psychiatric disorders that affect attention, neuropsychological assessment of attention, and neuropsychological models of attention. Part III was directed at a review of theoretical issues in the analysis of attention, including factors that constrain attentional performance (e.g., memory, spatial and temporal

dynamics, processing speed). An examination of computation models of attention was also included.

It has been 20 years since the original publication of the *Neuropsychology of Attention*. The emphasis placed on the study and assessment of attention has increased dramatically since that time. At the time of its publication, attention was a construct that had long been of theoretical interest in the field of psychology and was receiving increased research by cognitive scientists. Yet, attention was typically viewed as a nuisance variable, a factor that needed to be accounted for when assessing brain function but of limited importance in its own right. Neuropsychological interest in attention has steadily increased. Several factors contribute to this. (1) Attention is comprised of processes that govern the moment-by-moment interface of internal cognitive experience with the outside world. (2) It has become apparent that attention is one of the most vulnerable cognitive functions. Attention is affected by a wide range of medical and psychiatric conditions. (3) We are now able to better operationalize and assess attention in a systematic way. (4) Problems with attention are increasingly being reported by people in the United States, in part due to the increased complexity and pace of modern living. Attention Deficit Disorder (ADD) has become one of the most widely diagnosed conditions of childhood. (5) Rapid advances in functional brain imaging have enabled the measurement of brain activity associated with cognitive processes. Brain activation occurs in response to the momentary processing demands that exist during the task, which typically involve strong attentional involvement. The brain systems that most commonly activate during functional imaging (e.g., cingulate cortex, prefrontal cortex) are areas known to play essential roles in attention. In light of these facts, there has been an explosion of interest in the neuropsychology of attention.

Over the past two decades, there has been a virtual explosion of clinical, cognitive, and neuroscience research directed at better understanding attention and its underlying processes. The number of published manuscripts addressing the functional neuroanatomic and the neural bases of attention has increased geometrically, and attention is now a major focus of many studies utilizing functional brain imaging methods to study cognition. Review of published articles accessible through PubMed suggests that since 1995, over 20,000 studies have been published examining the neural bases of attention and clinical disorders of attention associated with various neurological and psychiatric disturbances. A large number of these studies include neuropsychological investigations of clinical disturbances of attention. Accordingly, the time is ripe for a reconsideration of the neuropsychology of attention at this point in the early twenty-first century.

In light of the many advances in the neuroscience of attention, several topics warranted greater consideration in this second edition.

1. Functional neuroimaging was in its infancy when the first edition of this book was written. Knowledge of the neural mechanisms underlying attention came primarily from psychophysiological studies employing methods based on EEG, electrophysiological and ablation studies of laboratory animals, and of course the analysis of neuropsychological abnormalities secondary to brain lesions in humans. While these continue to be important methods for the

study and clinical assessment of attention, functional neuroimaging has had a profound impact on the neuroscience of attention. Many functional neuroimaging findings that emerged over the past two decades are reviewed, and an entire chapter has been devoted to the neuroimaging of attention.

2. The construct of working memory and its relationship to attention was not well developed, so this received limited coverage.
3. The literature on attention disturbances associated with specific neurological disorders was limited at the time; therefore, this information was summarized with less detail than would be optimal. At this point, there is considerable knowledge regarding attention disturbances associated with specific neurological and psychiatric conditions that should be integrated.
4. The clinical assessment part is dated. There are now many more tests of attention that should be reviewed.
5. Attention was largely not reviewed from a developmental perspective in the first edition. There is a need for integration of work coming from the study of child psychology, and this fits with and informs about the neuropsychology of attention more broadly.
6. Treatment approaches (pharmacological and behavioral) received only limited coverage in the first edition.

Accordingly, there was a need for a new edition of this book to present an updated and integrated review of what is known about attention, the disorders that affect it, and approaches to its clinical assessment and treatment. Such a book will provide perspectives for experimental neuropsychological study of attention and also provide clinicians with insights on how to approach this neuropsychological domain.

The second edition of the *Neuropsychology of Attention* was written with several goals in mind: (1) to provide an update on the large body of experimental and clinical findings regarding the neuropsychological bases of attention, (2) to examine the degree to which previous theories and models fit with current evidence regarding the underlying processes and the functional brain systems known to govern attention, (3) to provide a more focused and thorough review of how attention has been approached in the context of the dramatic developments that have occurred in functional and structural brain imaging, (4) to provide an expanded review of neuropsychological research on the disorders of attention associated with specific neurological and psychiatric conditions, and (5) to update readers on current methods for assessing attentional disturbances. The overall goal of this second edition of the *Neuropsychology of Attention* is to provide a synthesis of theories, concepts, and experimental findings regarding the processes and brain mechanisms responsible for normal and disordered attention in humans.

As in the first edition, Part I introduces and reviews basic concepts that provide the conceptual foundation for neuropsychological consideration of attention. Theoretical and empirical information that provides the foundations for the neuropsychology of attention has come from many different disciplines within the fields of psychology, cognitive science, neuroscience, and medicine. Historically, there was often relatively little exchange between these different scientific disciplines, which probably accounted for the lack of coherence in the research being conducted on attention and even the language

and concepts used to explain attentional phenomena. Accordingly, it was necessary to establish the features common among the different approaches to the study of attention, as a starting point for subsequent analysis. Without consistency across constructs used to define and characterize attention, scientific inquiry into the neuropsychological bases of attention seemed fraught with problems. Over the past two decades, greater coherence has been achieved both with respect to the language used to describe and study attention and also underlying processes and mechanisms. Conceptual frameworks have been developed, tested, and employed. Consequently, neuropsychological study of attention is now much more feasible than in the past. Yet, for neuropsychologists and students who come to the study of attention at this point in time and who have not witnessed the evolution of the constructs and research that occurred over the last half of the twentieth century, it is also easy to overlook the origins of current thinking regarding neuropsychology of attention. Consideration of past cognition, behavior, and neurophysiological research on attention provides a useful historical perspective and important conceptual foundations necessary for systematic neuropsychological study of attention and the brain disorders that affect attention.

Accordingly, we again begin Part I of the second edition of this book with consideration of the roots of current theories of attention in philosophy, cognitive psychology, behaviorism, and psychophysiology and then proceed to consider the neuropsychology of attention as it now exists in the twenty-first century. Several broad domains of theoretical and experimental knowledge of relevance to the study of attention are addressed: (1) information-processing models, (2) other cognitive approaches, (3) behavioral theories of attention, and (4) psychophysiological and neurophysiological evidence regarding the nature and mechanisms of attention. There has been little previous integration of attentional concepts developed from these different domains, though this is not altogether surprising if one considers the different scientific and philosophical perspectives that each represents. An attempt is made to present the strengths and weaknesses of each of these approaches and to develop a more unified conceptual framework regarding the cognitive, behavioral, and neural mechanisms of attention. Attention directed at response selection and control (executive–attention) is reviewed, as well as both sustained and focused attentions. At the end of Part I, a theoretical framework of attention is presented that is applied to subsequent discussions of the neuropsychology of attention.

In Part II, neuropsychological disturbances of attention are reviewed with consideration of the functional neuroanatomic systems that are affected by different disorders. This part has been expanded since the first edition, as attention has now been studied extensively with respect to a number of neurological and psychiatric disorders. Attention disturbances observed with these disorders are reviewed in greater detail. Consideration of brain disorders on attention provides an important means of understanding the role played by particular brain systems for attention. Disturbances of sensory selective attention, including those associated with hemineglect syndrome, are considered in Chapter 12. Experimental animal and human studies that have delineated the neural systems underlying selective attention are reviewed. Disorders of response intention and more broadly executive–attention are reviewed next.

This is followed by consideration of the role of frontal cortical systems (Chapter 13) and subcortical and limbic influences (Chapter 14). Specific neurological diseases that affect attention are reviewed in Chapter 15, including Alzheimer's disease, subcortical neurodegenerative diseases (e.g., multiple sclerosis, Parkinson's disease, Huntington's disease), cerebrovascular disease, traumatic brain injury, seizure disorders, and HIV. Systemic medical illnesses that affect attention are then reviewed in Chapter 16, including the impact of metabolic disturbances and attention dysfunction in the context of delirium. Attentional influences on behavioral risk factors for illness are also considered. Next, psychiatric conditions that affect attention are considered (Chapter 17), followed by Attention Deficit Disorder (Chapter 18). A number of books are now devoted to ADD. Chapter 18 contains an overview of this literature, with a specific emphasis placed on the nature of the attentional disturbances that occurs and presumed neural underpinnings. Chapter 19 reviews neuropsychological assessment of attention, with discussion of both neuropsychological and more traditional psychological methods of evaluating attentional dysfunction. Experimental methods developed from information-processing approaches are also described. This chapter has been expanded to discuss certain tests that were developed since the first edition that have had an impact on the field. Inventories used in the behavioral assessment of ADD are also discussed. Neuropsychological models and frameworks developed to account for attention are reviewed in the final chapter of Part II.

Attention occurs as a function of multiple interacting neural systems in response to exogenous stimuli from the environment and endogenous organismic influences. Accordingly, it is important to consider neural, behavioral, and physical constraints on attention, as well as the relationship between attention and related experiences, such as consciousness and awareness. Part III begins with a discussion of the relationship between consciousness, self-awareness, and attention. This is followed by a consideration of neural constraints on attention (Chapter 22) and then of specific factors that influence attention, including processing speed and cognitive resources (Chapter 23), memory (Chapter 24), and spatial and temporal dynamics (Chapter 25). Chapter 26 addresses neuroimaging methods for the study of attention. Computational neuroscientific approaches are considered in Chapter 27, including neural network and connectionist models of attention. Computational models provide formal operational systems for examining specific theories of attention and testing whether conceptualized attentional processes are feasible and fit with empirical evidence from cognitive and neuropsychological studies of human performance. The final chapter provides a synthesis of cognitive, behavioral, and neural mechanisms underlying the attention. Neuropsychological models of attention are reexamined in light of this synthesis. The second edition of the *Neuropsychology of Attention* provides a foundation for understanding the processes and disorders of attention and their underlying neural mechanisms.



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