

Preface

Rapid developments in brain imaging have occurred over the past decade. These advances have revolutionized cognitive and behavioral neuroscience, and are likely to have major influence on clinical psychological, psychiatric, and neurological practice over the coming years. News stories now appear on almost a daily basis in the national and international media describing findings from neuroimaging studies that have application to health and behavior. Interest in these neuroimaging efforts stems from the innate human curiosity to better understand how one's mind works, and the nature of brain dysfunction. There has been a greater realization by the layperson, scientist, and health care practitioner over the past decade that the mind and behavioral processes play an essential role in preventive health, response to illness, and the basic underlying mechanisms of many diseases. Brain imaging seems to be inherently interesting, and has increasingly drawn the efforts of large numbers of talented young behavioral scientists who strive to integrate these approaches with their research and clinical work.

The number of published empirical research studies incorporating neuroimaging methods to explore clinical and more basic neuroscience questions has increased exponentially over the past two decades. Structural neuroimaging data is now routinely included in neurological, neuropsychiatric, and neuropsychological studies, often as a way of verifying the brain disturbance that is the focus of investigation. In fact, failure to include neuroanatomic evidence of the location of brain lesions in neuropsychological studies of disorders in which there is localized damage (e.g., stroke) is often grounds for manuscripts being rejected for publication. Many excellent scientific journals now exist that provide a vehicle for disseminating neuroimaging research findings. Some focus specifically on brain imaging methods, such as *Neuroimage* and *Human Brain Mapping*, while others come from specific fields, including neuropsychology. Most of these journals are oriented toward cognitive and clinical neuroscience or applied medicine, including a large number of journals from the fields of neurology, neuropsychiatry, and radiology. With the exception of the recently launched journal, *Brain Imaging and Behavior*, few journals are oriented toward neuroimaging in the context of the clinical behavioral sciences. However, increasingly niche journals focusing on particular behavioral topics are publishing neuroimaging studies as well. For example, the *American Journal of Clinical Nutrition* has published recent studies on brain imaging findings in obesity, while journals like *Nicotine and Tobacco Research* publish studies on brain mechanisms underlying nicotine dependence and smoking behavior. In sum, neuroimaging has proliferated into the research literature on many topics in behavioral science, although to date this research is quite scattered across disciplines and journals, and not well integrated.

Books provide a vehicle for integrating information from emerging fields, such as neuroimaging. The majority of neuroimaging books have focused on the use of particular imaging methods in clinical medicine, with neuroradiology and neurology being primary sources. A number of books dealing with the more technical aspects of magnetic resonance and radiological physics and engineering also exist. Cognitive psychology and neuropsychology books now often include chapters addressing neuroimaging applications related to the study of brain and cognition. Furthermore, cognitive neuroscience texts have increasingly incorporated functional neuroimaging as a major topic. There are excellent books that address basic functional neuroimaging methods and concepts, such as the “Functional MRI: an introduction to methods.”¹

Yet, there are few books to date that consider and review emerging research in the application of brain neuroimaging methods for the study and assessment of behavioral and cognitive disorders. The “Handbook of Functional Neuroimaging of Cognition” is an example of a book that does an excellent job with respect to integrating knowledge on functional imaging in the cognitive sciences.² Frank Hillary and John Deluca, contributors to the current text, recently published a book “Functional Neuroimaging in Clinical Populations,” that addresses the use of functional imaging for the study and assessment of clinical brain disorders.³ It is one of the only books on the topic with a neuropsychological orientation to date.

It is quite remarkable that virtually no book currently exists that addresses the application of brain imaging to behavioral medicine, especially in light of the large number of research projects that have been initiated over the past several years, and the interest of the National Institutes of Health in this area of investigation. Most of the books previously mentioned were either written from a cognitive neuroscience perspective, from the standpoint of clinical medicine and standard clinical practice, or they are heavily focused on basic imaging physics and methods. Books that do focus to a greater extent on neuropsychological and behavioral topics have tended to primarily cover functional brain imaging, with little emphasis on related types of neuroimaging, such as diffusion-weighted, perfusion-weighted, and metabolic imaging methods, such as magnetic resonance spectroscopy. Furthermore, they have addressed topics of relevance to behavioral medicine and neuropsychology to only a very limited degree. Accordingly, there seemed to be a compelling need for a book to introduce clinical and behavioral scientists to a broader range of neuroimaging methods and their application to behavioral medicine and clinical neuroscience questions.

These considerations motivated the writing of this book. Our goal was to provide relatively broad coverage of current research trends in the clinical application of brain neuroimaging methods in the context of behavioral medicine, neuropsychology, and related areas of medical psychology, as well as to introduce readers to the spectrum of neuroimaging methods that are currently available.

Objectives. This book is a response to a need within behavioral medicine, neuropsychology, and more broadly the clinical and behavioral neurosciences for an integrated review of current neuroimaging methods and their clinical and research applications. The book canvases a relatively broad range of topics, covering not only functional neuroimaging, but also structural imaging, as well as neuroimaging methods that provide information underlying pathophysiology. The goal is to provide an introduction to these neuroimaging approaches, and their potential value in the assessment and treatment of medical and behavioral disorders. In this regard, we believe this book may be valuable not only for specialists in behavioral medicine and

neuropsychology, but also for clinical psychologists, psychiatrists, neurologists, and physicians and clinical health providers who are interested in the neurobiological and brain-behavior contributions to health and medical disorders, and seek to understand how neuroimaging may be useful in their clinical practice. The topics covered in this book may also help to stimulate new ideas among researchers using neuroimaging methods to study the brain and behavior. The broad objectives of the book are outlined below.

Provide an introduction to a variety of neuroimaging methods for clinicians working in the field of behavioral medicine, as well as neuropsychologists, neuroscientists, and clinicians of psychology, psychiatry and neurology.

Consider the strengths and limitations of specific methods, including constraints that may impact their future use in clinical situations.

Provide an integration and synthesis of current research and thinking on neuroimaging in behavioral medicine and clinical neuroscience.

Review current clinical and research evidence regarding the use of these methods for the assessment of specific brain and behavioral disorders.

Consider how these methods can be used in combination to understand the relationships among brain structure, pathophysiology, and function.

Consider current research questions being examined through neuroimaging within behavioral medicine and clinical neuroscience, and provide insights into future directions of research.

Organization. The book is organized into three sections. Part One introduces neuroimaging, including basic concepts, theoretical considerations, and methods. It consists of chapters that address theoretical and methodological considerations and constraints on the clinical application of neuroimaging. This is followed by chapters providing overviews of specific imaging approaches, along with some technical information about each approach, methodological constraints, and a discussion of what type of information each method provides.

Part Two consists of chapters that discuss the use of neuroimaging methods in behavioral medicine. Specific areas of focus will include obesity and eating disorders, physical activity and exercise, nicotine and amphetamine effects, pain, fatigue, and emotional experience in the context of medical disorders.

Part Three considers neuroimaging in clinical neuroscience for the study and assessment of brain disorders affecting behavior and cognition. This chapter emphasizes brain disorders that have major medical implications, including Stroke, cardiovascular disease, HIV, Alzheimer's disease, and Multiple Sclerosis. This section of the book emphasizes how multimodal imaging can help to disentangle neuropathological mechanisms underlying these conditions and brain-behavioral relationships.

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