Preface

Abnormal behavior is fascinating, particularly on an individual level—how is it possible for a person to see and hear things that aren't there? Why does another person claim her parent is an imposter, or a third person deny that his left leg belongs to him? However, abnormal behaviors can also be intriguing because of the information they offer about how *typical* people function. Why do most people recognize their parents day after day, and how do we know which hand is ours? Observations of abnormal behaviors pose mysteries to be solved and can profoundly challenge our beliefs about the self and our control over our own behavior. We will consider these and other examples of abnormal behavior and examine their implications for how our selves actually work.

For nearly all of human history, the explanations for abnormal behavior have been woefully inadequate. In everyday or folk psychology, we typically explain behavior with reference to an actor's beliefs and desires and we assume the actor is rational. When an actor's behavior deviates from the rational norm, folk psychology offers two options for explanation: (1) the actor's behavior actually makes sense in a broader context or (2) the behavior doesn't make sense and is therefore "crazy." The broader context might include the actor's childhood or previous social interactions, for example. The second option is not really an explanation because it just asserts that the behavior is unexplainable. With increasing exposure to neuroscience research, everyday or popular psychology has a new explanatory option for abnormal behavior: "there is something wrong with the actor's brain." For example, the popular media reported that John Hinckley shot President Ronald Reagan because Hinckley was schizophrenic, and what made this explanation convincing was that a structural magnetic resonance imaging scan revealed that Hinckley had

enlarged ventricles, which are associated with schizophrenia (and many other disorders, as well). So, for better *and* worse, explanations of abnormal behavior in terms of the brain are being assimilated into everyday psychology. This book is about our current research-based brain explanations for abnormal behavior, including both their scope *and* limits. The goals of this book are to explain cognitive neuroscience models for abnormal behavior so that they are easily understood by nonspecialists and to review how adequate these models are. What is novel about this book is that it attempts to apply the same set of models to virtually the entire domain of abnormal behavior across three different kinds of disorders: neurological disorders, psychiatric disorders, and neurodevelopmental disorders.

Historically, neurologists have focused on syndromes with an identifiable etiology, such as an acquired lesion (e.g., aphasia) or a genetic syndrome (e.g., Huntington's disease) or an identifiable pathophysiology (e.g., plaques and neurofibrillary tangles in Alzheimer's disease). Psychiatrists have focused on behaviorally defined disorders that lack a clear etiology or pathophysiology (e.g., major depression or schizophrenia). Neurodevelopmental disorders overlap with both of the previous two categories because some neurodevelopmental disorders are defined etiologically (e.g., early-treated phenylketonuria [PKU] and Down syndrome) and some are defined behaviorally (e.g., dyslexia and autism), but all are considered to arise from changes in brain development. It is increasingly recognized that most psychiatric disorders are neurodevelopmental disorders as well, because their precursors are evident in childhood and are thought to arise from changes in brain development. A developmental perspective is also important for studying neurological disorders, even acquired ones, because the behavioral manifestations of brain lesions depend crucially on the point in development at which they are acquired. In genetically influenced syndromes like Alzheimer's and Huntington's, there are early manifestations (called *prodromal* features) that appear long before the clinical diagnosis and there is a characteristic developmental course after disease onset. So, even though neurological, psychiatric, and neurodevelopmental disorders have typically been studied separately, all three kinds of disorders should be explainable in a common theoretical framework. The application of such a framework will not only increase our scientific understanding of these disorders, but also improve prevention and treatment.

As we will see, there is a close, reciprocal relation between theories of normal function and explanations of disorders, and there is a continuing dialogue between discoveries in each domain. So, disorders have helped and continue to help us discover and analyze the components of

the human mind in a way that studies of typical function sometimes cannot.

To understand these models of abnormal behavior, the reader needs to understand this dialogue. That is, the reader needs to understand the history and the original and later theoretical significance of each model. Issues over the interpretation of disorders lie at the heart of the field of cognitive neuroscience, both during its inception in the 19th century and today. The reader also needs to understand how these issues relate to broader issues in the philosophy of mind and the history of science, particularly biology. Consequently, the book begins with this broader context and then traces the history of continuing debates in cognitive neuroscience over the core issue of localization of function. As we will see, explanations of disorders often reveal core assumptions about how functions are localized and thus how the mind works. In fact, explaining all three kinds of disorders in a common framework is a very important test of the universality of our cognitive neuroscience models of normal and abnormal behavior and its development.

A final important point is that the seemingly sharp line drawn between normal and abnormal behavior starts to dissolve when we realize that the symptoms of many of these disorders lie on a continuum, with the cutoff for "disordered behavior" being somewhat arbitrary. So, it is inevitable that some individuals below the cutoff nonetheless have some of the defining symptoms. Moreover, rarer and seemingly pathognomonic symptoms can nonetheless be found in typical children at younger stages of development, and can be induced in typical adults by increasing their processing burden, revealing sometimes unexpected commonalities in the mechanisms underlying normal and abnormal behavior. The book will include relevant examples of seemingly pathognomonic symptoms that actually have analogues in typical development and in typical adults with reduced processing resources.

This book is divided into three main sections: (I) What Explanations Are Possible?, (II) What Are the Disorders?, and (III) What Becomes of the Self? The first section considers the history of neuroscience and the constraints that are placed on neuroscience explanations by the rest of science, including developmental science. It then presents cognitive neuroscience explanations of abnormal behavior, both classical and contemporary, and evaluates their scientific adequacy. The second section applies these models to disorders of all three types (neurological, psychiatric, and neurodevelopmental) in different domains of neuropsychological function: perception, attention, language, memory, action selection, emotion regulation, social perception and cognition, and global functioning. In

each domain of function, we will briefly present contemporary theories of that particular normal function, including its development, and then evaluate how well those theories work to explain abnormal behavior in that domain. The final section examines the implications of the previous chapters for our conception of the self. To help the reader with technical terminology, this book includes a Glossary. The first time a technical term is used, it appears in bold print. There are also two Appendices to help the reader. Appendix A lists regions of the human neocortex by their names and Brodmann numbers and briefly describes their functions. Appendix B provides a list of online resources to help the reader learn more about neuroanatomy, functional neuroimaging, brain connectivity, neural network modeling, and genetics.

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