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BOOK REVIEW: WHAT LIES BENEATH

Reviewed by William S. MacAllister

Leonard F. Koziol & Deborah E. Budding. (2009). *Subcortical structures and cognition: Implications for neuropsychological assessment*. New York: Springer, 405 pp. (ISBN 978-0-387-84866-2.) $129.00 (hbk).

Whether consciously or not, many neuropsychologists adopt a view that neuropsychological dysfunction stems primarily from cortical structures. Some may give lip service to the contributions of basal ganglia and cerebellar structures, but it is rare to see a neuropsychological report or journal article that truly recognizes the magnitude of importance played by subcortical structures. This book starts with the premise that most neuropsychologists adopt a "corticocentric" model when interpreting neuropsychological data, and seeks to demonstrate the fallibility of such a myopic approach. While prior books have discussed the subcortical contributions to specific cognitive domains such as language and memory (e.g., Crosson, 1992), this work takes a broader view, addressing all cognitive functions. Seldom has such a book generated so much buzz among neuropsychologists; this volume has been mentioned frequently on various neuropsychology list-serves, always in a positive light. Accordingly, I was eager to see it for myself and I am happy to report that it did not disappoint. Drs. Koziol and Budding have written a highly readable and thought-provoking book that will challenge the reader's current knowledge and help one to look beneath the surface. It is a must read for the serious-minded neuropsychologist and should be on the reading list for every neuropsychology graduate student.

As discussed in the preface, the book has a clearly defined goal to debunk the traditional view that subcortical structures are merely "co-processors of movement." Instead, the authors assert that the cortex and subcortical structures (including the basal ganglia and cerebellum) operate in parallel to generate behavior. To demonstrate this point the authors provide the reader with a practical understanding of these cortical–subcortical functional relationships. This is done by examining the neuroanatomical interconnections of these structures, providing evidence for these relations in known disorders, and applying this knowledge to

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neuropsychological tests and clinical cases. The introductory chapter provides a brief but compelling discussion of the brain's vertical organization, including a discussion of excitatory versus inhibitory circuits between the basal ganglia and cortex. It then culminates in the contention that the basal ganglia represent the brain's first executive system. What follows are dense, but obligatory descriptions of neural circuitry that illustrate the neuroanatomical underpinnings of the intimate relationship between cortex and subcortical structures.

Neuropsychologists with a strong interest in neuroanatomy and neural circuitry will be intrigued by the book as a whole—however, clinicians will find the later chapters particularly useful. Chapter 5, for example, provides a detailed review of cerebellar systems and the conditions known to affect these systems that are of particular relevance to pediatric neuropsychologists (e.g., preterm birth, agenesis of the corpus callosum, etc.). Due attention is paid to the cerebellar cognitive affective syndrome, which has received considerable attention in recent years (e.g., Schmahmann & Sherman, 1998). Chapter 6 highlights the importance of subcortical networks in social skill, judgment, and non-verbal communication, whereas chapter 7 discusses more "classic" disorders of the basal ganglia, including attention deficit/hyperactivity disorder (ADHD) and obsessive compulsive disorder, as well as the subcortical contributions to disorders more commonly considered diseases of the cortex (e.g., Alzheimer's disease). Chapters 8 and 9 discuss specific neuropsychological tests, highlighting how these tasks assess different frontostriatal circuitry, thereby explaining test findings that, on the surface, may seem contradictory (e.g., discordant scores on the Wisconsin Card Sorting Test and the Tower of London). The authors challenge the myth of the "frontal lobe" test, demonstrating how a given pattern of test results cannot reliably distinguish between lesions of the cortex, basal ganglia, or cerebellum. The final chapters present case examples, complete with clinical history and neuropsychological data, to illustrate these points.

The book appropriately balances theory and real-world applicability. What makes it so readable is the ability of the authors to summarize complex neuroanatomy and function in meaningful metaphors. For example, set loss errors on the Wisconsin Card Sort are described as occurring due a lack of pallidal inhibition on the thalamus, i.e., "'the bouncer' failed to 'throw out' or inhibit responses to distracting stimuli" (p. 55). The authors have also made a conscious effort to bridge the gap between structure/neuroanatomy, findings from other cognitive neurosciences (e.g., data from fMRI), and behaviors seen in the office including specific findings on neuropsychological tasks that tap these circuits. Using this approach the authors again identify several shortcomings of our tests, noting where the tools of the trade fail to appropriately assess given circuits.

There is some degree of redundancy across chapters, with later chapters revisiting material discussed previously—some readers may deem this unnecessary. On the plus side, however, this allows separate chapters to be more-or-less self-contained, not strictly building on prior material. This may be helpful for those disinclined to read the book cover-to-cover, opting instead delve into a specific chapter, perhaps relevant to a given patient in their practice. Others may find the dense descriptions of cortical/subcortical circuitry difficult to tackle. However, such material is a necessary evil in a volume with goals such as this. It is interesting to

ponder what the next generation of neuropsychologists will be like if this text becomes a standard in the neuropsychological training curriculum. Whereas most practicing neuropsychologists may have to "invert" their thinking when tackling this book, training the next generation of clinicians to appreciate the complementary interactions between cortex and subcortical structures from the start will eliminate many biases that may have served to impede progress in our understanding of brain–behavior relationships. Writing a book of this scope is a truly Herculean undertaking, and the authors should be applauded for the comprehensiveness of this work. If you'll pardon the pun, this book will assuredly give the reader a "deeper" understanding of the brain.

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