

Introduction

Neuropsychology for the 21st Century: Methodologic Advances

By Robert M. Bilder, PhD

Neuropsychology is undergoing revolutionary changes that are redrawing the boundaries of the field, altering its key clinical and scientific aims, and modifying the way these aims are accomplished. In this month's issue of *CNS Spectrums* (the first in a two-part series of issues) leading clinicians and researchers have codified some of these effects as they impact key territories, with a broad impact on both science and medicine involving the central nervous system. These papers emphasize current trends at the level of underlying methodologies, which have broad contextual influences on the field.

The first two papers describe major influences on neuropsychology from the adjacent fields of genetics and neuroimaging. Now that the rough draft of the human genome is in place, it is a matter of when—not if—the genetic contributions to major disorders of the central nervous system will be clear. Bates and Malhotra provide an overview of the remarkable progress being made in the identification of the genetic bases of major neurocognitive phenotypes. They summarize evidence showing not only the potent genetic contributions to general intellectual ability and multiple specific cognitive domains, but also to the heritability of some electrophysiologic correlates of cognitive processes, and the structural anatomic bases of these traits. It is clear that appreciation of both the heritable and complementary environmental contributions will soon have a major impact on both our understanding of functional systems in the brain and their disruption by various pathologies.

As we refine our appreciation of the boundaries on the heritability of these abilities, the identification of relevant phenotypes is proceeding at a rapid pace with the assistance of functional neuroimaging. Sadek and Hammeke provide an excellent summary of important methodologic issues, along with the strengths and weaknesses inherent in major modern approaches to functional imaging. They highlight the importance of experimental design issues that are crucial to the understanding of functional imaging results or in designing appropriate studies. Next, the authors provide a survey of the "state of the art" in functional neuroimaging as it has been applied to epilepsy, neurodegenerative disorders, traumatic brain injury, chronic pain, and psychiatric disorders. These neuroimaging studies are leading to a new era of investigation that integrates classical neuropsychology and lesion-based inferences with knowledge from cognitive neuroscience. These opportunities to use brain activity as the "dependent variable," influenced by cognitive manipulations, provide an exciting complement to the traditional neuropsychological approach in which brain lesions served as the independent variable, and we observed these effects on cognitive performance.

The next two articles focus on methodologic issues that are currently molding the science and practice of clinical neuropsychology. The maturity of a clinical discipline is often marked by the objectification of its measurement meth-

ods. William Barr highlights new developments in the assessment of neuropsychological change. This is essential to all investigations of treatment effects, appraisal of spontaneous recovery, and detecting cognitive deterioration or stability in the face of degenerative disease. Barr states that the field has moved beyond assessing statistical significance to questioning the clinical meaning of changes in test scores. He reviews key contributions to uncertainty in our inferences about change, highlighting the influences of test-retest reliability, prior exposure, practice effects, regression to the mean, and effects of initial test scores. He details two modern methods for evaluating change: (1) the reliable change index and (2) standardized regression based methods. Barr goes on to detail existing applications of these methods to comprehend the effects of epilepsy surgery and sports concussions, and potential applications in clinical trials of novel psychopharmacologic agents, where the appropriate deployment of these methods could yield important advantages.

Finally, Chris Randolph describes a range of emerging influences on neuropsychological assessment. He documents surprisingly low rates of referral for neuropsychological assessment, even in indications such as head injury where one might think referral would be a "no-brainer!" Randolph attributes this under-utilization to widely held impressions that neuropsychological testing is a long and tedious process that is burdensome to patients while often providing only limited additional information to the referral source. He delineates historical background leading to its current state. He also emphasizes significant developments, including the development of abbreviated assessment measures with improved psychometric properties, increased attention to the precision in measurement of profile characteristics, and discrepancies between scores. The author looks forward to the increased application of computerized neurocognitive assessments. This can provide more complete standardization and precision of stimulus delivery and response collection. Moreover, computers can dynamically manipulate the administration process, depending on how well the patient may be performing. The future holds further promise that on-line, dynamically updated databases will automatically provide the broadest possible basis for interpreting scores, considering demographic factors, treatments received, and prior or concurrent performance on other tests.

These articles describe a new neuropsychology: one that builds upon advances in basic science providing superior models of normal brain function and diseases; one that uses technology to maximize information yield in both clinical and research applications; one that is evolving toward more rational, evidence-based, and quantitative approaches to the description of neuropsychological abilities, their inter-relations within patients, and their changes over time as a function of illness and treatment. **CNS**

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