

**Introduction to the *JINS* Special Issue Commemorating the  
50th Anniversary of the International Neuropsychological Society**

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The International Neuropsychological Society is celebrating its 50<sup>th</sup> anniversary (1967-2017). Over the course of these fifty years, members of the society have made great strides in advancing our knowledge of the workings of the human brain both in health and in disease. For the past two decades, many of these advances have appeared in the society's flagship scientific outlet, the *Journal of the International Neuropsychological Society*. To commemorate the INS 50<sup>th</sup> anniversary, the two previous *JINS* editors, Igor Grant and Kathleen Haaland, joined the current editor, Stephen Rao, in organizing this special double issue of *JINS*. We have invited some of our leading senior investigators, most of whom have served in leadership positions in the INS, to write reviews in their areas of expertise. These reviews are designed to highlight scientific discoveries that have contributed to progress in the field of neuropsychology over the past 50 years. The authors were instructed to selectively discuss landmark discoveries that have had a lasting impact in advancing scientific knowledge rather than to provide comprehensive literature reviews. In addition, the authors were asked to provide their predictions regarding scientific directions of their field over the coming decade.

The papers reflect in a remarkable way the evolution of neuropsychology over the past 5 decades. There is a movement from viewing neurocognitive change from a static anatomic perspective to one that embraces the notion of functional connectivity within neural circuits, and considers how imbalances in circuitry crosstalk may be reflected in the kinds of processes that we neuropsychologists study — e.g., executive function; components of memory and attention; and so forth. The field of neuropsychology now interacts with technological advances in structural and functional brain imaging, electrophysiological methods, fluid biomarkers (e.g., cerebral spinal fluid), and genetics, to name a few. The increased emphasis on observational longitudinal designs has provided a more comprehensive understanding of the evolution of neuropsychological disorders. Finally, while neuropsychology has traditionally focused on assessment, each of these reviews also highlight advances made in the treatment of neuropsychological disorders.

We have organized this special issue into four sections: Brain Systems and Assessment, Neurological Disorders, Neuropsychiatric Disorders, and Pediatric Disorders. In the following sections of this introduction, we highlight some of the key take-home messages from these scholarly reviews. It is important to note that all of these invited reviews were peer reviewed and required multiple revisions prior to acceptance. Another caveat is that we do not pretend to have covered the entire scope of the scientific underpinnings of neuropsychology and we are sure that we have omitted several key research areas in our diverse field. Likewise, we recognize that only a small percentage of our thought leaders in neuropsychology were able to be invited to contribute to this special issue.

## Brain Systems and Assessment

In this section, Corballis emphasizes that *hemispheric asymmetry* exists in great apes as well as humans (though to a lesser extent in the former), is characterized by significant individual variability and complex genetic influences, and encompasses a broader range of functions and associated neural networks than initially thought before more recent neuroimaging studies.

McDonald emphasizes significant developments in our understanding of *emotion* including delineation of the neuroanatomical substrates for different aspects of emotion, the influence of emotion on cognitive processes and the clinical implications of emotion, which necessitates the need to directly examine emotion clinically using newly developed normative procedures.

Verfaellie and Keane discuss a shift toward a more nuanced understanding of the medial temporal lobes (MTL) in *human memory and amnesia* over the past 30 years. On the one hand, this body of evidence has highlighted that not all types of memory are impaired in patients with MTL lesions. On the other hand, this research has made apparent that the role of the MTL extends beyond the domain of long-term memory, to include working memory, perception, and future thinking.

Dronkers and Baldo emphasize that the study of *language* has had a major impact on our understanding of brain-behavior relationships. This paper highlights well known historical case studies with updates using structural MRI and functional imaging in group studies which show that language, like other complex cognitive processes, is dependent upon neural systems rather than single cortical loci.

Stuss and Burgess review how our knowledge of *prefrontal functions* in the context of neuropsychological assessment has been transformed over the last fifty years with key themes including development of theoretical frameworks that address the role of prefrontal systems in the organization of human cognition, the importance of naturalistic tests, the emerging integration of functional imaging into clinical practice, and how we might develop new ways to measure executive function to fill existing gaps.

Haaland, Dum, Mutha, Strick, and Troster, a multidisciplinary group of experts in *movement and movement disorders*, summarize the influence of animal and human studies in showing that the corticospinal tract includes projections from multiple premotor regions as well as the motor cortex, that cognition strongly impacts even what appear to be simple motor skills, and that differential connectivity among cortical, cerebellar and striatal regions influences normal movement and impairment with movement disorders and cortical lesions.

Casaletto and Heaton identify historical pioneers and their approaches to *neuropsychological assessment* as well as factors that have influenced neuropsychological interpretation (e.g., normative standards, cultural considerations, quantifying longitudinal change). They also emphasize the importance of enhancing ecological validity and ways that technological advances have impacted assessment.

## **Neurological Disorders**

Hermann, Loring, and Wilson discuss five major paradigm shifts that have occurred within the neuropsychology of *epilepsy*, including departure from syndrome-specific pathophysiology, bidirectional comorbidities, quality of life, surgical outcomes,

and iatrogenic treatment effects. Unlike most other disorders evaluated by neuropsychologists, surgical interventions have played an important role. This review focuses on the neuropsychological consequences of different surgical interventions and the re-emergence of EEG as an important research tool for probing cognitive dysfunction.

Yeates, Levin, and Ponsford highlight progress made through studies of *traumatic brain injury* in adults and children. The paper focuses on contributions of advances in neuroimaging in characterizing the pathophysiology of TBI, the impact of non-injury factors on outcomes (pre-morbid factors), and medical and non-medical interventions to improve outcomes.

Bondi, Edmonds, and Salmon survey historical advances in *Alzheimer's disease*, beginning with studies profiling the neuropsychological deficits associated with AD and its differentiation from other dementias, identification of specific cognitive mechanisms affected by neuropathological substrates, the shift in focus to the study of prodromal stages of neurodegenerative disease (Mild Cognitive Impairment), and the rise of imaging and other biomarkers to characterize preclinical disease prior to the development of significant cognitive decline.

Benedict, DeLuca, Enzinger, Geurts, Krupp, and Rao highlight advances made in the areas of neuropathology, neuroimaging, diagnosis, and treatment that pertain to the neuropsychological aspects of *multiple sclerosis*. This review focuses on the discovery that MS produces pathological lesions of gray matter that have consequences for cognitive functions, the use of multimodal imaging that integrates structural and functional imaging methods to better understand cognitive test performance and

functional reserve, screening and comprehensive assessment of cognitive disorders including pediatric MS, and outcome studies in cognitive rehabilitation.

### **Neuropsychiatric Disorders**

Sullivan shows us how early careful observations of neuropsychological patterns in *alcoholism* led to modern neuroimaging confirmations and deepening understanding not only of the structural neuroanatomy underlying alcoholism, but also to new appreciation of functional connectivity disruptions. Ongoing studies now hope to relate such functional connectivity changes not only to specific cognitive profiles but also to related deficits in self-regulation, impulse control, and reward processing that are linked to such neurocognitive deficits.

Saloner and Cysique summarize the progress from earliest reports of neurocognitive changes, first reported in 1987, to the delineation of the specific syndromes of *HIV* associated neurocognitive disorders (HAND). The authors demonstrate that neuropsychology has led the way in appreciating that the brain continues to be affected by the HIV process despite good control of virus by modern antiretroviral treatments; and they note that the consequences of these persisting mild cognitive disorders include disturbance in quality of life and everyday functioning in those affected by HIV.

Waters and Mayberg present *depression* as a failure in the coordination of distributed frontal networks, and discuss how differential functional brain responses to different therapies, e.g., pharmacotherapy vs. cognitive behavioral therapy (CBT), provide for a better understanding of the component elements of depression. They

suggest that increases in adaptive functionality of dorsal frontal networks controlling attention and executive function may be specifically targeted by CBT, whereas antidepressant drugs may reduce the hyper-reactivity of ventral corticolimbic structures.

Seidman and Mirsky note that the view of *schizophrenia* has shifted from one of “functional psychosis” (i.e., with no known brain substrate) to that of a neurodevelopmental disorder. Neuropsychological deficits, once viewed as the result of psychosis, are now thought to be a prodrome of the disorder, since they are found many years before the onset of symptoms and occur in biological relatives who never develop psychosis. They note a steady increase in convergence of neuropsychological, structural and functional brain mapping toward understanding of the neurodevelopmental events that lead to these symptoms, such as perinatal insults, abnormal neural network organization, faulty pruning, and genetic alterations.

Gonzalez, Pacheco-Colón, Duperrouzel, and Hawes address progress in the field of *cannabis use* which was just being born 50 years ago when the INS was founded. The earliest reports were a few experimental cognitive studies and case reports. Now, there is a vast neuropsychological literature and, as with studies on alcoholism and depression, an increased emphasis on structural functional brain correlates and their relation to neurodevelopmental outcomes. While they note that evidence for persisting adverse effects of moderate marijuana use by adults is inconclusive, there is increasing concern that marijuana may not be so benign in children, adolescents, and extremely heavy cannabis users.

## **Pediatric Disorders**

Fein and Helt indicate that the pace of research in *autism* has accelerated moving from an initial focus on behavior and cognition to advances associated with the incorporation of imaging and genetics. Despite these recent advances, a coherent picture of the syndrome at either a phenotypic or biological level has not emerged. They provide a roadmap for future progress, in which studies include individuals defined by social impairment without regard to repetitive behaviors in order to form narrowly defined subtypes, focus on characteristics that are less influenced by environmental factors, study children as early as possible thereby minimizing environmental influence, emphasize the longitudinal course, examine the relationship between specific subtypes and environmental risk factors, distinguish between what participants can do and what they typically do, and aggregate large data sets across sites.

Mahone and Denckla review the key literature pertaining to the neuropsychology of *Attention-Deficit Hyperactivity Disorder (ADHD)* over the past 35 years. These include the evolution of the diagnosis, influential theories, landmark treatment studies, and advances in brain mapping techniques, including anatomic, task activation and resting state fMRI, and diffusion tensor imaging. Challenges associated with studying and treating a heterogeneous neurodevelopmental disorder like ADHD are described, along with an emphasis on associated disorders and conditions and special populations.

Fletcher and Grigorenko make the case that experimental trials of interventions focused on improving academic skills and addressing comorbid conditions are most effective for diagnosing and treating *learning disabilities* with a particular focus on reading disability. They conclude that neuropsychological assessment needs to move



away from a focus on delineation of cognitive skills toward performance-based assessments of academic achievement and comorbid conditions, along with intervention responses that lead directly to evidence-based treatment plans. Finally, they emphasize that the path to further understanding learning disabilities will be strongly influenced by interdisciplinary research that includes the neuropsychologist and links data from cognitive neuroscience with assessment and treatment of these disorders.

Upon reflection of the articles contained within this special issue, we believe members of the INS will be proud of the many scientific accomplishments that have occurred over the past 50 years of our society's existence. We are also assured that the future will see even greater scientific innovation in the field of neuropsychology. We think you will agree.

On a closing sad note, Larry Seidman, an Associate Editor of *JINS* and a co-author of the review on schizophrenia in this special issue, died unexpectedly in September, 2017. We will miss this valued friend and colleague, who has made such important discoveries in the neuropsychology of mental health research.