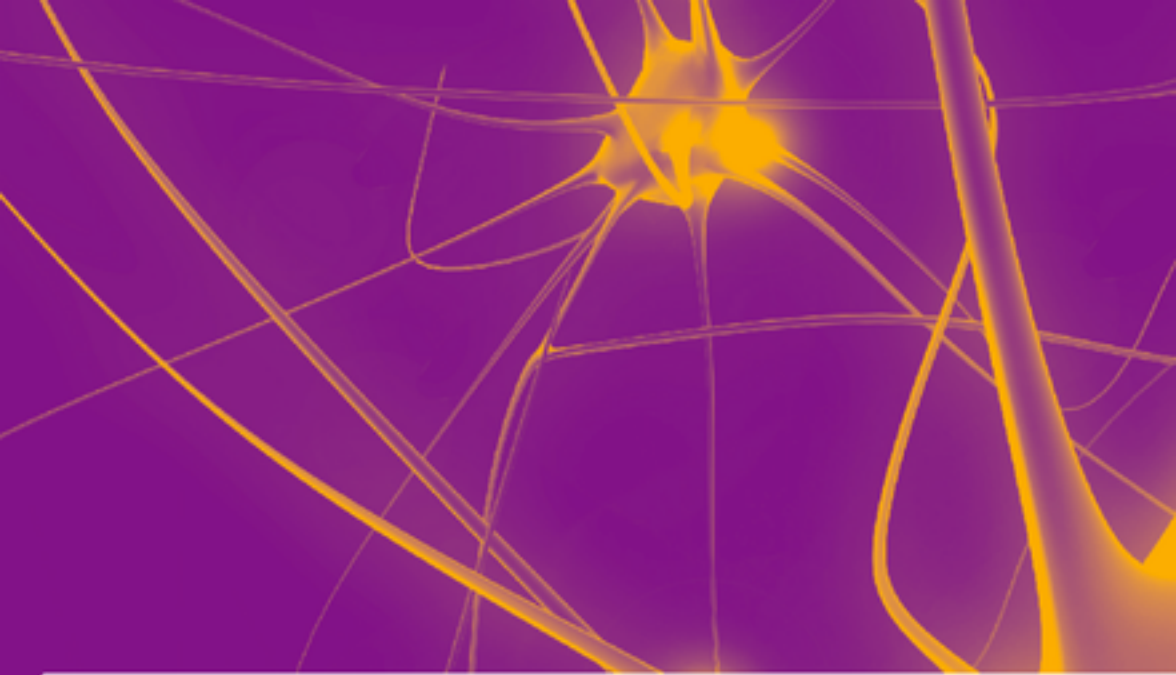




Neuropsychological Assessment in the Age of Evidence-Based Practice

Diagnostic and Treatment Evaluations

Edited by

STEPHEN C. BOWDEN



Series on
Evidence-Based
Practices

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Neuropsychological Assessment in the Age of Evidence-Based Practice

National Academy of Neuropsychology Series on Evidence-Based Practices

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*This book is dedicated to my four inspirations—Sylvia, Robyn, Jenny, and Claire.
And to the memory of Fiona J. Bardenhagen, PhD, who introduced me to
evidence-based practice.*

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Preface to the *National Academy of Neuropsychology Series on Evidence-Based Practices*

The field of clinical neuropsychology has advanced extensively and successfully in the worlds of psychology and neurology by following two major tenets. The first has been the constant focus on exploring and understanding the complex and intricate relationship between observed behavioral function and brain structure (and, of course, changes to that structure). From early observation of the relationship between injury and behavior to today's combination of psychometric testing, cognitive neuroscience, and structural and functional neuroimaging techniques, this focus has served the field extremely well. The second has been the rigorous adherence to careful, replicable scientific principles of questioning and theorizing, data collection, and use of sophisticated statistical analysis in testing, evaluating, and interpreting information about brain-behavior relationships. More than ever, this has been backed by greater and greater reliance on an evidence-based approach. It is in the spirit of this strong foundation of empirical evidence aimed at improving the quality of informed clinical decision making that the National Academy of Neuropsychology Series on Evidenced-Based Practices developed and continues.

For a significant amount of time, members of the neuropsychology community and, in particular, the membership of the National Academy of Neuropsychology (NAN) had voiced a desire for the development and availability of thorough and accurate resources that are directly applicable to the everyday needs and demands of clinical neuropsychology in a meaningful and accessible way, but provide the latest knowledge based on the most recent and rigorous scientific evidence within the field. The *National Academy of Neuropsychology Series on Evidence Based Practices* is meant to provide just such a series of resources.

At the Series' inception, it was important to first identify an excellent publisher with a history of publishing significant psychological and scientific volumes who would share this vision and provide significant support for a quality product. After lengthy research and discussions with multiple publishers, the venerable Oxford University Press (OUP), one of the most renowned and respected publishing companies in existence, was selected by the NAN Board of Directors. For their part, OUP has committed to the long-term development and support of

the NAN Series and, as can be seen in the pages herein, has spared no effort or expense to provide the finest-quality venue for the success of the Series.

The Series is designed to be a dynamic and ever-growing set of resources for the science-based clinical neuropsychologist. As such, the volumes are intended to individually focus on specific, significant areas of neuropsychological inquiry in depth, and together over time to cover the majority of the contemporary and broad clinical areas of neuropsychology. This is a challenging endeavor, and one which relies on the foremost experts in the neuropsychological field to provide their insight, knowledge, and interpretation of the empirically supported evidence within each focused topic. It is our hope that the reader recognizes the many established scholars from our field who have taken on the task of volume editor and/or chapter author.

While each volume is intended to provide an exhaustive review of its particular topic, there are numerous constants across the volumes. Importantly, each volume editor and respective chapter authors have committed to constraining themselves to providing only evidence-based information that meets that definition. Second, each volume maintains a broad consistency in format, including an introductory chapter outlining the volume, and a final discussion chapter summarizing the state of the art within that topic area. Each volume provides a comprehensive index, and each chapter provides relevant references for the reader. Third, each volume is designed to provide information that is directly and readily usable, in both content and format, to the clinical neuropsychologist in everyday practice. As such, each volume and chapter within the volume is obliged to provide information in such a way as to make it accessible as a “pull off the shelf” resource. Finally, each volume is designed to work within a pedagogical strategy such that it educates and informs the knowledgeable neuropsychologist, giving a greater understanding of each particular volume focus, and provides meaningful (read “useful”) information geared towards enhancing her/his empirical practice of neuropsychology. In keeping with the educational focus of the Series, a unique aspect is a collaboration of the Series contributors and the NAN Continuing Education Committee such that each series volume is available to be used as a formal continuing education text via the Continuing Education Units system of NAN.

It is my hope, and the hope of the consulting editors who provide their time, expertise, and guidance in the development of the NAN Series, that this will become an oft-used and ever-expanding set of efficient and efficacious resources for the clinical neuropsychologist and others working with the plethora of persons with brain disorders and dysfunction.

L. Stephen Miller
Editor-in-Chief

*National Academy of Neuropsychology
Series on Evidence-Based Practices*

Preface to the Fourth Volume in the *National Academy of Neuropsychology Series on Evidence-Based Practices*

An edited volume devoted to the contemporary as well as the aspirational understanding of neuropsychological test methods as a way to inform and direct the practitioner's selection, evaluation, use, and interpretation of assessment tools might be seen as a daunting task. In truth, it is a difficult undertaking, but one that is so very important to our field, that NAN and the editors of this ongoing Series felt it was worth the challenge. The field of neuropsychology has maintained a long history of following best practices of test psychometrics and using that knowledge in the design and interpretation of assessment tools, and has been a leader in the larger field of clinical assessment. However, advances in our analysis of the influence of test-associated factors on our test results has provided opportunities for much greater rigor and precision in the use of these clinical tools. This opportunity comes with a responsibility to expand our skills and understanding of the ways in which we evaluate the reliability and validity of our tools, their sensitivity and specificity as related to our clients, and the best ways in which to present and use this information for the betterment of our clients. This results in a need to develop these skills as new advances occur.

Even within the ranks of psychometric-savvy neuropsychologists, however, there remains a gap between the current state of recognized best practices in assessment-tool evaluation and the everyday use of these practices within those same ranks, and in applying that information to those everyday practices with the clients seen. Much of this can be found to be the result of few, if any, approachable and readable materials to help in the understanding of these best evaluation practices, combined with the intimidating prospect of learning new statistical methods. Hence, the thrust of this volume and its main objectives are the presentation of the current state-of-the-art best evaluation practices in neuropsychological assessment, directly addressing the major issues and skills needed to appropriately integrate statistical best practices into our understanding and evaluation of our assessment tools, and real-world examples on how to do so.

Here, in this fourth volume of the *National Academy of Neuropsychology's Series on Evidence-Based Practices—Neuropsychological Assessment in the Era of Evidence-Based Practice: Diagnostic and Treatment Evaluations*—Dr. Stephen

C. Bowden has taken on the formidable task of assembling international experts across a diverse landscape of the most important issues associated with a best-practices approach that is truly evidence-based, yet provides methods applicable to the real world of the practicing clinical neuropsychologist. This important volume provides an empirically derived set of methods to evaluate our measures, from selection to use through interpretation, that can and should be adopted at the individual-patient level. This will inform researchers and practitioners alike, and make available the latest science examining these relationships.

Dr. Bowden is Professor of Psychology at the Melbourne School of Psychological Sciences in Melbourne, Australia. He is a member of NAN and a Fellow of the Australian Psychological Society. He is also Co-Editor-in-Chief of the prestigious journal *Neuropsychology Review*. Dr. Bowden is a prolific researcher of neuropsychological methodology and evaluation, receiving multiple extramural grants and publishing in the best journals of our field. He has been a standard-bearer in advocating for greater evidence-based support for the tools we use, has been a leader in the development of critically appraised topics (CATs) in neuropsychology, and has written extensively on a host of issues concerning the reliability, validity, and interpretability of tests and test findings. Additionally, as an academic full professor, he has a long history of teaching complex neuropsychological and statistical theory. Thus, he is the perfect choice for providing this platform for evidence-based methods of neuropsychological practice.

This volume covers the major thematic issues in evidence-based neuropsychological assessment, including evaluation of the quality of test research, current approaches to understanding assessment tools, evaluating reliability and validity specific to neuropsychological tests, and even what we mean by “evidence-based neuropsychological practice.” Additionally, the great group of chapter authors provides specific skills and knowledge of critical areas to consider, including test-reliability levels, test-score change criteria, neuroimaging data, and evaluating performance validity tests. Importantly, these chapters all aim to provide this information in practical and approachable methods, with practical and concrete examples throughout.

As with the earlier volumes in the NAN Series, this volume is aimed primarily at neuropsychologists, but it should also be useful to a multitude of professionals who are interested in understanding how issues of reliability and validity, and their evaluation and interpretation, influence what we can and cannot say about our neuropsychological data. It is my hope that this volume provides the much-needed base on which all empirically driven neuropsychologists can rely.

L. Stephen Miller
Editor-in-Chief

National Academy of Neuropsychology
Series on Evidence-Based Practices

Editor's Preface

Welcome to *Neuropsychological Assessment in the Age of Evidence-Based Practice: Diagnostic and Treatment Evaluations*. With heartfelt thanks to the excellent group of contributing authors herein, and the support of the National Academy of Neuropsychology for allowing a work of this type to be brought to fruition, I hope that this volume will provide a welcome and timely addition for clinical neuropsychologists. Appropriate methods of evidence-based neuropsychology practice can provide skills that are critically needed and easily learned, and provide information of direct relevance to clinical decisions, yet these have not always been readily available for clinicians. This volume is meant to help fill this void.

In this volume, two key elements of evidence-based practice that facilitate clear thinking about the validity of clinical judgements are emphasized. Firstly, learning to understand the most important elements of research design so as to quickly identify published research studies of high quality, and avoid over-reliance on studies of low quality. Secondly, developing a better understanding of the rules of evidence, so that statistically significant research findings derived from higher-quality studies can be turned into patient-relevant information.

The contributing authors and I have worked to insure that these methods of evidence-based assessment are clearly described for neuropsychologists. The key elements of research design are described, including the relevance of study design, reporting guidelines, and methods of critical appraisal. The aim is to provide everything necessary for a clinician to understand how to identify and evaluate high-quality scientific research methods, how to incorporate this evaluation into our everyday practice, how to communicate the relevance of study results to our work with patients, and how to do this in an approachable and user-friendly manner.

Although the concept of evidence-based practice is familiar to many clinical neuropsychologists, the term has nevertheless gained many meanings. For some clinicians, the term evidence-based practice refers to little more than the practice of consulting the literature on a regular basis to ensure that there are statistically significant research findings supporting established or newer assessment or intervention techniques. Or clinicians consider that they are engaging in evidence-based practice by generating statistically significant research findings.

However, as several authors in this volume show, evidence-based practice conveys much more meaning than a general scientific disposition to clinical practice. Instead, evidence-based practice enables a clinician to subject published research, and established or authoritative opinion, to careful scrutiny to discern the scientific rigor and practical value for any aspect of clinical activity. Clinicians adopting the methods of evidence-based practice described in this volume, can be confident that they are adopting methods that are subject to some of the most rigorous peer-review and widely-debated scientific evaluation in the history of health-care.

I would like to extend my appreciation to Joan Bossert at Oxford University Press for her continuing support of this series, and to the National Academy of Neuropsychology book series committee of Steve Miller, Glenn Larrabee, and Martin Rohling for their invitation and assistance with the production of this volume. A particular word of thanks goes to Steve Miller for his sustained support and advocacy throughout the compilation of this volume. I thank Lib Yin Wong and Simon J. Scalzo for assistance with manuscript preparation. Finally, I would like to thank the many graduate students and colleagues who have helped me better understand evidence-based practice. I hope this volume will prove a useful addition to any clinician's skill-set.

Sincerely,
Stephen C. Bowden
Editor

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Neuropsychological Assessment in the Age of Evidence-Based Practice

Why Do We Need Evidence-Based Neuropsychological Practice?

STEPHEN C. BOWDEN

Paul Meehl argued that knowledge gained through clinical experience in professional practice was inevitably a mixture of truths, half-truths, and myth (Meehl, 1997). The possibility that learning through clinical experience gives rise to knowledge that is not valid, or is based on myth, creates challenges for any discipline that claims scientific credentials. These challenges have an impact on educational practices, the development of scientific thinking in graduate students, and on methods of professional development for mature professionals. As is well known, scientifically unfounded practices have been described throughout the history of clinical psychology, including the use of tests without established validity and reliance on clinical decision-making methods that preclude scientific evaluation (Garb, 1988; Wood, Nezworski, Lilienfeld, & Garb, 2003). And clinical neuropsychology is not free from a history of myth, mostly arising from a neglect of scientific methods. Instead, we need methods that allow students, young professionals, and mature professionals alike to identify clinical knowledge that is based on good evidence and so limit the potentially misleading effects of unscientific thinking. Unscientific thinking risks wasting patients' time, misusing scarce health-care resources, and may be potentially harmful (Chelmsford Royal Commission, 1990; Wood et al., 2003).

As Meehl (1997) argued, scientific methods are the only way to distinguish valid clinical knowledge from myth. Many older professional colleagues were trained in an era when scientific methods for the refinement of professional knowledge were less well taught. As a consequence, many colleagues developed their approach to professional practice in an era when scientific methods to guide clinical practice were less valued or less accessible (Grove & Meehl, 1996; Lilienfeld, Ritschel, Lynn, Cautin, & Latzman, 2013; Wood et al., 2003). One effect of the less rigorous scientific training in the past has been to encourage clinicians to believe that a reliance on "clinical experience" is a valid source of knowledge, without the need for explicit evaluation of knowledge claims (Arkes,

1981; Garb, 2005; Meehl, 1973). Younger colleagues trained in clinical neuropsychology at the present time, and critically, older colleagues who choose to engage in effective professional development, have access to scientific methods to refine clinical thinking that were relatively little known just two to three decades ago. Using resources that are readily available on the Internet, professionals of any age can train in methods for the scientific evaluation of clinical knowledge that are widely adopted across health care disciplines (see www.cebm.net/; www.equator-network.org/). These are the methods of evidence-based practice (see Chelune, this volume).

In fact, methods of evidence-based practice are not new, but they have often been neglected (Faust, 2012; Garb, 2005; Lilienfeld et al., 2013; Meehl, 1973). The methods provide a refinement of scientific thinking that has been at the center of scientific psychology for many years (Matarazzo, 1990; Meehl & Rosen, 1955; Paul, 2007; Schoenberg & Scott, 2011; Strauss & Smith, 2009). However, in contrast to many conventional approaches to evaluating validity in psychology, the methods of evidence-based practice provide skills that are quickly learned, easily retained if practiced (Coomarasamy, Taylor, & Khan, 2003), and provide information of more direct relevance to clinical decisions than the broad principles of test validity and research methods typically taught to most graduate psychologists. While good research-methods training is critical for development of the scientific foundations of practice, evidence-based practice builds on, and brings into sharp clinical focus, the relevance of a strong foundation of scientific education. As Shlonsky and Gibbs (2004) have observed, “Evidence-based practitioners may be able to integrate research into their daily practice as never before” (p. 152). Ironically, however, “evidence-based practice” is in danger of becoming a catchphrase for anything that is done with clients that can somehow be linked to an empirical study, regardless of the quality of the study or its theoretical rationale, any competing evidence, or consideration of clients’ needs (Shlonsky & Gibbs, 2004, p. 137).

CLINICAL VALIDITY HAS MANY LEVELS OF QUALITY

The two key elements of evidence-based practice that facilitate clear-thinking about the validity of clinical judgements are (i) understanding the most important elements of *research design* to quickly identify published research studies of higher quality, so avoiding over-reliance on studies of lower quality, and (ii) understanding *rules of evidence*, so that statistically significant research findings derived from higher-quality studies can be turned into patient-relevant information (Sackett, 1995; Straus, Richardson, Glasziou, & Haynes, 2011). These methods of evidence-based practice are described for neuropsychologists throughout this volume and show that “validity” is not an all-or-none condition, but varies widely across a range of quality (Gates & March, 2016). Key elements of research design are described in the chapters that explain the relevance of study design and reporting guidelines and ways to grade the quality of methods used in any particular study (see chapters by Chelune and Schoenberg, this volume). Rules of

evidence are described in detail in chapters by Berry and Miller, where methods of critical appraisal are illustrated. The methods of critical appraisal are designed to allow practitioners to quickly evaluate the quality in a published study and so to grade the level of validity from weaker to stronger (www.cebm.net/; www.equator-network.org/). As these chapters show, it is not necessary to be an active researcher to be a sophisticated consumer of research and a provider of high-quality evidence-based practice (Straus et al., 2011). Rather, a clinician needs to understand how to identify high-quality scientific research methods and how to communicate the relevance of study results to patients. The latter techniques are facilitated by the methods of critical appraisal described by Berry and Miller herein.

As Meehl (1997) also argued, the adoption of careful scientific scrutiny to guide clinical practice is not merely the best way to refine scientific understanding, but is also a fundamental ethical stance. We owe our patients accurate guidance regarding which of our practices rest on good evidence and which of our practices rely on less certain evidence or unfounded belief (Barlow, 2004). The American Psychological Association Ethical Principles and the Standards for Psychological Testing and Assessment require that clinicians undertake treatment and assessment practices that are founded on scientific evidence (American Educational Research Association, American Psychological Association, & the National Council on Measurement in Education, 2014; American Psychological Association, 2010). By extension, the ethical guidelines also require clinicians to be explicitly cautious when practices sought by a patient, or offered by a clinician, exceed the limits of our scientific knowledge, that is, lack strong scientific support. The methods of evidence-based practice provide some of the most time-efficient techniques to identify practices based on strong evidence and to help identify when assessment or treatment practices exceed the limits of knowledge based on well-designed studies. When supportive evidence from a well-designed study cannot be found, then a clinician is obliged to infer that the assessment or treatment practice does not rest on quality evidence and may be of uncertain value.

CLINICAL EXPERIENCE IS NOT ENOUGH TO GUIDE SCIENTIFIC PRACTICE

Two to three decades ago, it was uncommon to criticize expertise based on authority or clinical experience (Fowler & Matarazzo, 1989; Isaacs & Fitzgerald, 1999; Russell, 2012). Readers familiar with the history of debate in clinical decision-making will appreciate that the discussion of methods underlying evidence-based practice reiterates the historical transition from a reliance on *clinical experience* as the preeminent criterion of professional wisdom (Garb, 2005; Lezak, 1976; Matarazzo, 1990; Walsh, 1985) to, instead, placing greater reliance on more objective knowledge derived from well-designed studies in clinical psychology and clinical neuropsychology (Arkes, 1981; Barlow, 2004; Einhorn, 1986; Fowler & Matarazzo, 1989; Grove & Meehl, 1996; Paul, 2007). The same

conclusions regarding the concerns with over-reliance on clinical experience or experiential learning as the arbiter of judgement validity has been widely discussed in the broader human decision-making literature (Brehmer, 1980; Garb, 2005; Shanteau, 1992). For a succinct and humorous analysis of how to ignore the lessons of decision-making research, the reader is directed to David Faust's satirical account of how *not* to be a scientific practitioner (Faust, 1986). One of Faust's many recommendations to ensure that graduate students and young clinicians *do not* become scientific in their thinking is to keep them ignorant of the decision-making literature that highlights the greater fallibility of subjective, intuitive clinical thinking versus the less fallible effects of greater reliance on objective, research-based thinking (Brehmer, 1980; Garb, 2005; Grove & Meehl, 1996).

Sackett's (1995) description of the implementation of evidence-based medicine *at the bedside* outlines many of the changes in clinical thinking that parallel the changes in clinical psychology and clinical neuropsychology regarding the uncertain value of learning by experience. Sackett (1995) argued that traditional approaches to clinical expertise assumed that extensive exposure to patients, together with thorough training in the nature of clinical conditions, was both *necessary* and *sufficient* for valid professional practice. These approaches are readily evident in older, and even some contemporary, textbooks on neuropsychological practice. Instead, Sackett argued that exposure to patients, and their clinical presentations, is necessary for good clinical skills but is also, at times, highly misleading (Faust, 2007; Meehl, 1973). For example, an accurate perspective on *abnormality* (clinical conditions) also requires an accurate and comprehensive understanding of *normality*, including the relevant control statistics.

In the language of psychological criterion-related validity or evidence-based diagnostic validity (see chapters by Bunnage and Riley, this volume), it is not sufficient, for example, to know the diagnostic *sensitivity* of a test (the extent to which the test correctly identifies people with the condition of interest) to know whether the test is a useful diagnostic aid. A clinician must also know the diagnostic *specificity* (the extent to which the test correctly identifies people without the condition of interest (for a detailed description of these diagnostic validity terms, see chapters by Bunnage and Berry, this volume). Having established that a test has useful sensitivity and specificity, a clinician then needs to determine whether the sensitivity and specificity provide useful information across the range of base-rates in the populations to which the test will be applied (Baldessarini, Finklestein, & Arana, 1983; Wood, Garb, & Nezworski, 2007). Perhaps the most common error in the interpretation of valid test scores is to ignore the impact that base-rates have, potentially turning a valid test into a source of misleading information, either at low or high base-rates (Bunnage, this volume; Larrabee, 2011). As noted, contemporary ethical guidelines require that we only use assessment or intervention techniques that have been shown to have useful validity (American Educational Research Association et al., 2014; Kaufman, 1994). Therefore, it is arguably unethical to rely on clinical knowledge gained from experience alone.

Similarly, to identify a new clinical condition, it is not sufficient to provide a detailed clinical case description. It is also necessary to show that the condition is associated with clinical or pathological manifestations that have high sensitivity and specificity in relation to the relevant control population (e.g., Davison & Lazarus, 2007; Devinsky, 2009). Turning to treatment and interventions, the fields of clinical psychology and clinical neuropsychology have accepted for many years that it is not sufficient to show that a treatment is beneficial by only describing anecdotes of single cases that appeared to benefit from the treatment (e.g., Barlow, 2004; Paul, 2007). Instead, to establish that a treatment works, it is necessary to show that the treatment leads to statistically significant and *worthwhile* clinical effects under carefully controlled experimental conditions involving either replicated, randomized controlled trials, replicated observational (cohort) studies, or multiple-baseline, single-case experiments, at a minimum (Barlow, 2004; Paul, 2007; Straus et al., 2011).

Many of the same principles of evidence-based practice were anticipated by earlier accounts of high-quality clinical research in psychology and the logical and information-gathering steps necessary to turn that research into patient-relevant decisions (Meehl, 1973; Paul, 2007). For example, Meehl's (1973) approach to clinical thinking anticipates many of the elements of what we now term "evidence-based practice," well described in his chapter entitled "Why I Do Not Attend Case Conferences" (Meehl, 1973). In that chapter, Meehl highlighted the low standards of scientific thinking evident in some clinical case conferences. Instead, Meehl highlighted the importance of good theory (see Riley and Lee chapters, this volume), careful measurement of theoretically justified clinical constructs (see chapter by Jewsbury and Bowden in this volume), with attention to the reliability properties of relevant test scores and other data used for clinical decision-making (see chapter by Bowden and Finch), and attention to Bayesian inference in diagnostic decisions (see chapters by Berry, Bunnage, and Chelune).

IMPROVING ON THE SCIENTIST-PRACTITIONER MODEL

In line with the recommendations of earlier advocates of high scientific standards (Barlow, 2004; Faust, 1986; Garb, 1988; Meehl, 1973; Paul, 2007; Russell, 2012), evidence-based practice involves three explicit steps not usually evident in descriptions of the widely embraced scientist-practitioner model (for review see Groth-Marnat, 2009). Firstly, evidence-based practice scrutinizes the method quality of published studies to determine the strength of their scientific inference and the risks of bias that may overestimate the importance of the reported findings. Secondly, evidence-based practice encourages re-examination of reported statistical results in any published study to verify the accuracy of reporting and the patient-relevance of statistical findings. Third, evidence-based practice encourages consideration of patient circumstances and careful integration of any important research findings with patient preferences and circumstances (Straus et al., 2011). Methods of evidence-based practice outlined in this

volume encourage clinicians to take a rigorous approach to the evaluation of research findings as well as patient circumstances and preferences. Perhaps the most important element of the evidence-based approach is the overt strategy of not taking a study author's interpretation of the importance of study results at face value, but reevaluating reported results for patient relevance (see chapters by Berry, Chelune, Miller, and Schoenberg in this volume).

As noted above, a prominent feature of the evidence-based approach is the reduced emphasis on subjective clinical opinion (Garb, 1998; Straus et al., 2011). This view is not the same as saying the clinical experience has no value. Rather, experiential learning can be informative under certain circumstances, but can also be misleading because many unsuspected biases can influence the way we learn through experience (Brehmer, 1980; Davison & Lazarus, 2007; Einhorn, 1986; Faust, 1986; Garb, 1998). Instead, in a scientifically rigorous profession, insights derived from experience usually need to be subjected to careful scientific scrutiny and verification before assuming that any particular clinical insights are valid (Davison & Lazarus, 2007; Faust, 2012; Garb, 1998). Contemporary students of neuropsychology may not appreciate how dramatic a shift has occurred in the status of clinical experience as a source of knowledge and authority over recent decades.

Haynes, Devereaux, and Guyatt (2002) provide an excellent description of how our understating of expertise has changed. Expertise is no longer thought to be a function of the accumulation of knowledge derived from the scientifically fraught activity of experiential learning. Rather, expertise is now described in terms of the respective practitioner's knowledge of quality evidence derived from well-designed studies, together with an ability to interpret that knowledge in terms of the rules of evidence and patient acceptability (Haynes et al., 2002).

THE PROBLEM OF OVER-RELIANCE ON CLINICAL EXPERIENCE

For many years, neuropsychologists were taught that once a patient was diagnosed with Korsakoff syndrome, then the patient would have the disability associated with the severe amnesia for the rest of his or her life (Butters & Cermak, 1980). Korsakoff syndrome is a severe post-acute phase of Wernicke-Korsakoff syndrome attributable to thiamine deficiency, but most often seen in association with alcohol-use disorders (Bowden, 1990, 2010; Scalzo, Bowden, Ambrose, Whelan, & Cook, 2015). For most of the last century, the prevailing view was that, once acquired, Korsakoff syndrome "usually persisted indefinitely" (*Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* [DSM-IV-TR]; American Psychiatric Association, 2000, p. 178). No amount of clinical experience in tertiary hospital settings dissuaded clinicians from that view. As a graduate student, this author saw a steady trickle of patients with Korsakoff syndrome with severe amnesia and, on the advice of his teachers, advised these patients and their carers that the condition was permanent. We now know that this view is unnecessarily pessimistic, a product of what the Cohens described as the *clinician's illusion* (Cohen & Cohen, 1984), namely, a view of the clinical

characteristics or course of a disorder that is inaccurate, arising from biased sampling of people with the condition. Clinical experience in an academic, tertiary, clinical neuroscience setting was not corrective, and the current author might have spent the rest of his career perpetuating this incorrect view of the chronic course of Wernicke-Korsakoff syndrome and nothing about the repeated exposure to the occasional patient with acute or post-acute symptoms of severe Wernicke-Korsakoff syndrome would have altered that view.

However, this author chose to undertake research on Wernicke-Korsakoff syndrome in a state hospital for long-term care of patients with alcohol use disorders. With a conscientious staff and access to medical records on many clients stretching back several decades, a different view of the chronic course of Wernicke-Korsakoff syndrome became apparent. Medical and nursing staff drew my attention to patients who had been admitted on previous occasions, sometimes years earlier, with “classic” severe, acute-onset Wernicke’s encephalopathy followed by a severe, chronic Korsakoff’s syndrome who had subsequently recovered to some extent, sometimes apparently showing nearly full or full recovery in cognitive function and resumption of independent living. Perusal of medical files showed that many patients had experienced repeated episodes of WKS with partial or substantial recovery, sometimes with repeated episodes and recovery between the episodes, a view now commonly held (Bowden, 1990; Bowden & Ritter, 2005; Bowden & Scalzo, 2016; Kim et al., 2010; Victor, 1994; Victor, Adams, & Collins, 1971).

The revision in my thinking about Wernicke-Korsakoff syndrome is an illustration of one of the specific *but limited* benefits of descriptive single-case studies or clinical experience (Davison & Lazarus, 2007), namely, that observation of only one patient who showed recovery from severe Korsakoff’s amnesia challenged the conventional view that all patients with Korsakoff’s amnesia had a permanent amnesia (American Psychiatric Association, 2000, 2013; Kopelman, Thomson, Guerrini, & Marshall, 2009). Armed with clinical observations that appeared to disprove the conventional wisdom about the permanence of Korsakoff syndrome, I then read the literature more thoroughly, only to discover that Korsakoff himself had described the potential for recovery from severe amnesia in his original description (for translation, see Victor & Yakovlev, 1955). Other researchers, who had done long-term-outcome studies on patients admitted to hospital with acute Wernicke-Korsakoff syndrome had shown that many such patients recover to some extent (Victor, 1994; Victor et al., 1971), although we still have a poor understanding of the factors underlying recovery (for reviews, see Bowden, 1990; Bowden & Scalzo, 2016; Svanberg, Withall, Draper, & Bowden, 2015; Victor, 1994). Surprisingly, the view that patients with chronic Wernicke-Korsakoff syndrome will all show a severe, lasting amnesia still persists, although it is now well accepted that the acute Wernicke’s phase is extraordinarily variable (Kopelman et al., 2009; Sechi & Serra, 2007).

The illustration of the limited understanding of the variable course and potential recovery from Wernicke-Korsakoff syndrome may not be so exceptional when we rely primarily on knowledge derived from clinical experience.

For example, a similar misunderstanding prevailed for many years regarding the unnecessarily pessimistic view of the chronic course of schizophrenia (see Menezes, Arenovich, & Zipursky, 2006). If we are prone to develop and maintain significant misunderstandings regarding commonly studied, severely disabling conditions, how much more likely is it that we will not fully understand less-common conditions, in the absence of carefully designed studies of the spectrum of severity and course of illness? The principles of evidence-based practice illustrate that we should adopt a scientifically conservative view and assume that, in the absence of relevant, well-designed observational or cohort studies of the course, clinical spectrum, and diagnostic criteria, we should assume that we have an incomplete understanding of that particular disorder. In this volume, Schoenberg's chapter outlines the widely adopted criteria for "best" clinical evidence, and Chelune's chapter illustrates how we can incorporate best-quality evidence into clinical thinking to guide understanding. The same guidelines for best evidence can help us guard against assuming we have a good understanding when our knowledge is based on inadequate or poor-quality studies. Specifically, the methods of critical appraisal allow us to identify high-quality information when it is available, rate the validity of the respective studies, and, hence, rate the validity of our understanding (see chapters by Berry and Miller, this volume).

MISUNDERSTANDING PSYCHOMETRICS

Another essential technical aspect of test score interpretation relates to the understanding of psychometric principles. The dictionary of the International Neuropsychological Society (Loring, 2015) defines *psychometrics* as the "scientific principles underlying clinical and neuropsychological assessment." Although psychometric principles are covered in most graduate courses, many practitioners gain only a relatively superficial appreciation of their importance in the interpretation of test scores. As a consequence, imprecise or frankly indefensible test-score interpretation is sometimes observed in clinical practice and research. Psychometric principles underlie the scientific interpretation of diagnosis or the observation of changes in response to treatment interventions or changing brain function. It is difficult to be a successful evidence-based practitioner if one is using poor assessment tools or does not know how to distinguish good tools from poor (Barlow, 2005). Unfortunately, there is a common view that practitioners are not adequately trained in psychometric principles, and that clinical psychology (including neuropsychology) on one hand, and psychometrics on the other, have diverged as specializations when they should be more closely integrated to better inform clinical practice (Aiken, West, & Millsap, 2008; Cronbach, 1957; Cumming, 2014; Sijtsma, 2009; Soper, Cicchetti, Satz, Light, & Orsini, 1988).

In fact, some unfortunate misunderstandings of psychometrics persist. Rather than psychometrics being seen as the scientific foundation of clinical assessment for diagnosis or evaluation of change, as it should be, it is instead characterized as, for example, an American-style fixed-battery approach to assessment (for

diverse views see Macniven, 2016). The diversity of North American approaches to the practice of clinical neuropsychology, including the popularity of flexible approaches, is well described by Russell (2012). In other approaches, psychometrics is described as of lesser importance for true clinical insights that are best derived from a reliance on experience and subjective intuitions, thereby downplaying norms and tests standardization. Any approach that places low emphasis on test norms and test reliability and validity is an illustration of the older understanding of clinical expertise, which elevates the role of subjective judgment and downplays the importance of well-designed research to inform clinical thinking (Isaacs & Fitzgerald, 1999). In this light, a rejection of psychometrics risks throwing the scientific ‘baby’ out with the psychometric ‘bath water’ (Meehl, 1973; Wood et al., 2007).

Four chapters in the current volume provide a summary of how psychometric principles of validity and reliability inform theoretical development and assessment precision in clinical neuropsychology. Lee and colleagues describe the ways validity methods have been used to refine models of psychopathology for diagnostic assessment. Riley and colleagues show how assessment of cognitive disorder has been refined using validity methods. Bowden and Finch review the interpretation of reliability and the dramatic impact on precision in clinical assessment associated with use of test scores with lower or unknown reliability. Hinton-Bayre shows how reliable-change criteria can be used to improve precision in the interpretation of clinical change. These four chapters review foundational knowledge in scientific practice of neuropsychology.

PEER REVIEW DOES NOT GUARANTEE QUALITY OF STUDY FINDINGS

Peer review is a basic criterion of credibility in scientific disciplines (Smith, 2006). Yet, it has been recognized for many years that peer review—the process by which most manuscripts are evaluated for eligibility for publication in “peer-reviewed” journals—is a flawed process (Cumming, 2014; Smith, 2006; Straus et al., 2011). Common criticisms of peer review include that the process favors positive (statistically significant) study findings, is subjective and inconsistent, is biased in a variety of ways, and provides inadequate scrutiny of the quality of methodology in studies submitted for publication (Smith, 2006; Straus et al., 2011).

Methods of critical appraisal are specifically designed to overcome some of the limitations of peer-review by providing readers with the skills necessary to identify common methodological flaws and rate the quality of evidence relating to any particular clinical question (Straus et al., 2011). The chapter by Chelune outlines how clinicians can overcome some of the limitations of peer-review by educating themselves in the skills of critical appraisal, skills which build on the EQUATOR network, a framework of quality evidence in health care that has been adopted by a large number of biomedical journals (<http://www.equator-network.org/>). The chapters by Berry and Miller in this volume give detailed

examples of how to undertake critical appraisal of diagnostic validity and treatment studies, respectively.

ORGANIZATION OF THE BOOK

After this introductory chapter, the next three chapters review the validity of evidence for theories of cognitive function and psychopathology relevant to neuropsychological practice. In Chapter 2, Riley and colleagues review the fundamental importance of theoretical refinement in clinical neuropsychology, showing how the validity of tests is always enhanced by a strong theoretical framework. Riley and colleagues show that there is a strong, reciprocal relationship between the quality of our theories of neuropsychological assessment and the validity of our assessment practices. In Chapter 3, Jewsbury and Bowden review current models of cognitive assessment, suggesting that one particular model stands out as a comprehensive schema for describing neuropsychological assessment. These authors provide a provisional taxonomy of neuropsychological tests to guide practice and promote further research. In Chapter 4, Lee and colleagues show that refinements in models of psychopathology provide a strong empirical guide to the assessment of psychopathology across a wide variety of patient populations and clinical settings.

In the subsequent chapters, reviews and applications of the principles of evidence-based practice are explained and illustrated. In Chapter 5, Bowden and Finch outline the criteria for evaluating the reliability of test scores, showing that simple techniques allow clinicians to estimate the precision of their assessments and also to guard against the potentially distracting influences of tests with low reliability, an epistemological trap for the unwary. The specific application of reliability concepts to the detection of change over time is then reviewed by Hinton-Bayre in Chapter 6, showing the variety of techniques that are available to clinicians to improve detection of change related, for example, to therapeutic interventions or changing brain function. Chelune describes, in Chapter 7, the broad framework of evidence-based practice in clinical neuropsychology, showing how clinicians, if they are conversant with the principles, can bring the best evidence to bear on their clinical decisions. Chelune draws together best-evidence techniques that have a long history in clinical psychology and neuropsychology and broader health-care research. In Chapter 8, Bigler describes the current state of evidence supporting the clinical interpretation of neuroimaging studies, delineating imaging techniques that have established clinical validity and those that are under development.

The final chapters in this volume illustrate the clinical application of best-evidence criteria and techniques for evaluation of published studies. Schoenberg describes the EQUATOR network criteria in Chapter 9. These criteria form the basis of study design and reporting standards that have been adopted by a large number of biomedical journals, including an increasing number of neuropsychology journals (e.g., Lee, 2016; Bowden & Loring, 2016). The EQUATOR network criteria highlight the importance of well-designed clinical studies to

understanding diagnostic validity and treatment effects. In Chapter 10, Bunnage outlines the primary statistical criteria for demonstrating diagnostic accuracy, criteria that underpin the interpretation of test score utility. The core skills of critical appraisal are demonstrated in Chapters 11 and 12. In the former, Berry and colleagues illustrate the techniques of critical appraisal as applied to a diagnostic test. In the latter, Miller illustrates the application of critical appraisal techniques to the evaluation of an intervention study. Both of these chapters show how clinicians can use quality ratings and rules-of-evidence criteria to decide on the methodological strength and patient-relevance of published findings, helping to overcome some of the limitations of peer review, when necessary. The volume concludes with a summary chapter outlining some the key skills for an evidence-based practitioner of neuropsychology.

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