Clinical Neuropsychology

Theoretical Foundations for Practitioners

Edited by
Mark E. Maruish & James A. Moses, Jr.

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Foreword

Arthur Benton

More rapidly than might have been anticipated, clinical neuropsychology is coming of age. I mean by this that it is evolving from what was largely a set of assessment procedures coupled with the diagnostic inferences to be drawn from them into a true discipline, conscious of its conceptual bases and concerned with the cognitive and neural mechanisms that mediate the behavior of normal individuals and patients with brain disease. This book, ably edited by Mark Maruish and James Moses, makes a distinctive contribution to this evolution in that it emphasizes these fundamental issues. At the same time, clinical and forensic practice, problems of training and organization, and the relationship of clinical neuropsychology to allied fields are also covered in considerable detail.

Without exception, each chapter in the volume provides a thoughtful and up-to-date analysis of the area it covers, and some are truly outstanding. *Clinical Neuropsychology: Theoretical Foundations for Practitioners* fills a clear need at this stage of development of the field. It is a valuable asset that will be welcomed by clinicians and researchers alike.

Preface

For nearly two decades, the level of interest, study, and practice devoted to clinical neuropsychology has enjoyed a rate of growth that may be unprecedented in the behavioral science field. The number of doctoral-level training programs with clinical neuropsychology tracks has increased dramatically. This has been accompanied by an increase in the number of predoctoral clinical psychology internships with neuropsychology rotations, and in the number of predoctoral internships and postdoctoral fellowships focused solely on clinical neuropsychological training. Membership in professional organizations such as the American Psychological Association's Division of Clinical Neuropsychology (Division 40), the National Academy of Neuropsychology (NAN), and the International Neuropsychological Society (INS) also has grown steadily. In addition, the number of journals that have been proliferated from the growing interest in and need for information in the area of clinical neuropsychology further reflect how far the field has progressed. However, it probably is the American Board of Professional Psychology's (ABPP's) acknowledgment of clinical neuropsychology as a speciality that most strongly identifies the field as being a discipline in its own right rather than being a subspecialty of clinical psychology.

With the emergence of clinical neuropsychology as one of the fastest growing specialties in the field of psychology comes the need for current and future practitioners to stay abreast of the most recent research in the field. The professional journals just mentioned more than adequately meet this need. At the same time, there also is a need to stay up-to-date on the current thinking on topics and issues that are important to the practice of the profession. For this reason, we set out to produce this volume. Drawing on the expertise of some of the leaders in the field, our intent was to provide the practitioner with a source for discussions of topics that are important to their ongoing development as clinical neuropsychologists but which generally are not addressed in the literature to any great degree.

We begin with a discussion of topics related to the emergence of clinical neuropsychology as a psychological specialty. First, the multidisciplinary origins and subsequent evolution of clinical neuropsychology as a professional specialty are detailed in the chapter by Meier. The rapid development of this clinical subspecialty has been made possible by concurrent, parallel advances in three related areas. Developments have been made in basic experimental neurobehavioral and cognitive research methodology. Advances in cognitive theoretical model building and psychometric assessment methods also have been contributory to the emergence of clinical neuropsychology as a specialty area. In addition, the development of

sophisticated methods of neurobehavioral syndrome analysis have contributed to the emergence of clinical neuropsychology as a professional practice area. Meier presents a detailed, integrative survey of these key trends in experimental and clinical neuroscience during the past half-century, and he delineates the role of the clinical neuropsychologist as that of providing the integration and application of this multidisciplinary knowledge base to the syndrome analysis of neurobehavioral disorders.

Meier evaluates ongoing developments and controversies in the development and implementation of standards for neuropsychological training and professional practice. In particular, alternative models and standards for doctoral academic neuropsychological instruction, predoctoral and postdoctoral clinical training, professional credentialing, and board certification are presented. Meier himself has been a pioneering and leading figure in the development of each of these areas and thus is able to bring personal as well as professional expertise to the discussion.

Meier clarifies the boundaries of clinical neuropsychological practice and its evolving relationship to allied disciplines. He also discusses the development of specialty journals, professional societies, academic training programs, and advanced practice level specialty accreditation. These factors all have become increasingly important to the formal establishment and recognition of clinical neuropsychology as a professional practice specialty.

The interdisciplinary nature of clinical neuropsychology that Meier presents in the previous chapter is developed from the neurological viewpoint by Shuren. He illustrates the conceptual foundations of behavioral neurology and its conceptual and clinical relationship to clinical neuropsychology. His presentation begins with a historical overview of the development of neurobehavioral syndrome analysis. The historical origins and shortcomings of narrow localizationist and global holistic models of brain function are analyzed and shown to be incomplete. Refinements in the development of modular and integrative theories of functional brain systems are highlighted through discussion of the work of Penfield, Geschwind, and Sperry. Concepts from behavioral neurologic syndrome analysis also are shown to have influenced psychometric test development by clinical neuropsychologists.

Shuren defines the role of the behavioral neurologist as the diagnosis, medical treatment, and neurobehavioral analysis of neurologic disorders. He illustrates the integrated roles of the neurologic and mental status examinations in neurologic diagnosis and prognosis. Complementary methods of brain lesion localization and behavioral syndrome analyses using neurological and neuropsychological methods are described and clinically illustrated through case examples and clinical syndrome analyses. Throughout the chapter, Shuren advocates and models the complementary roles of behavioral neurology, clinical neuropsychology, and both basic and applied neuroscience to the analysis of neurobehavioral disorder.

Friedrich and Rader present an integrated model of modular cognitive processing that is based on complementary experimental and clinical behavioral analyses. The theory postulates specific modular cognitive components that may underlie complex information processing. This rigorous cognitive model often provides unique insight into complex neurobehavioral systems and syndromes. Friedrich and Rader's historical review of information processing models reveals that neurobehavioral theorists have postulated such hierarchically organized cognitive systems for over a century.

Friedrich and Rader discuss the analytic principles that guide current research trends in the development and validation of a general model of cognition. They present integrative research reviews of cognitive models of memorial processing, spatial perception, and visual imagery. These findings also have direct relevance to neurobehavioral modeling of neurologic functional system modeling. A fine-tuned theoretical basis for clinical syndrome analysis and standardized test development directly emerges from the model. The cognitive theory that they present also has proven to be useful in neural functional system modeling and in the analysis of specific cognitive deficit that is associated with discrete brain lesions.

In the first chapter of the "Issues in Neuropsychological Assessment" section, Pritchard presents an introductory overview of the field of forensic neuropsychology. He begins with a discussion on the differences between forensic and clinical neuropsychology. Noted here are differences between the two subspecialties in terms of their goals, the clients they serve, and the questions they address, as well as differences in the manner in which each arrives at decisions. The role of the neuropsychologist as an expert witness is discussed, both generically and with regard to what he or she has to offer the court.

Pritchard next presents a discussion of the types of questions commonly addressed in the field of forensic neuropsychology, including substantive questions of criminal, civil, and administrative law. Because it is an issue that must frequently be addressed, a discussion of malingering, or dissimulation, is presented. Issues related to training and general qualification standards and ethical considerations for forensic neuropsychologists are brought to bear, and desirable developments in the field are articulated. As an adjunct to the chapter, the reader also will find the American Psychological Association's *Specialty Guidelines for Forensic Psychologists* as the appendix.

In his chapter, Cripe reports that "The assessment of personality is one of the most important and challenging aspects of clinical neuropsychological practice" (p. 119). In tackling the topic of personality assessment of the brain-impaired, he addresses a number of issues that must be considered by clinical neuropsychologists and psychologists from other specialty areas who have occasion to assess such patients. These issues run the gamut of topics related to the general focus of his chapter. Issues related to personality, its neuroanatomical and neurophysiological bases, and methods of measuring personality also are presented. Particular attention to the use of the MMPI for personality assessment of the brain-impaired population is paid by the author. As an alternative to reliance on a single instrument such as the MMPI, Cripe enumerates specific guidelines for assessing the personality of the brain-impaired patient. Suggestions for areas of development in this field, including the area of new instrument development, also are provided.

The use of computers in psychological assessment is quite pervasive. Thus, any book dealing with the foundations of clinical neuropsychology would be wanting if it did not address the use of computerized test administration in neuropsychological assessment. For the purpose of this work, Kay and Starbuck first convey a historical perspective for computerized neuropsychological assessment. Next, they articulate the advantages of computerized test administration over the standard paper-and-pencil mode of administration. Conversions standard paper-and-pencil tests to computerized administration and tests specifically developed for administration via the computer are discussed. The authors go on to discuss in detail a number of commercially and publicly accessible batteries of neuropsychological tests. In closing the chapter, Kay and Starbuck present an evaluation of the current state of computerized neuropsychological test applications and convey predictions about future developments in this field.

In their chapter, Bigler, Porter and Lowry review the relationships of a wide variety of contemporary neuroimaging techniques to neurobehavioral syndrome analysis. They present brief overviews of the scientific basis and clinical indications for use of Computerized Tomographic Imaging, Magnetic Resonance Imaging, Single Photon Emission Computed Tomography, and Positron Emission Tomography. In addition, they discuss recent developments in Activation or Functional Magnetic Resonance Imaging, Magnetic Resonance Spectroscopy, Quantitative Electroencephalography, Brain (electrical activity) Mapping, and Magnetoencephalography. Extensive annotated illustrations are provided to allow one to compare the results of these neuroimaging methods.

Bigler and his colleagues also provide a detailed tabular overview of the literature that relates structural and functional brain imaging findings to cognitive function primarily in studies that have been published since 1989. They note that the literature published prior to

that time very likely is based on technology that is now outmoded. To aid information location and retrieval, they have provided summaries of key articles in an extensive series of related tables that provides information on the neuroimaging method, neurobehavioral syndrome, lesion localization, patient sample, and neurobehavioral findings for each study.

Two chapters on the role of clinical neuropsychology in the treatment of brain-impaired patients follow next. First, Klonoff and her colleagues address one of the key components to the treatment and rehabilitation of persons with brain injuries, that is, cognitive retraining. In presenting an overview of the principle considerations and elements to this approach, the authors begin by stressing the importance of taking a milieu approach to cognitive retraining to enhance the patient's ability to apply gains made in the therapeutic setting to their functioning within the community. The role of neuropsychological assessment in identifying appropriate candidates also is presented. Related to this is the identification of patient characteristics whose presence increase the likelihood of success of cognitive remediation efforts.

In presenting their approach to treatment of the brain-injured patient, Klonoff et al. emphasize the importance of making the patient aware of his or her deficits. This is said to require "a sophisticated understanding of the patient's needs and capacity to flexibly shift and adapt treatment procedures" (p. 225). They show how interpreting the patient's performance, teaching compensatory strategies, and relating in-session observation to "real-life" behavior and situations can be helpful in accomplishing these goals. Also, general recommendations for remediation of deficits in specific areas of neuropsychological functioning (e.g., memory, attention, language) are given. In addition, the importance of working cooperatively with other rehabilitation disciplines—occupational therapy, speech therapy, recreational therapy—is discussed. Finally, the authors present a case study and preliminary empirical findings to address issues pertaining to outcome assessment and treatment efficacy of cognitive retraining exercises.

Schefft and his colleagues provide an extensive overview of the application and usefulness of self-regulation procedures that can be used with brain-injured patients. They first review factors that influence the use of self-regulation therapy. Included here is a discussion of the types of cognitive, behavioral, and emotional disabilities and handicaps brain-injured patients may present, as well as issues related to the evaluation of them. Next, various approaches to and models of treatment of these patients are reviewed. Included here are those models and approaches that are either self-regulatory or non-self-regulatory in their orientation.

In the final sections of their chapter, Schefft et al. present a detailed description of a self-regulation approach that has developed from work with a variety of psychiatric and neurologic populations. In describing the approach, the authors touch on the sources that influence or shape the dysfunctional behavior in brain-injured patients and draw the distinction between automatic versus controlled processing. They present a framework for the therapy process and outline strategies for achieving subgoals of therapy. Finally, future directions in this area are noted.

Diagnostic issues are covered in chapters by Goldstein and Csernansky et al. Goldstein's chapter begins by summarizing the shift of thinking about the etiology of mental illness from one in which mental disorders were viewed as having either a functional or organic basis to one in which biology serves as the basis of "most, if not all" (p. 306) mental disorders. Occurring along with this revolution in thinking has been a revolution in the direction of interests of some neuropsychologists. We now see a group of neuropsychologists focusing on the analysis of psychiatric disorders, either exclusively or in addition to the analysis of neurological disease. Goldstein notes how this change in focus likely began in the field of alcoholism, followed later by an interest in the neuropsychological aspects of schizophrenia. These areas of inquiry are explored, as are those of more recent research, including anxiety

and mood disorders, personality and developmental disorders, attention-deficit hyperactivity, and autism.

In summarizing the state of affairs, Goldstein acknowledges how recent technologies have allowed for much of the recent work in the area of psychopathology. At the same time, they do not permit the definitive analysis of the neurobehavioral deficits that are associated with psychiatric disorders. Several methodological considerations are suggested to aid in future research planning. These include moving away from simplistic models of brain functioning, the state–trait aspect of the disorder, and symptomatic/diagnostic heterogeneity of diagnostic categories.

Csernansky, Black, and Faustman's chapter presents an overview of the *Diagnostic and Statistical Manual* (*DSM*) disorders in which significant cognitive deficits are their distinguishing characteristics. Beginning with a brief history of psychiatric nosology, the authors proceed to a discussion of the nosology of organic mental disorders, organized by a system of five classes. Class I disorders include those traditionally associated with brain damage (e.g., dementias, mental retardation, delirium). Class II disorders cover psychiatric symptoms associated with drug use (e.g., alcohol intoxication, delirium tremens). Indicative of Class III disorders are psychiatric syndromes which occur with other illnesses known to affect the brain. Examples include Tourette's syndrome and obsessive-compulsive disorder with encephalitis lethargica and schizophrenic-like psychosis with Wilson's disease. Class IV disorders lack consistent clinical–pathological correlational findings and include classic migraine headaches and tic disorders. Finally, Class V disorders include such severe disorders as schizophrenia, autism, and bipolar disorder. Although traditionally viewed as "functional" in nature, Class V disorders are now considered by many to be the result of brain abnormalities.

With the classification scheme defined, Csernansky et al. proceed with a presentation of neurological and neuropsychological findings for Class I and II disorders. The thrust of their presentation is on findings related to Alzheimer's disease, although other dementias (e.g., multi-infarct) and amnestic disorders also are addressed. In addition, findings for Class III disorders, (e.g., depression, mania, and anxiety that are secondary to a medical disease/disorder) are discussed.

The final two chapters of the book address issues in clinical neuropsychological research. In the first of the two chapters, Reynolds and Murdoch-James present an integrated discussion of basic test development psychometric principles. Principles of test domain sampling, item construction and analysis, target population selection, and the need for objectively quantified scoring system development are reviewed. Methods of qualitative and quantitative item scaling, test norm development, and demographic variable influence on level and pattern of component skill performance also are highlighted.

These presentations illustrate proper psychometric technique as well as common errors in neuropsychological test development. The basic principles and methods for establishment of content, construct, and criterion-related validity are reviewed, and examples of their application to neuropsychological test development are provided. Multivariate experimental design issues, base rate estimation, and actuarial analysis of classification accuracy shrinkage that occurs with cross-validation are highlighted. Much neuropsychological research has been compromised due to inattention to these principles.

In the final chapter, Krull and Adams address experimental design issues that are centrally relevant to neuropsychological research. They encourage conduct of hypothesis-driven rather than exploratory studies. Emphasis is placed on the evaluation and extension of theoretical models of neurobehavioral function. Key methodological issues include evaluation of sampling bias, base rate estimation, demographic variable matching, and careful control group composition. They also recommend use of explicit group inclusion and exclusion criteria, as well as consideration of the differential effects of fatigue on clinical and control groups. They

note that performance pattern heterogeneity within a single diagnostic group often is overlooked. As a result, it may require the use of an experimental design in which disease progression staging is controlled in addition to demographic variable matching. Base rate analyses typically are lacking in neuropsychological research and should be included in actuarial classification studies.

Finally, Krull and Adams recommend refinement of neuropsychological experimental design to focus on modular patterns of cognitive performance rather than global intergroup performance level differences. They also call for analyses of functional systems or networks of related skills (see chapter 3, this volume) rather than on cognitive skills in isolation from each other.

We hope that the reader finds the information presented in this volume stimulating, informative, and useful as a tool for professional development. We also hope that it helps the reader obtain a better feel for where the field of clinical neuropsychology is, where it has come from, where it is going, and the potential problems and opportunities it faces as it continues to evolve and define itself. It is only through an awareness of where the profession has been and where it is going that its members can work to ensure that it develops in a manner that will help to further crystallize its identity and maximize the contributions it can make to both science and service.

1

The Establishment of Clinical Neuropsychology as a Psychological Specialty

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Clinical neuropsychology has evolved as a specialized area of knowledge and practice with extensive intra- as well as interdisciplinary foundations. Considered from the perspective of the sociology of the professions, the specialty is characterized by activities in a number of scientific and professional domains. These domains can be seen as having laid the foundation for the practice of clinical neuropsychology, whose specialized mission encompasses roles that address psychological or behavioral manifestations of neurological, neuropathological, pathophysiological, and neurochemical changes in brain disease and the full range of aberrations in the central nervous system that may arise during development. The evolution of this mission has followed the characteristic course of scientifically based professional role functioning, insofar as the foundations in knowledge and practice have been derived not only from the discipline of psychology, but also from the various related disciplines within the traditional professions of medicine, education, and law.

Historically, three primary developmental domains appear to have provided the basis for this area of specialized knowledge and practice: basic experimental research in physiological and cognitive psychology, the development of quantitative and qualitative neuropsychological principles and procedures for clinical practice, and the syndromal analysis of the behavioral consequences of central nervous system lesions (Meier, 1992). The growth of the specialty has also been influenced by the introduction of formalized procedures for accrediting educational programs and individual competencies. The developmental process, based on a considerable expansion of interdisciplinary knowledge and practices during the past half-century, appears to be following a productive course. This is evidenced by the parallel development of participating organizations, publication of numerous books and journals, and

the continued expansion of role applications beyond traditional neurological, neuropsychiatric, and rehabilitation settings into the forensic, educational, and vocational contexts.

HISTORICAL ANTECEDENTS

The historical foundations of this specialty are already sufficient to warrant a detailed historical account of its evolution. Such an account is beyond the scope of this chapter, which is designed to provide a general perspective by means of a review of major contributors in each of the three aforementioned converging lines of knowledge and practice. Even such a brief overview is insufficient to identify all major contributors so that the individuals identified here by no means constitute an exhaustive list. Although incomplete, such identifications may help to guide interested graduate students and practitioners in the field into the literature and to aid in formulation of career objectives. Extensive introductions to the prescientific, as well as the early scientific, literature of historical significance are available and should be read by the serious student or practitioner (Luria, 1966; Meyer, 1961). A review of modern clinical neuropsychology in general historical perspective, but not a detailed history, is also available (Meier, 1992). This section summarizes the developments within each of the three major developmental domains identified in the first paragraphs of this chapter.

Developments in Physiological, Comparative, and Cognitive Psychology

Karl Lashley (1929) was an extremely influential individual during his time. Publication of *Brain Mechanisms and Intelligence* resulted in the attribution of his intellectual leadership by many individuals who themselves subsequently became major figures in this domain. The doctrine of *strict localization of function* was widely held at that time; therefore, Lashley's finding that the behavioral consequences of experimentally induced brain lesions in rats were a direct function of the amount, rather than the location, of the tissue removed provided the basis for an opposing doctrine that incorporated *mass-action* principles into a theory of brain function. This work clearly forced an understanding of the nervous system as a functionally dynamic and resilient system, as opposed to a static and discretely differentiated "switchboard" conceptualization.

Although primarily an experimental psychologist, Lashley was known to rotate in clinical settings, such as at St. Elizabeth's Hospital in Washington, DC, and at laboratories engaged in the experimental analysis of higher cognitive functioning in primates, such as the Yerkes Primate Laboratory. Many physiological and comparative psychologists worked directly with Lashley, including Donald O. Hebb (1949), who subsequently engaged in interdisciplinary clinical research with Wilder Penfield at McGill University, where they set in motion a major series of research activities relating to the effects of removal of prefrontal or anterior/mesiotemporal tissue on intractable focal seizure disorders and, by extension, on higher cognitive and memory functioning. Hebb attempted to integrate the existing literature toward achieving an empirically based foundation for the *regional localization* doctrine that sought to formulate a rapprochement between the localizationistic and mass-action doctrines in the analysis of the behavioral consequences of cerebral lesions and ablations. His characterizations of cell assemblies and their functional relationships were similar to such concepts as the pluripotentiality of function and dynamic systems and subsystems as formulated by A. R. Luria (1966), the Russian psychologist and neurologist who is more widely acknowledged as having attempted to synthesize elements of strict localization and mass-action doctrine toward a general theory of higher cortical functioning. It was clear that the available empirical

bases for formulating theoretical concepts were already sufficiently extensive to force consideration of more dynamic theories of higher cortical functioning.

Although Hebb's *behavior–cognition integration* was a major step toward a comprehensive theory of higher cortical functioning, there was an expanding experimental research literature that related to the effects of circumscribed cortical ablations on learning and problem-solving behavior which was expanding the empirical foundation for the analysis of brain–behavior relationships. One of the more noteworthy investigators in this area was Harry F. Harlow at the University of Wisconsin, who developed one of the first regional primate laboratories after World War II. Interestingly, Harlow is known primarily for his experimental studies of infant–maternal relationships in primates. However, the earlier work of his group is noteworthy for having provided perhaps the first experimental demonstration of a double dissociation of the effects of focal anterior and focal posterior cerebral lesions. The major experimental paradigm for isolating the effects of prefrontal regions was the *delayed reaction*, as described by Carlyle Jacobsen (1936). Visual-discrimination learning paradigms were introduced to isolate the effects of temporoparietal lesions. By demonstrating that solution of the oddity problem was affected by lesions in either the anterior or posterior association cortex (Harlow, Davis, Settlage, & Meyer, 1952), the double dissociation between delayed reaction and visual-discrimination deficits (as a function of the cephalocaudal location of the lesion) was set into even more dramatic relief. The nonspecificity of effect, therefore, and the higher position of the oddity problem function in the hierarchical organization of function in the cerebral hemispheres also were characteristic of the formation of learning sets.

It is perhaps unfortunate that Harlow abandoned this line of research in favor of the work on maternal surrogate–infant relationships for which he is most widely known. Harlow's research direction, however, was pursued in substantially greater depth by other physiological psychologists in subsequent decades. Among these, Mortimer Mishkin is known for having refined the experimental ablation approach, both methodologically and conceptually, thereby adding substantially to our knowledge of the regional localization of function in the prefrontal and inferotemporal cortex. Although Mishkin did not work directly with Harlow, there were relatively few physiological psychologists at that time and they were in ready communication with each other by means of the *Journal of Comparative and Physiological Psychology*. Mishkin worked with many on the Eastern seaboard, including Rosvold, Hebb, Sperry, Pribram, and Milner. Pribram is perhaps best known for his highly sophisticated theoretical formulations, but he was also a substantive empirical researcher as well as a neurosurgeon who was able to foster the development of neurosurgical skills among physiological psychologists at that time. He collaborated with Mishkin, who was helped on his career course to ultimately gain major professional recognition, including the Scientific Contribution Award from the American Psychological Association (APA; Mishkin & Pribram, 1954; Pribram, 1986).

The role of the temporal lobe in human learning and memory is now relatively well established. Mishkin and his associates have been able to introduce relatively refined experimental paradigms for studying the interaction between the amygdala and hippocampus in recognition memory and the independence of those structures in associative learning in primates. They have now identified separate pathways for object representation and for spatial vision connecting the occipital and inferotemporal cortices. They are exploring further the cognitive effects of interruptions in relationships between the cortex and the basal ganglia on stimulus–response learning. They are also elucidating the relationship between the cortex and the limbic system and their role in the mediation of stimulus–stimulus processing and learning (Mishkin, 1982; Mishkin & Petri, 1984; Mishkin & Ungerleider, 1983). Although

this work may not have direct implications for comparable behavioral and cognitive processes in humans, it shows that where experimental analysis of behavior is feasible and the corresponding anatomical control can be achieved experimentally, theoretical refinements of potential significance for our understanding of human brain function can be achieved.

Hebb, of course, is well known for his positive influence on many students and colleagues in the late 1940s and 1950s. Among these, Brenda Milner at McGill University is perhaps the most notable. Her academic background was in experimental and comparative psychology after receiving the ScD degree at Cambridge. She had also worked with Oliver Zangwill at Cambridge as a graduate student, where she participated in construction of psychological tests and in radar research during World War II. She obtained the PhD in psychology at McGill, where she also participated in prepublication debates over Hebb's monumental 1949 volume. Her seminal article on the temporal lobes (Milner, 1954) was based on her PhD dissertation and her early work with Hebb and Penfield. A long series of important studies of the effects of prefrontal, anterotemporal, and mesiotemporal removals on learning and memory and on intractable focal (partial complex) seizures followed (Milner, 1964; Milner & Teuber, 1968). These carefully described studies reported perseveration and impairment in abstract reasoning and categorical thinking, as measured by the Wisconsin Card Sorting Test, as a consequence of prefrontal ablations. Dissociated from such deficits in the ability to shift set for the acquisition of a new sorting principle (conceptual flexibility), she also expanded on her earlier work implicating the anterior/mesiotemporal region in learning and recent memory functioning. Her findings about the effects of focal temporal lobe lesions have expanded remarkably on accounts of the neuroanatomical basis of mnestic deficits in Wernicke–Korsakoff Syndrome (Talland, 1966).

Milner (1967) has also been engaged in the study of cerebral dominance and the use of brief cognitive and memory testing procedures during specialized invasive procedures, such as the Wada Test. Her interlaboratory relationships with the group at the Massachusetts Institute of Technology (MIT) and the late Hans-Lukas Teuber has led to much collaborative work. In turn, she has also extended her interests by means of collaboration with Roger Sperry and his colleagues at the California Institute of Technology (Milner, Taylor, & Sperry, 1968). Among her many well-known students are Suzanne Corkin, Doreen Kimura, and Donald Taylor.

At the other end of what became known as the "MIT–McGill Axis" was the laboratory developed by Hans-Lukas Teuber, initially at New York's Bellevue Hospital and later at MIT. Teuber completed a doctoral degree in experimental psychology at Harvard University after he immigrated to the United States. While in the U.S. Navy, Teuber was assigned to the San Diego Naval Hospital, where he became associated with Morris Bender. Bender was among the few behavioral neurologists in this country who was interested in higher cortical functioning, especially the higher sensory processes, including visual perception, stereognosis, and tactile discrimination. These functions are now assessed routinely on a qualitative basis in a comprehensive neurological examination.

Teuber is remembered as a superb teacher and integrator of current knowledge, who had extraordinary extemporaneous speaking skills when he conveyed his rich theoretical conceptualizations that were based on a wide range of animal and human research in both clinical and experimental contexts. He had access to premorbid baseline data from group tests given in the military and, by means of contract research, was able to study the behavioral effects of penetrating missile wounds in veterans of World War II and Korea (Teuber, 1962, 1964, 1966). An engaging personality as well as the consummate communicator, he attracted large numbers of both students and colleagues.

Teuber's laboratory became engaged in numerous studies of visual field defects, somatosensory functioning, developmental complications of early brain lesions, problem-solving behavior, and many aspects of higher cognitive functioning, including studies of the conditional reaction (Weinstein, 1985). The works of his group on tactile sensitivity, two-point discrimination, point localization, pattern discrimination, roughness discrimination, spatial orientation, and body image are widely cited. His closest students and colleagues were Sidney Weinstein, Josephine Semmes, Mortimer Mishkin, Lila Ghent, and Stanley Battersby. The psychological component of cognitive neuroscience was initiated largely through his laboratory.

Following his untimely death, his influence continues at MIT, where Suzanne Corkin and her associates now represent that group on the McGill–MIT Axis. Activities of those two groups are well represented in the knowledge base for clinical neuropsychology as it relates to the effects of selected ablations and lesions on higher cortical functions in man. These more basic lines of neuropsychological research are being extended remarkably through the Society for Neuroscience and through the expansion of the neurosciences beyond the study of primary sensory and motor processes into the areas of sensory perception, attention, and problem-solving ability, as well as learning and memory. Such expansion has led to the *Journal of Cognitive Neuroscience*, edited by Michael Gazzaniga, Sperry's protegé, and published by MIT Press. The basic work conveyed through this journal includes frequent reference to clinical phenomena as a basis for conceptualizations that lead to specific experiments and theoretical formulations. A British journal, *Cognitive Neuropsychology*, expands on the neurobehavioral studies reported in cognitive neuroscience through an even more deliberate emphasis on clinical phenomena, such as the neurobehavioral syndromes, as a point of departure for the conduct of cognitive research.

Disciplinary boundaries in neuroscience are decidedly permeable, as can be inferred from the composition of the teams that report research results in these journals. The studies often require some integration of behavioral, neurophysiological, and neurochemical data so that cognitive neuroscience clearly has become an interdisciplinary venture. The recent body of knowledge in each area has already become so elaborate as to elude comprehensive knowledge on the part of the individual (scientist or practitioner), even within a particular discipline on a given subject. This will necessarily prompt permeability of disciplinary boundaries even more and require an increasingly interdisciplinary team approach to research.

Team approaches have long been acknowledged to be essential in basic, as well as more clinical, research. Such an approach is exemplified by the work of Roger Sperry and his group. Sperry received a master's degree in psychology at Oberlin and a PhD in zoology at the University of Chicago. He has been a major contributor to basic neurobehavioral research and the first Nobel Laureate with linkages to psychology. Sperry was also associated with Lashley while at the Yerkes Laboratories, where he began to study the selective growth of neural connections after the placement of highly circumscribed lesions. While studying with Paul Weiss, a neurophysiologist at the University of Chicago, Sperry (1958) wrote his doctoral dissertation on the reorganization of function following the surgical interchange of nerves and muscles in the frog. This work prompted modification of the neurological and neuropsychological concepts of central nervous system plasticity and the functional interchangeability of neural connections.

The work for which Sperry received the Nobel Prize involved the experimental analysis of the organization of lateralized cerebral functions using the corpus callosotomy paradigm, also known as the split-brain preparation (Sperry, Gazzaniga, & Bogen, 1969). This paradigm established the foundation for the multitude of related studies that followed and that

have essentially confirmed many of the hypotheses derived from the clinical and experimental studies of the effects of focal lesions in either cerebral hemisphere. This research paradigm permitted the isolation of each cerebral hemisphere under controlled cognitive processing conditions to yield further experimental evidence that only the dominant cerebral hemisphere has access to word knowledge in confrontation naming, and that the nondominant cerebral hemisphere has a relative advantage for processing figural or nonverbal stimuli.

Development of Quantitative and Qualitative Neuropsychological Assessment Procedures

While physiological/experimental and cognitive neuropsychological research was being generated on the east coast, and to some extent on the west, a number of investigators, primarily in the midwest, were developing objective psychometric procedures that extended the assessment of higher cortical functions from standardized intelligence tests to specialized tests of perceptual, memorial, and abstract reasoning abilities as applied to individuals with known or suspected central nervous system lesions. The Wechsler and Binet scales were already in wide use and were being studied again, primarily in the midwest, for their sensitivity to the effects of lateralized lesions in the cerebral hemispheres. The marginal sensitivity of intelligence tests to the behavioral consequences of brain lesions, especially in neurologically "silent regions," led to the construction of adjunct procedures, the earliest of which was the Halstead Neuropsychological Test Battery.

Halstead received his doctorate from Northwestern University. His ties to neurology were largely made through Heinrich Klüver (a physiological psychologist) and Paul Bucy (a neurosurgeon). The initial motivation for Halstead's work came from the necessity to validate his theory of "biological intelligence" (Halstead, 1947). He was not highly concerned with clinical application (G. Goldstein, 1985; Reed, 1985). Halstead was impressed with the relative insensitivity of some tests of brain dysfunction in individuals with known neurological involvements, as compared to the potentially more powerful sensitivity of some other tests to intrinsic brain changes. He postulated two types of intelligence, one being instrumental in learned behavior and the other having an innate and fundamentally intrinsic organic basis, and thus more dependent on the integrity of the cerebral hemispheres. This latter, or *biological intelligence*, was hypothesized to decline after involvement of the prefrontal association cortex, the region of the cerebral hemispheres that is now believed to subserve *executive functions*. The distinction between these components of intelligence was similar to Hebb's (1949) Intelligence A and Intelligence B, and to Cattell's (1963) distinction between crystallized and fluid abilities.

Halstead can be regarded as having formed the first quantitative neuropsychological laboratory, and he set out to define and assess higher cortical functions in man, beginning in about 1936. His battery came into wide clinical use as a result of the amendations and extensive research generated by Ralph M. Reitan, one of Halstead's graduate students at the University of Chicago. Reitan (1964) has devoted his entire career to extending studies with this battery, which is now known as the Halstead–Reitan Neuropsychological Battery (HRNB), to a wide array of neurological populations by means of comparisons with groups of normal, psychiatric, and medical control subjects. The Halstead Impairment Index, a composite measure of outcomes defined by group differences on each of 10 subtests, continues to serve as the pivotal measure for interpreting test results on this test battery.

Tens of thousands of patients have now been assessed across numerous neuropsychological laboratories, especially those developed by Reitan's students, including Charles Matthews, Hallgrim Kløve, Homer Reed, James Reed, and Kathleen Fitzhugh-Bell. The HRNB

is rarely used without the addition of procedures for the assessment of higher functions that are not sampled extensively by the HRNB. Owing to the paucity of effectively valid tests of planning and executive functions, adjunctive procedures often involve the use of the Wisconsin Card Sorting Test, the Porteus Maze Test, and verbal and figural associative fluency procedures to augment the Halstead Category Test (the primary basis for assessing such functions within the HRNB). The growing number of useful tests of verbal and nonverbal immediate and delayed memory has also led to the adjunctive assessment of such functions in this context, because the battery provides a less formal analysis of such functions than is considered necessary for a comprehensive neuropsychological evaluation. The HRNB does constitute an attempt to relate theory to practice, but it is primarily an empirically based set of procedures for inferring the presence of organic cerebral disease and its probable diffuse, focal locus, or both; analyzing the most likely etiological factors underlying the cognitive dysfunctions evidenced in the battery; and analyzing these findings for rehabilitation and recovery.

Another midwestern neuropsychologist, Arthur L. Benton, had his educational roots in the east, where he earned a PhD at Columbia University with Joseph Zubin and Carney Landis. He became involved in the assessment of manual test performances of psychiatric patients at the New York State Psychiatric Institute. Previous experience with Morris Bender at the San Diego Naval Hospital added to his biological orientation, because he had some opportunity to assess individuals with brain injuries during World War II. A noted historian and academician, Benton developed advanced knowledge of clinical/behavioral neurology, and also developed an interest in developmental phenomena and in speech and language (Benton, 1964, 1969). His first effort at developing a quantitative test resulted in the Benton Visual Retention Test, a measure of immediate figural recall (Benton, 1945). Initially identified as a clinical psychologist who directed a program at the University of Louisville and then at the University of Iowa, he did not become engaged heavily in neurobehavioral research until he joined the Neurology Department at the University of Iowa. It was here that his relationship with Robert Joynt and Maurice Van Allen helped him to launch a major program of neuropsychological research. Within this framework he was able to nurture and support a series of graduate students and visiting colleagues who became interested in developing their research and clinical skills in clinical neuropsychology. His subsequent record of research and development of procedures for assessing visuospatial judgment, visuoconstructional praxis, facial recognition, auditory perception, serial digit learning, cerebral dominance, developing language disorders, and language behavior are well known and have been identified selectively for didactic purposes (Costa & Spreen, 1985).

Benton's outstanding record in neuropsychology began in about 1958, when he was almost 50 years old. His record of achievement led the International Neuropsychological Society (INS) to establish an award in his name directed at recognizing research productivity in midcareer. Among those who trained or worked with Benton are Harold Bechtoldt, Don Shankweiler, Otfried Spreen, Harvey Levin, Kerry Hamsher, Nils Varney, and Julia Hannay. He also has influenced many of the best-known behavioral neurologists in the world, including Ennio DeRenzi (Italy), Amiram Carmon (Israel), Henry Hécean (France), Klaus Poeck (Germany), and Sumiko Sasanuma, a Japanese speech pathologist. To this partial sampling could be added the names of virtually all professionals who have had any contact with Benton, both within and outside of psychology and well beyond the geographic boundaries of the midwest. He received the Distinguished Professional Contribution Award of the APA in 1979. There does not appear to be anyone else whose work bridges the many domains in which Benton has functioned professionally and academically, including behavioral neurology, cognitive neuropsychology, neurolinguistics and aphasiology, developmental neuropsy-

chology, clinical psychology, and experimental/physiological psychology. His name is legion as an integrator of knowledge within and between these domains.

American clinical neuropsychology is known for its large armamentarium of quantitative procedures (Filskov & Boll, 1986; Meier, Strauman, & Thompson, 1987). Muriel Lezak's (1995) comprehensive description of procedures and norms was a welcomed and necessary attempt to bring order to what had become a highly diverse collection of applicable quantitative procedures. A related development has been the identification of principles that incorporate qualitative criteria for analyzing the behavior of individuals when executing tasks that may also be subject to quantitative analysis. The work of the Boston University group, notably Harold Goodglass and Edith Kaplan, has contributed significantly to clinical practice by drawing deliberate attention to the processes underlying neuropsychological deficits. The Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983) is an example of an assessment instrument that depends as much on qualitative as it does on quantitative aspects of the protocol. Kaplan (1983) has modified the Wechsler Memory Scale to incorporate such qualitative considerations, and she has developed adjunctive qualitative analytic procedures for the Wechsler Adult Intelligence Scale–Revised to help delineate the processes underlying disturbances in brain functioning. The work of Goodglass and Kaplan has bridged clinical psychology, developmental psychology, neuropsychology, neurolinguistics, and behavioral neurology in ways that have contributed to both theory and practice (Jones & Butters, 1983). Among those who have worked in that tradition and who now are recognized for their many contributions are Nelson Butters, Sheila Blumstein, Edgar Zurif, Laird Cermak, and Marlene Oscar-Berman, who demonstrate how the Boston group has bridged the basic and applied worlds in the domains of language, learning and memory, and other higher cognitive functions (Goodglass, 1985).

This brief review of converging lines of experimental and clinical research in the history of clinical neuropsychology is intended to convey the evolution of a specialty that did not develop in isolation, but rather was decisively influenced by multiple fields within psychology and more broadly in the neurosciences. Some of the clinical applications that are most widely practiced today have been incorporated selectively into the armamentarium of the clinician. These concepts and procedural variations have some basis in the basic cognitive and experimental/physiological foundations of the specialty. Similarly, as clinical neuropsychological practices advance, particularly as a function of the study of amnesic and prefrontally lesioned patients, basic researchers in neuropsychology and the neurosciences have been able to ask more pertinent questions and to guide their research, in part, on clinical grounds.

Developments in Behavioral Neurology and Neuropsychiatry

Despite the strong linkages between American and European medicine during the late 19th and early 20th centuries, the interest within European neurology and psychiatry in the description and neuroanatomical bases of various behavioral syndromes was not characteristic of early American neurology and psychiatry. Following World War II, some European neurologists emigrated to the United States, such as Derek Denny-Brown who had trained with MacDonald Critchley in England. Denny-Brown ultimately located in Boston, where he began to influence younger neurologists. There was some interest in the neurology of behavior in North America through the neurosurgeon Wilder Penfield, who worked in experimental collaboration with Hebb and Milner at McGill University and, in addition, through Morris Bender, who collaborated with Teuber when he was at New York University.

A major work on the parietal lobes (Critchley, 1953) was widely read in the United States and Canada, as was the work of Kurt Goldstein, a neuropsychiatrist who had trained at Heidelberg and Breslau before leaving Germany for the United States in the 1930s. Goldstein

had achieved considerable academic stature for his work on penetrating missile injuries after World War I, but he did not become known in the United States until the mid-1930s, when he began publishing a series of studies on the effects of frontal lobe lesions on abstract reasoning and categorical thinking, as reflected in performance on sorting tasks designed to measure loss of the abstract attitude and the ability to form concepts (K. Goldstein & Scheerer, 1941). Goldstein was engaged primarily in private practice in this country and was a conceptualizer who engaged philosophical and psychodynamic issues, organismic psychology, psychoanalysis, and Gestalt theory. However, he is best known in neuropsychology for his work on abstract reasoning and categorical thinking in association with penetrating brain injuries and schizophrenia. He also was among the first investigators to explore cognitive functions that transcended primary sensory and motor functions. He investigated the assumption of particular cognitive sets, the conceptual flexibility required to shift cognitive sets as prompted by changes in environmental feedback, and the ability to maintain simultaneous or compound cognitive sets. His work complemented methodologically the procedures developed by Weigl in Germany, and helped to lay the foundation for the development of the Wisconsin Card Sorting Test as a means of assessing the ability to abstract from the common properties in a test situation the essential principles for guiding actions and decisions.

Goldstein's work is an example of the permeability of interdisciplinary boundaries. He relied heavily on relatively formalized psychometric procedures and worked with psychologists, but was formally trained in medicine. The interest in this area of assessment remains extremely strong because it constitutes one of the few methodologies with some demonstrated sensitivity to the effects of prefrontal cortical involvement. The definitive assessment of the effects of prefrontal lesions remains relatively elusive, however, given the inconsistency with which even these more sensitive measures can identify the presence of frontal lobe disease, though some progress toward improved construct validity of inferences derived from attentional tasks is being achieved (Stuss, 1991).

The 19th century European literature on the neurology of aphasia was relatively unknown in this country until Norman Geschwind (1965) published a summary of that work. Norman Geschwind served a residency with Denny-Brown and Fred Quadfasel at the Boston Veterans Administration Medical Center. Geschwind had earlier been influenced by the mass-action views of higher cortical functioning of the British neurologists, such as Hughlings Jackson and Henry Head. Bent on obtaining a deeper knowledge of 19th century European behavioral neurology, Geschwind secured a Moseley scholarship and spent 3 years at Queen Square Hospital in London, where he immersed himself in that literature. He subsequently reversed direction theoretically and became an advocate of a relatively strict localizationistic view, at least as it is applied to clinical phenomena during the acute and subacute phases of cerebrovascular accidents of a relatively localized nature.

In his theoretical formulations (Geschwind, 1965) and in his many highly articulate presentations around the country, he brought to the attention of North American neurologists, psychiatrists, and psychologists the symptomatic features or syndromes associated with the white-matter disconnection of selected structures in the brain. He began a collaborative relationship with Harold Goodglass and Edith Kaplan at the Boston Veterans Administration Medical Center, where they developed a major program of research and a set of procedures for assessing aphasia that are now widely taught in the training programs of various disciplines (Damasio, 1985; Goodglass, 1986). Geschwind went on to describe anatomical asymmetries between the cerebral hemispheres that contradicted traditional views of structural equivalence of the hemispheres (Geschwind & Levitsky, 1968). He also came to recognize mechanisms that facilitated recovery and that required some deviation from a strict localizationistic view of CNS functioning. His research interests expanded considerably into the epidemiology of dyslexia before his untimely death in 1985. In the course of his brief but

extremely productive career, he inspired numerous protégés to high levels of clinical and academic achievement, including Martin L. Albert, D. Frank Benson, Antonio Damasio, Kenneth Heilman, and Alan Rubens.

European neurology and North American psychology and medicine became increasingly connected after World War II. In France, Henry Hécean and F. Lhermitte came to prominence as a result of their extensive neurobehavioral research and their publications, along with Jean De Ajuriaguerra. *Neuropsychologia* was an early journal, edited by Hécean, whose relationship to American neuropsychology was mediated largely by Arthur Benton and Brenda Milner. He had done research with both Benton and Milner on the lateralized specialization of function in the cerebral hemispheres, the epidemiology of aphasic syndromes and other neurobehavioral syndromes, and the psycholinguistic analysis of aphasia (Albert, 1984). He was a collaborator of Oliver Zangwill in England and, accordingly, he was instrumental in relating the growing French and Anglo American literatures. Similarly, Ennio DeRenzi in Milan established the journal *Cortex*. Like Hécean, DeRenzi was closely associated with Benton, with whom he spent some time as a postdoctoral associate at the University of Iowa. These individuals provide another relevant context in which Benton's contribution to interdisciplinary collaboration was influential.

Perhaps the most widely read European neurologist is A. R. Luria, who had a PhD in psychology (1936), as well as an MD (1943) from the Moscow Medical Institute. He is well known for his major text, *Higher Cortical Functions in Man* (Luria, 1966). Distinctions between psychology, psychiatry, and neurology were less well-defined in European medicine before World War II, partly because Luria, like many others, began his clinical practice in psychoanalysis, the predominant movement within the clinical domain of numerous disciplines. His research initially was focused on the isolation of unconscious processes underlying motor responsivity. The prescribed Soviet materialistic psychology of that time prompted a shift into a study of human reflexes. Social psychological interests were diverted into more ideologically benign areas. This was to the good fortune of neuropsychology, because his contributions were clearly path-finding and path-determining for neuropsychology, considered from a broad interdisciplinary perspective. Vygotsky, another major Russian psychologist, influenced Luria through his cultural–historical theory of cognitive functioning, which proposed that perception, attention, and memory are converted into socially structured cognitive functions through learning. Therefore, Luria developed an interest in the symbolic operations underlying the very highest mental functions and became launched on an intensive course of clinical and experimental investigation.

Luria was instrumental in placing numerous neuropsychological papers from around the world on the program of the International Congress of Psychology held in Moscow in 1966. He was unable to travel outside the Soviet Union due to political constraints, but he was permitted to communicate with colleagues in England and, through them, with colleagues elsewhere in the world. His text includes a remarkable breadth of content and depth of knowledge of the world literature for an individual who was so isolated. He became a major conceptualizer of the existing literature, and he became best known for his sophisticated elaboration of the general regional localization theory of higher cortical functions, which attempts to integrate the localizationistic and the mass-action/equipotentiality doctrines. Through his extensive study of the consequences of brain injuries during World War II, he achieved a level of conceptual formulation that carried the theory of higher cortical functioning toward the level that is now being attained in cognitive neuroscientific research. Luria's formulations of the concept of functional neural systems and their behavioral analysis through qualitative and quantitative test procedures, and through the analysis of symptom configurations for inferring the regional localization of the primary disease process, are now well accepted. The concept of *pluripotentiality* (or redundancy of function) at different levels

of the nervous system has had explanatory value for the analysis of recovery of function after acute cerebral injury.

Perhaps more than any other individual in the history of clinical neuropsychology, Luria has facilitated the integration of basic and clinical research. In accord with the more quantitative American emphasis in the assessment of higher cortical functions, his work prompted various individuals to formalize procedures he described in analyses of individual cases for large-sample research and for diagnostic and rehabilitation application (Christensen, 1975; Golden, Hammeke, & Purisch, 1980).

CLINICAL NEUROPSYCHOLOGY: WHAT IS IT?

The foregoing historical overview indicates that the knowledge underlying neuropsychological practice has been derived from multiple disciplinary and interdisciplinary sources over the past half-century or more. The major empirical and theoretical domains have been the basic experimental research in physiological, comparative, and cognitive psychology; the development of quantitative and qualitative neuropsychological principles and procedures for clinical application; and the descriptive syndromal analysis of the behavioral consequences of localized and diffuse neuropathological processes. The primary role of the clinical neuropsychologist is the integration of knowledge and practice across these domains. This professional function is reflected in the current definition of a clinical neuropsychologist as put forth by the Division of Clinical Neuropsychology of the American Psychological Association (Division 40 Task Force, 1989a).

The use of the designation *clinical neuropsychologist* is complicated by the fact that individuals of numerous disciplines identify themselves by the use of this term, yet there is no statutory authority within state licensing laws that isolates this role from the other roles of the various professions involved, including psychology, various medical specialties, and the speech and language professions. As nonstatutory credentialing procedures have been developed (e.g., American Board of Clinical Neuropsychology/American Board of Professional Psychology), some confusion has arisen with respect to the eligibility of individuals from disciplines other than psychology to be examined for the professional clinical neuropsychology credential. Even within psychology, state licensing statutes do not embrace specialty licensure considerations, although some states are attempting to enact legislation that will empower state licensing boards to examine in specialized areas of psychology such as neuropsychology (Mendoza, 1993).

A general definition of what constitutes clinical neuropsychological practice is necessarily very broad, as suggested by the Division 40 definition which also attempts to incorporate criteria for training and supervised experience (Division 40 Task Force, 1989a). Such definitions must necessarily be augmented by the delineation of roles and responsibilities that are encompassed by that definition. This task has been performed by the APA Division 40 Task Force on Education, Accreditation, and Credentialing (TFEAC), a continuing policy-oriented body that was established initially in 1977 by the International Neuropsychological Society (INS), and subsequently was cosponsored by INS and Division 40 of APA before becoming the sole responsibility of Division 40 in about 1982.

The rationale for recognition of a new specialty was derived from the scientific and professional products of the various supporting organizations of which INS and Division 40, through the efforts of the TFEAC, provided a leading role. These organizations generated the basic and clinical knowledge foundation through various experimental, cognitive, physiological, developmental, and applied activities, and through the proliferation of research into the psychological processes affected by the pathophysiological processes that determine the nature

and extent of neuropsychological deficits in neurologic and psychiatric disorders. Setting aside for the moment the special problems that must be addressed when clinical neuropsychology is defined in terms of its practice by specialists in other disciplines, such as behavioral neurologists and speech pathologists, it seems reasonably clear that the scientific and professional activities of psychologists in clinical neuropsychology are being integrated into a progressively more definable and expanding area of specialization within psychology (Benton, 1987; Costa, 1983; Division 40 Task Force, 1987; Meier, 1981; Rourke, 1991). The discussion that follows focuses on the specialized functions of psychologists as clinical neuropsychologists.

The first and still fundamental practice of clinical neuropsychology is the evaluation of psychological and behavioral disturbances associated with organic central nervous system dysfunction. The clinician is required to establish a comprehensive database of historical and current general medical and surgical, neurological, pharmacological, developmental, and psychosocial factors underlying the presenting problem. Included in this database is the entire complement of specialized neural diagnostic procedures such as neural imaging, electroencephalography, and brain-mapping techniques. An assessment strategy is derived from the database and referral issues and requires knowledge of the various neuropsychological protocols, test procedures, and inventories that are available through a rapidly expanding literature. This function includes the application of fixed batteries at their current stage of validation and the design of flexible test batteries based on an understanding of the probable primary processes that may be affected by the underlying disease process. The assessment goal is to address relevant neurobehavioral aspects of higher psychological functioning that are considered to be central to understanding the cognitive strengths and deficits of the individual.

The following assessment functions were identified by the Divison 40 Task Force (1987):

- Differential diagnosis between psychogenic and neurogenic syndromes and disorders (e.g., depression vs. dementia).
- Differential diagnosis between two or more suspected etiologies of cerebral dysfunction (e.g., neoplasm vs. cerebral vascular accident).
- Delineation of spared and impaired functions secondary to an episodic event (e.g., cerebral vascular accident, head trauma, infection).
- Establishment of baseline measures to monitor progressive cerebral disease or recovery processes (e.g., neoplasm, demyelinating disease, head injury).
- Comparison of pre- and postneuropsychological functioning following pharmacologic, surgical and behavioral interventions (e.g., drug trials, tissue excision, shunts, revascularization, language, or cognitive therapy).
- Assessment of cognitive and affective status for the formulation of rehabilitation strategies and the design of remedial interventions.

Competency in clinical neuropsychology requires the knowledge and skills to comprehend and integrate information in numerous areas of psychological science and the clinical neurosciences, including:

- Selected aspects of functional neuroanatomy, neuropathology, and pathophysiology.
- Disorders of attention, sensory, perceptual, conceptual thinking, language, memory, and voluntary and involuntary motor and affective processes.
- Neurological and related diseases, including their manner of presentation, course, and treatment.
- CNS effects of systemic disorders.
- Child development and ontology of neuropsychological processes.

- Expected decrements in neuropsychological processes as a function of normal aging.
- Behavioral pathology and psychopharmacology.
- Psychophysiological principles underlying behavioral pathology.
- Sociocultural factors as codeterminants of behavior.
- Principles of personality assessment and interviewing skills.
- Principles of test administration and interpretation relating to both fixed and flexible neuropsychological batteries.
- Principles of cognitive remediation and derivation of specific intervention strategies.

It is immediately evident that the assessment role in clinical neuropsychology includes the derivation of intervention strategies and, by implication, an intervention role. Because clinical neuropsychologists are ordinarily specializing from a generic applied base, either in clinical, counseling, or school psychology, they have already acquired a foundation in assessment and intervention that is being extended by means of specialized training and supervised experience into the neurobehavioral domain, when it is broadly defined. A search for a core curriculum that will ensure the development of neuropsychological competency necessarily would include cognitive, physiological, and experimental psychology; differential psychology, abnormal psychology, and life-span developmental psychology. The curriculum would also include relevant areas of clinical neuroscience, including clinical neurology, behavioral neurology, and specialized neurodiagnostic technologies as a basis for refinement of skills to extend competency into increasingly more specialized activities. The latter would appear to include design and validation of new neuropsychological procedures to extend applications in behavioral analysis and modification, learning disorders, psychopharmacology, psychophysiology, remedial interventions, behavior genetics, psycholinguistics, personality, and psychopathology (functional and organic). Therefore, clinical neuropsychology as practiced by psychologists would build on a knowledge base that includes other disciplines as well as subdisciplines within psychology. Members of the subdisciplines of psychology involved in this knowledge base do not ordinarily practice clinical neuropsychology unless, of course, they have taken steps to acquire the generic applied, as well as the specialized, knowledge and clinical skills that comprise a full competency in the specialty.

Parameters of Practice in Clinical Neuropsychology

Clinical neuropsychology has evolved as a specialized area of knowledge and application and is increasingly recognized as having distinct disciplinary and interdisciplinary features. It is noteworthy that within the discipline of psychology, clinical neuropsychology has not received uniform recognition as a specialty, owing largely to the characteristic lag between developments in the field and modification of APA policies to address those changes. APA has recognized this problem for many years and has charged committees and boards within the organization to pursue a rationale for the identification and continued recognition of new specialties. It has been more than a decade since the APA Subcommittee on Specialization (SOS) of the APA Board of Professional Affairs submitted its first report. The SOS report was subsequently revised in the form of a manual (Sales, Bricklin, & Hall, 1984) that included a proposed set of principles and procedures which a new specialty might address to establish its case for initial identification and continued recognition as a specialty.

Clinical neuropsychology had been evolving through an identifiable sequence of developments and was the first area of practice to provide an organized response to the SOS manual. It was hoped that the APA would devise procedures for review of such a claim by appropriate organizational and interorganizational bodies. This hope did materialize, so there is now a

formal mechanism for the recognition of new specialties within the APA. The Commission for the Recognition of Specialties and Proficiencies in Professional Psychology (CRSPPP) was established by the APA in 1995 to receive and process petitions by sponsoring organizations in support of an emerging area of practice to be recognized as a specialty or as a proficiency. The Division 40 Planning Committee (chaired by the author) then prepared a petition package for submission to the CRSPPP, following guidelines modeled largely after the earlier deliberations of the SOS, in support of claims by Division 40 that clinical neuropsychology meets the CRSPPP criteria for a specialty. CRSPPP unanimously approved this petition in April, 1996. This endorsement has now been forwarded to the Council of Representatives for further action and movement through the APA governance structure.

An important contribution of the SOS was the identification of four parameters of specialized practice that characterize a specialty and help to differentiate a given specialty from preexisting and other emerging specialties; that is, *problems*, *procedures*, *populations* and *settings*. The SOS also elaborated conceptually the distinction between generic and specialized competencies and proposed that any specialized competency must be built on a generic applied core as well as basic knowledge of psychology. Generic applied competency requires a foundation in psychological science with a predominantly clinical emphasis, although such training may be attained through other generic avenues if a clinical internship is included. The generic base for clinical neuropsychology was expected to include the structure and process of interviewing, intellectual abilities, aptitude, interest and personality measurements, selected psychotherapy and counseling interventions, consultation skills, and a consumer/patient educational orientation. Specialized competency was deemed to include comprehensive history taking, definition of clinical problems/issues to be addressed, establishment of problem- and goal-oriented records, proficiency in goal attainment scaling as a basis for intervention, quality assurance and service systems evaluation, application of a wide range of neuropsychological assessment procedures to multiple populations served by neuropsychologists, test construction and validation, remedial and supportive intervention design and implementation, individual and agency consultation, and consumer education skills. Such specialized competency was expected to be achieved by means of sets of skills anchored to the four parameters of practice that the SOS identified.

Clinical neuropsychologists function primarily based on referrals from health, education, and legal professionals; agencies and institutions; and in response to needs of other service systems (e.g., courts, schools, extended rehabilitation and general care facilities, military installations, chemical treatment facilities). Primary employment settings are estimated to be almost equally divided between hospital medical centers, private practice, a combination of (salaried) hospital- or clinic-based employment, and private practice (Putnam & DeLuca, 1990, 1991). The four parameters of practice identified by the SOS have implications for distinguishing between specialties and proficiencies and for the definition and assessment of competency.

Problems Confronted

Referrals for clinical neuropsychological assessment typically include, but are not limited to, the following: differential diagnoses between psychogenic and neurogenic syndromes; differential diagnoses between two or more suspected etiologies of cerebral dysfunction; elucidation of spared and impaired functions secondary to a cerebral cortical or subcortical event; establishment of neurobehavioral baseline measures for monitoring progressive cerebral disease or recovery; comparison of pre- and postpharmacologic, surgical, or behavioral interventions; and assessment of higher cortical functions for the formulation of rehabilitation strategies. Intervention problems include design of procedures for utilizing available functions to compensate for an impaired function, retraining of the impaired function to a

higher level of adaptive effectiveness, and environmental (ecological) manipulations to enhance adaptive effectiveness.

Populations Served

Adult neurological populations include cerebrovascular accidents, neoplasms, infectious and inflammatory diseases, degenerative diseases, head trauma, demyelinating disease, and various forms of dementing illness. Psychiatric populations of primary interest include somatoform disorders of pseudoneurologic character; depression as a component of, a diagnostic alternative to, or both to be differentiated from dementia; and psychosis as a pseudodementing disorder or as a differential diagnostic entity to be distinguished from behavioral disturbances in selected neurological populations such as partial complex seizure disorder.

General medical and surgical populations include older individuals who may have some neuropsychological deficits associated with an early dementing illness that may complicate medical or surgical management; candidates for kidney transplant or dialysis; candidates for cardiac surgery, including transplants; and chronic pain patients with a neurological versus functional basis.

Children with learning disabilities with a possible neurologic basis are referred from pediatricians, pediatric neurologists, and the schools, in addition to a marked expansion of neuropsychological evaluation and treatment of pediatric neurological patients. Growing referral populations include the chemically dependent (especially polydrug users and alcoholics), AIDS dementia cases, and victims of environmental toxin exposures.

Settings

Practice is prevalent in health science centers and associated teaching hospitals, community hospitals and clinics, rehabilitation institutes, military hospitals, Veterans Administration Medical Centers, and private practices.

Services and Procedures

Primary services include neuropsychological assessment, cognitive remediation and intervention, agency and institutional consultation, education and counseling for individuals and families, and selected psychotherapies or behavioral therapies as appropriate for neurologically involved individuals. A growing armamentarium of procedures is available for neuropsychological assessment (Lezak, 1995) and for cognitive remediation and intervention (Meier, Benton, & Diller, 1987).

The APA subsequently put a second group to work on the new specialty issue; namely, the Task Force on Scope and Criteria of Accreditation, which issued a report in June of 1989 that called for the establishment of procedures for recognizing new specialties. These procedures are currently under consideration and should result in more formal procedures for recognizing new specialties. Clinical neuropsychology stands at the top of the list for such recognition and has been invited to work through Division 40 and other interested organizations, such as the American Board of Professional Psychology, for early consideration. Therefore, clinical neuropsychology is likely to become the first formally recognized new specialty based largely on the work of the TFEAC and its liaison activities with the SOS/BPA and the Board of Educational Affairs (BEA) of APA. The American Board of Clinical Neuropsychology (ABCN), through its relationship with the American Board of Professional Psychology (ABPP), has become a leader in the development of knowledge and competency-based examining procedures. ABPP has been prompted by ABCN to provide leadership for the specification of criteria for postdoctoral programs, which probably will become the major source for advanced specialization training of clinical neuropsychologists in the future.

EDUCATIONAL MODELS

Predoctoral Level

The TFEAC has produced guidelines for predoctoral programs, doctoral internships, and postdoctoral education and training (Division 40 Task Force, 1987). Analysis of predoctoral options suggested five potential models for curriculum design (Meier, 1981). All require inclusion of courses and supervised practicum experiences in the critical knowledge and skill areas identified earlier. Representative curriculum outlines are available elsewhere.

Model I—Complete Intradepartmental Curriculum. This model would have all aspects of the curriculum, including psychological, neuropsychological and clinical neuroscience components, provided by a Department of Psychology graduate faculty in an applied (usually clinical) program. Only departments without access to a major health sciences center would be expected to attempt to apply this model. Such departments would necessarily be geographically remote and have limited clinical training opportunities. However, they might have access to a network of clinical facilities with qualified clinical supervisors that would be required to develop a definitive program. The likelihood of such a program meeting future accreditation requirements seems questionable given the knowledge and skill agendas outlined earlier.

Model II—Interdepartmental Supporting Program. Although the basic psychological science and generic clinical core courses would be provided by a graduate department of psychology, an interdepartmental supporting program (or minor), usually in a medical school located in a major health sciences center, would complement the curriculum through clinical neuroscience courses and supervised neuropsychological practicum (e.g., University of Iowa, University of Minnesota). This model adds one year to a characteristic clinical or other appropriate departmentally-based generic applied program and assumes inclusion of an internship with generic and specialty activity foci. A 2-year internship (one generic and one specialized) is usually necessary for definitive competency development as recommended for the future in all applied areas at the Gainesville Conference on Internship Training (Belar et al., 1989). A 1-year internship with generic and specialized components could be followed by 1 year of formal specialized postdoctoral training in this model.

Model III—Autonomous Designated Program. A comprehensive predoctoral curriculum designed to produce a fully competent clinical neuropsychologist has been attempted by a few departments. Such programs are notable for their independence of other applied programs, including clinical programs, within the sponsoring psychology department (e.g., University of Houston, Queens College of the City University of New York). Such programs are not eligible for accreditation review and approval under current APA policies. This may account, at least in part, for their small number. Another important factor is the need to establish a generic competency base before or while acquiring specialized competency, which presents a difficult challenge for such programs unless the curriculum is lengthened by at least 1 year. It is noteworthy that the Houston program has been integrated with the APA-Accredited Clinical Program in that department to form a track, much like programs at the University of Windsor and University of Memphis.

Model IV—Simultaneous Pursuit of PhD and PsyD Degrees. Although conceptually interesting, no examples of this model have been identified. In addition to being unrealistic to meet the needs of most students interested in clinical neuropsychology, the model does not circumvent the need for generic as well as specialized competency develop-

ment. However, a conceptual analysis of the model yields a better understanding of the academic requirements for developing research in contrast to clinical competencies in a given specialty (Meier, 1981).

Model V—Integrated Clinical Neuroscience Curriculum. A few universities have integrated relevant departmental resources into a clinically oriented, but largely basic, neuroscience curriculum. A core curriculum in neuroscience is pursued by students from different disciplines, including psychology. The primary goal of such programs is the production of clinical neuroscientists with an interdisciplinary orientation (e.g., University of California–Berkeley, Stanford University, University of Minnesota). Psychology students in such a curriculum who wish to acquire clinical neuropsychological competency are still confronted with the need for supervised generic clinical and specialized neuropsychological education and training. Such considerations apply as well to graduate students in experimental, physiological, cognitive and developmental psychology who sometimes enter the clinical neuropsychological arena without generic clinical or specialized clinical neuropsychological backgrounds. They may feel entitled to function in applied roles on the basis of their academic credentials, but then naively (yet in good faith) attempt to enter professional practice. Clinical neuropsychology continues to embrace the scientist–practitioner approach to training and practice, but appreciates that different orientations and competencies are involved in research and practice roles.

Predoctoral Internship Level

Like predoctoral programs in the (de facto) traditional specialties (e.g., clinical, counseling, school psychology), predoctoral internships are accredited by the APA. However, accreditation applies to the designated specialty and not to any specialized tracks within the internship. Accreditation, therefore, has only generic clinical implications for the competencies being developed. The primary goal of the internship is to ensure competency for entry into professional practice. Most jurisdictions then require 2 years of supervised applied experience for licensure. This renders most internships incomplete for specialized competency development. Many internships are providing substantial rotations in neurologic, psychiatric, and rehabilitation settings and they are preparing people very well for a formal postdoctoral specialty training year or two (e.g., University of Florida, University of Michigan). Accreditation criteria require that at least one half of the internship be devoted to generic clinical activities. Other than a 2-year internship format, internship experience does not appear to be sufficient for specialized competency attainment. Internships can provide an introduction to specialty practice, but they are increasingly followed by postdoctoral training (Meier, 1987).

Postdoctoral Level

The TFEAC anticipated that doctoral education-training would become the primary basis for establishing specialized competency in clinical neuropsychology. Although there has been some increase in the number of clinical psychology programs with specialized tracks in neuropsychology, the number of complete predoctoral programs have not increased significantly. Instead, most of the growth in training activities has occurred at the postdoctoral level. This is due, in part, to the absence of accreditation mechanisms for neuropsychological specialization at the doctoral and internship levels. More importantly, there appears to be wide recognition of a need to establish generic applied knowledge and skills before embarking on specialized competency attainment. The SOS Principles and Procedures documents appear to have anticipated this development by distinguishing between generic and spe-

cialized competencies and emphasizing the interdependency between them. In addition, the doctoral and internship levels have been pressed to provide adequate generic applied preparation within the traditional time frame, and cannot readily provide more than introductory specialized knowledge and practicum experience. Because most licensure statutes require 2 years of supervised postdoctoral experience, the predisposition to seek postdoctoral training is further increased. Add to such factors the marked increase in knowledge and application that is dramatically apparent when one attends a major professional meeting (e.g., INS, APA Division 40), and the need for postdoctoral training becomes even more compelling.

This rapid specialty development probably accounts for the growth in postdoctoral training opportunities that is reflected in the recent establishment of the Association of Postdoctoral Programs in Clinical Neuropsychology (APPCN). This association evolved from the Midwest Neuropsychological Consortium, a group of programs directed by ABPP/ABCN Diplomates in clinical neuropsychology that are largely located in large health sciences centers. The APPCN adheres to the TFEAC Guidelines for Postdoctoral Training (Division 40 Task Force, 1987). Formalization of postdoctoral training guidelines is proceeding further through initiatives from the American Board of Professional Psychology (ABPP), which sponsored an interorganizational meeting in 1991 that resulted in the establishment of the Interorganizational Council for Accreditation of Postdoctoral Programs in Psychology (IOCAPP). This group of organizations includes ABPP, APA, the National Register, APPIC, the Canadian Register, the Association of State and Provincial Psychology Boards (ASPPB), and representatives from ABPP specialty boards or associations of postdoctoral programs such as the APPCN. The impetus for this development came from ABPP at the suggestion of the American Board of Clinical Neuropsychology (ABCN) representative (Manfred Meier) on the ABPP Board of Trustees. APPIC and APA have now conducted postdoctoral conferences to define standards for postdoctoral education and training. The development of postdoctoral program standards by the APPCN and new specialty recognition by APA should lead to the accreditation of clinical neuropsychology postdoctoral programs in the near future.

It is assumed that clinical neuropsychology programs at all training levels (predoctoral, internship, or postdoctoral) have as a primary goal the development of clinical competence. Therefore, the distinguishing feature of such programs is their emphasis on training for clinical practice. The scientist–practitioner model that is widely endorsed as the primary basis for developing such skills calls for the establishment of research competency as well. The scientist component of that model could be extended to require development of a competency for utilizing research findings in clinical practice rather than mastery of an advanced level of research competency, which may well require more basic psychological and cognitive neuroscience preparation than postdoctoral clinical neuropsychological programs can provide.

There also is the issue of subspecialization, which appears to be following a pediatric/adult/geriatric compartmentalization. All levels of training would be expected to provide a life span developmental perspective through appropriate courses and practicum experiences; therefore, it may be premature for individuals to consider developmental stage subspecialization through entirely separate training programs that do not provide much overlap between age groups in their training activities. Nevertheless, subspecialized interests will inevitably arise and favor relative subspecialization in, for example, the pediatric as contrasted with the adult, or later adult, age groups. Considered from the standpoint of the four parameters of practice, the developmental dimension appears to pervade populations and settings which then present somewhat different constellations of problems and procedures for providing clinical services. It seems reasonable to require of any curriculum the introduction of a definitive developmental component which could then serve as a point of departure for guiding individuals into subspecialized areas. The ABCN/ABPP examination

permits the candidate to elect child or adult cases for corresponding components of the examination and for work sample production purposes. Therefore, a subspecialized component is already interwoven into the formal credentialing procedure.

The differentiation of specific professional knowledge and practice skill requirements in these areas may be sufficient to warrant the election to pursue subspecialized competency at about the time the person receives the doctoral degree. By that time, those interests should have congealed sufficiently. Postdoctoral programs would then be expected to differentiate those elements of their respective curricula sufficiently to help the interested candidate for the program to estimate the likelihood that her or his needs can be met. Certainly, the major postdoctoral training programs are already being identified as having relative strengths and emphases in the pediatric or adult domains or both. Detailed program brochures are now being developed utilizing the guidelines for program content, and are being distributed by the APPCN. Predoctoral and internship programs are listed in the *Directory of the Association of Psychology Postdoctoral and Internship Centers* (APPIC). Postdoctoral programs in clinical neuropsychology are also listed annually in *The Clinical Neuropsychologist*, as collated by Lloyd Cripe. Postdoctoral program criteria and a list of membership programs in the APPCN are available from Thomas Hammeke, Chair of the Organizing Committee for that organization.

In addition to these developments in postdoctoral education, groups are forming to define similar criteria for predoctoral and internship-level training. For this reason, specific recommendations with regard to program content and direction are not provided in this chapter. The interested reader should find considerable access to the available information through literature citations offered here. There is obviously major movement in training, following the important work of the TFEAC and relatively extensive analyses of curriculum considerations and projections for the future (Bornstein, 1988; Costa, 1983; Division 40 Task Force, 1987; Meier, 1981, 1987; Rourke, 1991).

RECOGNITION OF NEUROPSYCHOLOGY AS A PSYCHOLOGICAL SPECIALTY

The slow, but deliberate, progress within APA toward recognition of new specialties attests to the greater differentiation of roles and responsibilities, based on their advancing knowledge and practice within the discipline of psychology. Clinical neuropsychology was the first new specialty in 28 years to be recognized by the American Board of Professional Psychology (ABPP). The last previous specialty to be recognized by ABPP was school psychology, preceded by counseling and clinical psychology, both of which were recognized for credentialing when ABPP was founded in 1947.

Further evidence of recognition of clinical neuropsychology has been the proliferation of professional and scientific organizations that have served an integrative role for this remarkable expansion of its basic and applied scientific knowledge that guides clinical practice. A parallel development has been the virtual explosion of major texts and journals that are devoted largely to clinical neuropsychological issues.

Scientific and Professional Organizations

There were no organizational mechanisms to provide a forum for clinical neuropsychology until the formation of the International Neuropsychological Society (INS) in the 1960s. The INS initially met as a relatively small and informal group, usually at APA meetings, and did not expand remarkably until the 1970s (Smith, 1980). Its continued rapid growth has led to a current multidisciplinary membership that exceeds 3,000. The INS growth curve spurted

with the New Orleans meeting in 1973, which was the first year that INS offered a comprehensive scientific program. Arthur Benton was president of INS at that time and he deemed it appropriate to forge ahead with a major program, given the expanding knowledge base for neurobehavioral theory and clinical practice. He appointed a program committee of international stature, chaired by Paul Satz, that attracted numerous program submissions from major contributors to the field at that time. The INS remained primarily a North American organization, but gradually extended its mission and scope to include a European branch.

Aaron Smith was the key figure in the establishment of INS, and he worked effectively to maintain the organization in its formative years as editor of the *INS Bulletin*, which he established. He subsequently received a Distinguished Service Award from the INS for his many professional contributions, including the editorship of this periodical, which served as the central organizational device for clinical neuropsychology as the specialty was beginning to achieve formal recognition, well before INS and other subsequent organizations became more structured (Butters, Benton, Goodglass, Rourke, & Bakker, 1984). The INS went on to adopt its first official journal, the *Journal of Clinical Neuropsychology*, which later became the *Journal of Clinical and Experimental Neuropsychology*, edited by Louis Costa and Byron Rourke. Although this is an independent journal, it has served as the official journal of the INS for the purpose of publishing the abstracts of the two annual meetings of the association. INS has recently decided to publish its own organizational journal.

Because the readiness to establish a Division of Clinical Neuropsychology within APA was lacking at that time, due largely to the novelty of the specialty and, as yet, its lack of wide recognition, INS remained the major vehicle for individuals and groups that were interested in clinical neuropsychological theory, research, and practice. Growth was reflected in an annual attendance exceeding 600, and a membership that reached 2,000 by 1980. By then, the INS had become more widely international as well as interdisciplinary. Clinical neuropsychologists, experimental and physiological psychologists, behavioral neurologists, psychiatrists, neurosurgeons, physiatrists, speech pathologists, and professionals from assorted rehabilitation disciplines were joining INS in substantial numbers. Nevertheless, disciplinary composition of the INS remained approximately 90% psychologists; the remainder of the membership came from all of the other disciplines. However, the variegated composition of INS fostered both an interdisciplinary and an international orientation in its membership.

The differentiation of roles and responsibilities and the differing educational and professional perspectives of such a diverse set of interests made it difficult for the INS to consider the professional issues confronting North American clinical neuropsychologists in the 1970s. Nevertheless, at Arthur Benton's recommendation, the INS Board of Governors established the Task Force on Education, Accreditation, and Credentialing which was chaired by the present author. It was charged with developing guidelines for predoctoral, internship, and postdoctoral training; guidelines for the credentialing of individual competencies; and the formulation of a proposal for accreditation of educational programs at various levels. These guidelines and recommendations were intended to encourage more systematic educational efforts and the establishment of external review procedures for assessing both the competence of individual practitioners and the effectiveness of educational programs.

North American clinical neuropsychology was confronted with the responsibility for moving such indirect regulatory procedures in a direction that would encourage more deliberate preparation for research and practice which was, until then, provided by individuals who had little formal educational preparation or supervised clinical experience in neuropsychology. Most claims to professional competency were based on limited workshop and conference activities by practitioners who were lacking formal training and supervised experience. These ends are now being achieved, as evidenced by the advent of numerous formal postdoctoral

training programs and the expansion of clinical neuropsychological training opportunities within predoctoral and internship programs. There has been, however, less than the anticipated expansion of formal predoctoral programs of an exclusively neuropsychological nature.

The *Journal of Clinical Neuropsychology* was an immediate success and, combined with the already established *Neuropsychologia* and *Cortex* that were being published in Europe, the appearance of the new journal gave impetus to INS and the formation of other neuropsychological organizations in the scientific and professional communities. It quickly became evident that educational and professional issues would need to be processed within nations by members of the interested disciplines, and not through the INS. The TFEAC continued its work but encouraged groups to be formed that would permit the pursuit of such issues by nation and by discipline. This led to the formation in 1979 of a Steering Committee, chaired by Louis Costa and independent of INS, for the purpose of establishing a division within APA. This required the overcoming of significant political barriers because clinical neuropsychology was not formally recognized as a specialty by APA, and it was considered by many psychologists within APA to be a subspecialty of limited scope within the specialty of clinical psychology. Resistances were also encountered from the Division of Physiological and Comparative Psychology (Division 6), but the proposal for a new division passed the Council of Representatives in 1980, following considerable debate. With the proliferation of new divisions within APA, there was a natural resistance to further expansion. However, there was no rationale for a restrictive, reactionary attitude, and the relatively democratic governance procedures of APA prevailed to ensure a place for the specialty within that large organization. This series of events led to the formation of another journal, *The Clinical Neuropsychologist*, in 1987, which has served as the unofficial journal for Division 40 for the purpose of publishing the Division's abstracts of presentations at APA meetings.

The relatedness of INS and Division 40 as organizations was reflected in a proposal from INS to share responsibility for future planning and growth by inviting Division 40 to serve as a cosponsor of the TFEAC. As Division 40 matured and demonstrated that it could effectively address the professional issues and problems confronting clinical neuropsychology in the United States and Canada, the INS withdrew from the TFEAC and encouraged Division 40 to exercise sole managerial control. The first formal position statement from the Task Force was issued jointly in an attempt to define clinical neuropsychology as a specialty, generate models for predoctoral educational preparation, and delineate the knowledge base for establishing individual clinical competence (Meier, 1981). Subsequently, the Task Force developed guidelines for internship and postdoctoral programs which are being elaborated by the Association of Postdoctoral Programs in Clinical Neuropsychology (APPCN), thus setting the stage for the ultimate accreditation of programs at various levels (Division 40 Task Force, 1987). The TFEAC has now generated guidelines for doctoral, predoctoral internship, and postdoctoral training (Division 40 Task Force, 1987); entry into the specialty (Bornstein, 1988); continuing education (Bornstein, 1988; Meier, 1987); use of nondoctoral personnel (Division 40 Task Force, 1989b); computer-assisted neuropsychological evaluation (Matthews, 1987); and computer-assisted neuropsychological rehabilitation and cognitive rehabilitation (Matthews, Harley, & Malec, 1991).

A third major professional organization, the National Academy of Neuropsychology (NAN), was established independently of these developments in the late 1970s by a few individuals who used the organization primarily as a vehicle for presenting continuing education workshops to the many clinical practitioners who endeavored to expand their clinical skills. Continuing education, primarily for clinical practitioners, has become the primary role of NAN, which has added poster sessions to its programs in recent years. NAN has shown some recent interest in addressing educational and professional issues, but has not done so deliberately, emphasizing workshop activities in the course of its growth into an

organization of over 2,000 individuals. It published a newsletter for some years and more recently established the *Archives of Clinical Neuropsychology* as its official journal. NAN has clearly moved beyond its initial mission and facilitates practitioner focus on clinical issues through continuing education, workshop activities, and poster sessions. The formats of INS and Division 40 meetings emphasize symposia, platform and poster presentations, and a limited selection of continuing education workshop activities.

Collectively, the INS, APA Division 40, and NAN provide an ample organizational framework for pursuing almost any configuration of neuropsychological interests. Furthermore, APA provides access to developments in cognitive and physiological psychology as these specialties relate to clinical neuropsychology. The American Psychological Society (APS) offers opportunities for acquiring basic psychological knowledge as it relates to cognitive psychology, as does the Society for Neuroscience for those with primarily research interests. There is also a ground swell of interest at the local level, as evidenced by the formation of numerous city, county, state, and regional organizations in North America, and counterpart groups around the world. The latter are gaining access to these organizations, particularly INS, through the conduct of regional meetings such as that organized by a group of neuropsychologists from the Pacific Rim nations that was held in Australia in 1992. There has also been an effort to develop a world federation of neuropsychological societies, the impetus for which has come from psychologists in underdeveloped nations who need assistance in attending meetings of the aforementioned organizations and in developing their own organizations. The socialization of clinical neuropsychology as a specialty, as represented by all these organizational developments, is an inevitable consequence of the healthy growth of a vital human activity.

Credentialing Boards

Just as the deliberations of the TFEAC stimulated the formation of a Steering Committee for the establishment of a Division of Clinical Neuropsychology within APA, its efforts also gave impetus to the formation of a Steering Committee to establish the American Board of Clinical Neuropsychology (ABCN), chaired by the present author. As President of the ABCN, I was charged to negotiate a formal arrangement with the American Board of Professional Psychology (ABPP) to achieve recognition of clinical neuropsychology as a new specialty within the ABPP structure. The ABPP had served as the credentialing board for the evaluation of advanced competence in the specialties of clinical, counseling, school, and industrial/organizational psychology, since its inception in 1947. The ABPP Board of Trustees in 1982 agreed to the arrangement and assigned the ABCN with the responsibility for establishing eligibility criteria and an effective competency-based examination for the attainment of diplomate status in clinical neuropsychology. Therefore, the ABCN was permitted to function as an autonomous examining board, but was accountable to the ABPP Board of Trustees for the relevance of its eligibility criteria and the effectiveness of its competency-based examination. This was achieved by localizing administrative activities in the ABPP central office and through ABCN representation on the ABPP Board of Trustees, where the activities of ABCN could be monitored by the overarching board. In turn, ABCN could also influence the other areas of practice being credentialed under the jurisdiction of ABPP. The resulting interactions over the next decade have led to the examination of individuals credentialed by ABCN through ABPP, beginning with the initial ABCN board, which was examined by ABPP Diplomates in one or more of the other specialties who themselves were also examined, all with ABPP participation. The ABCN has now credentialed over 250 individuals. Its success has also contributed to change within the ABPP governance structure, insofar as ABPP has moved from a regionally controlled diplomating board to a specialty-centered diplomating board in which each specialty of ABPP is now required to form an autonomous

credentialing board. These boards have been formed and are responsible to ABPP for quality assurance and continued monitoring of the specialty boards' activities. Moreover, the diplomates of each specialty board are forming membership organizations to separate membership from credentialing functions and, thereby, to minimize the potential for conflicts of interest between boards and members.

There now exist 10 credentialing boards under the umbrella of the ABPP Board of Trustees (BOT). The BOT is made up of representatives from the following participating boards: Clinical Psychology, Counseling Psychology, School Psychology, Industrial/Organizational Psychology, Clinical Neuropsychology, Forensic Psychology, Family Psychology, Health Psychology, Behavioral Psychology, and Psychoanalysis. Clinical neuropsychology was the first new specialty added to the ABPP roster since school psychology was added as a diplomate specialty in 1974. It is interesting that with the establishment of ABCN, there quickly followed the addition of the Forensic, Family, Health, and Behavioral Psychology specialty boards. It is also noteworthy that the expansion of ABPP in the last decade has compelled a change within ABPP from a regional to a specialty-oriented organizational structure in which each specialty is constituted as an independent board for conduct of the examinations. In part, this change was prompted by ABCN's effective application of the assessment center approach to competency evaluation. Therefore, ABCN is contributing to increased standardization of procedures within and between specialties relative to level of difficulty, reliability, and validity for the assessment of competence.

The ABCN also was instrumental, through its representative on the ABPP/BOT, in fostering a stronger linkage between developments in the accreditation of educational programs, particularly postdoctoral programs, and development of competency at an advanced level as assessed by means of the ABCN examination. ABPP now regards formal postdoctoral preparation in a given specialty as both desirable and deserving of a shorter time lag following the award of the doctoral degree before becoming eligible to take the ABPP examination through the specialty boards. A distinguishing feature of ABCN's initial presentation to ABPP (before any examinations in clinical neuropsychology were given) was a document from the TFEAC that addressed the SOS manual toward describing how the assessment center approach could be applied to the evaluation of clinical competence. After meeting ABPP's general requirements as well as ABCN's eligibility criteria, applicants are asked to submit two work samples, the structure for which is clearly defined in manuals that have been developed to serve both the potential examinee and the work sample reviewers. With the approval of the work sample for defense, an oral examination is then carried out using the assessment center model (Bray, 1984; MacKinnon, 1975; Moses & Byham, 1977). The examination process is monitored by the ABPP through its liaison operations with constituent boards; it is implemented by the ABCN (Bieliauskas & Matthews, 1987, 1990).

The ABCN examination now also includes an objective knowledge evaluation that was developed in cooperation with the Professional Examination Service. This examination makes use of the format and test construction procedures that have been applied in the national psychology licensure examination. This objective examination is designed to screen candidates for general neuropsychological knowledge before they enter the work sample phase so that the oral examination phase should be reached only by individuals who are clearly ready to demonstrate advanced professional competence based on definitive clinical and theoretical knowledge. All of these activities are monitored through the ABPP/BOT and, therein, by the various other specialties that are represented on the BOT, which thus ensures profession-wide participation in the verification of procedural quality and effectiveness. The reciprocally beneficial effects of ABPP's change to a federated board organizational structure should increase the effectiveness of each specialty of psychology as specialty practice standards within the profession become more clearly defined and differentiated.

Accordingly, ABPP can be regarded as the first organization to recognize clinical neuro-

psychology as a specialty. All of the aforementioned professional and scientific organizations have contributed to the identity of the specialty in accord with their respective missions. The relationship of ABCN to ABPP has placed the competency examination process into an organizational framework that extends beyond these two organizations to include the entire configuration of organizations and regulatory bodies that define the profession of psychology.

A major locus of organizational interaction has been the establishment of the Interorganizational Council for the Accreditation of Postdoctoral Programs in Professional Psychology (IOCAPPP), also known as the "IOC." This council was established as a result of a meeting in Minneapolis of various organizations invited by the ABPP in September of 1991. The other participating organizations were the Association of State and Provincial Psychology Licensing Boards (AASPB), the National Register of Health Services Providers in Psychology (NR), the Association of Psychology Postdoctoral and Internship Centers (APPIC), the APA through its Board of Professional Affairs and Accreditation Committee, and representatives of the specialties and appropriate educational organizations such as the Association of Postdoctoral Programs in Clinical Neuropsychology (APPCN). The latter group has now met a number of times and has produced a model for the accreditation of postdoctoral programs for neuropsychological specialization. The model includes a program Self-Study Form and a Site Visit Evaluation Form, both of which are available through the Chair of APPCN. These forms were developed by the Midwest Consortium of Postdoctoral Programs in Clinical Neuropsychology, the forerunner of the APPCN. In addition, APPIC sponsored a major conference on postdoctoral accreditation in Ann Arbor, Michigan, in 1992. Because the APA also sponsored a conference on related issues that was held in Norman, Oklahoma, in January of 1994, a definitive interorganizational movement toward postdoctoral program accreditation is in progress.

As the initiator of the interorganizational conference that led to the formation of the IOC, ABPP is clearly committed to making its competency evaluation procedures for the determination of advanced competence reflect the knowledge and skill components that will help to set directions for the continued evolution of postdoctoral, as well as predoctoral and internship, training programs. The cooperative activities of these various organizations toward the generation of standards of practice and for establishment of the basis of competence in professional knowledge and practice have clearly led to continued effectiveness of ABCN; for example, as a specialty board in clinical neuropsychology.

Given this extensive developmental history, ABCN can be characterized as endorsing the scientist–practitioner model for the practice of clinical neuropsychology. That model would apply in the broadest sense to include not only the practitioner as a producer of research, but also the practitioner as a consumer of research. Therefore, the model does not preclude a nonresearcher from achieving advanced professional competence. On the contrary, the majority of individuals entering the ABCN credentialing process are not researchers or members of an intellectually elite group of clinical neuropsychologists; rather, they are commonly graduates of clinical programs with years of professional experience that have been supplemented by selected continuing education activities.

ABCN would appear to have introduced an orderly and professionally endorsed competency-based examination procedure for the specialty with the support, supervision, and assistance of ABPP and, indirectly, of the various organizations with which ABPP has established a dialogue. Accordingly, the effectiveness of ABCN and its relevance to the individual who claims advanced competence (or the necessary competence for effective professional practice) in clinical neuropsychology are subject to the scrutiny of the entire profession of psychology through the ABPP and, indirectly, through ABPP's associated network of regulatory organizations. Therefore, ABCN has stood the test of peer review at the organizational level so that its procedures and policies carry endorsements from legiti-

mate sources outside of the specialty as well as those within the specialty. A list of ABCN/ABPP diplomates is published in the APA Directory. It is this characteristic that distinguishes the ABCN/ABPP credentialing procedure from others that have been introduced, such as that of the American Board of Professional Neuropsychology (ABPN), which was originally established in 1982.

The ABPN Board members initially awarded their diploma to an unknown number of individuals, believed to approach 200, on the basis of a credentials review. The nature of this review does not appear to have been published or shared in any formal manner with the profession. Following an initial spurt of such credentialing activity, there appears to have been a cessation of ABPN work for a number of years before a cadre of individuals was activated to resume these credentialing activities. Descriptions of these activities are currently portrayed in a brochure that is available from the ABPN (American Board of Professional Neuropsychology, 1994). The brochure calls for the submission of a completed application package, followed by work samples if the application is approved, and an oral examination, which is described as consisting of testing in the areas of core knowledge, the work samples, and ethics. This general description is preceded by a statement of purpose and a history of the ABPN, including reference to the period of inactivity "during reassessment of the need for ABPN's continued existence." Initially, the informal impression originally conveyed was that this credential was to be directed at the journeyperson level professional. The more recently described activities are alleged to assess advanced competence and "the pursuit of excellence in the practice of neuropsychology." Therefore, ABPN has issued two different diplomas: The initial diploma was awarded to a group of unexamined individuals, and a later diploma issued only to a group of examined individuals (J. A. Moses Jr., personal communication, May 12, 1994).

There appears to be a "continuing education requirement" as a means of maintaining the ABPN credential. This is a laudatory feature if it is enforced. However, the brochure also refers to "candidate preparation workshops," which are "offered by members of the Examination Committee." Such workshops could place an examination committee in a conflict of interest if, for example, the examination committee subsequently is responsible for performing the examinations. If an examination committee were not so responsible, it would still be functioning in a role that could artificially increase the number of individuals reaching a particular criterion level of performance through coaching or other revelations in the course of these workshops.

It has been argued informally by proponents of this approach that the credential is more relevant for the practice of clinical neuropsychology than is the ABCN/ABPP credential, which has been perceived as having greater relevance for academicians. In any case, it is difficult to regard the ABCN and ABPN diplomas as equivalent measures of professional excellence or advanced competence (given the profession-wide evaluative framework within which only the ABCN functions). One reaches this conclusion based on the evidence even when one applies a more limited definition of competence as the necessary competence for effective practice (versus highly effective practice). Even a cursory review of the history of these two boards leads to the conclusion that the credentials issued by them are not comparable. Any suggestion that they are comparable could be very misleading to the aspiring clinical neuropsychologist who is seeking verification of her/his claim to advanced professional competence as well as to consumers of clinical neuropsychological services who are unlikely to have knowledge of the history of the potentially confusing credentialing configuration in clinical neuropsychology at this time.

Another board whose brochure has been distributed nationally is known as the American Board of Vocational Neuropsychology. The initial brochure invites members of various disciplines, at subdoctoral as well as doctoral levels of preparation, to apply for board

certification. The brochure is available to potential applicants (American Board of Vocational Neuropsychology, 1994). The activities of that board appear to fall outside the purview of this chapter, which is exclusively directed at issues that confront psychologists at the doctoral level.

Books and Journals

There has been a remarkable expansion of the number of journals and books that have appeared in the literature over the past few decades. There is now an immense pool of research findings to assist in the interpretation of test results and to ensure that neuropsychological theories of cognitive and personality functioning will continue to stimulate objective clinical and basic research activity. The publication of *Cortex* was quickly followed by *Neuropsychologia* in Europe. Luria's (1966) comprehensive integration of the available empirical knowledge with regional localization theory also constituted a major stimulus within an already expanding literature.

Many neuropsychological articles appeared in the 1950s in medical and psychological journals in the United States and Europe. Many of those journals continue to publish neuropsychological research, even as the number of journals that are devoted exclusively to neuropsychology increases. The number of journals whose primary editor is a psychologist (clinical or cognitive/experimental) has now reached at least 15. Also, there are at least 30 journals edited by nonpsychologists, usually specialty physicians and speech pathologists, that have been identified as publishing neuropsychological research. Similarly, the number of relevant books has increased geometrically over the past decade in each empirical domain.

The large number of books that are directly related to the practice of clinical neuropsychology is much too extensive to be listed here. Requests for a representative sampling of such books is made frequently by graduate students, postdoctoral fellows and practitioners in the field. A representative sampling of such books is offered in Appendix A.

It is likely that an alternate listing of books in the same areas, but with different authors, could be identified. This group of books is intended to convey the breadth and depth of knowledge and application in clinical neuropsychology. It seems extremely likely that any individual who has a working knowledge of the major subjects in these volumes and who can convert that knowledge into clinical practice would have no difficulty demonstrating the necessary competence for highly effective practice.

Similarly, representative journals for individuals interested in pursuing substantive knowledge of both theory and practice in clinical neuropsychology are listed in Appendix B.

SUMMARY AND FUTURE DEVELOPMENT OF CLINICAL NEUROPSYCHOLOGY

This chapter has been organized to present a historical perspective for the development of clinical neuropsychology. The discussion has been focused on the primarily professional issues confronting clinical neuropsychology as it enters early, and perhaps even middle, adulthood in its development as a specialty. This process is occurring at a time when opportunities for education and the actualization in practice of effective professional competence are likely to be progressively more difficult to achieve. In many situations professional specialty training activities, particularly postdoctoral training programs, have been instrumental in establishing practice positions in the very institutions in which the advanced training has occurred, or in institutions that are networked with the training programs. Common examples of this process include state hospitals, the Department of Veterans Affairs, the military, community hospitals, private practice groups, the schools, and the legal

system. Maintenance of training activities and the promotion of new positions, either in the public or the private sector, will depend on the continued availability of a significant cost–benefit ratio return for the services provided by clinical neuropsychologists.

The key to anticipating the future of clinical neuropsychology lies in the effects of national health reform on reimbursement for clinical services. As with the medical and allied health professions, clinical neuropsychology will need to adapt to changing conditions and undergo significant transformations in roles and procedures. There has always been a lag between the available basic and applied research in psychology and the level of application in practice. Professional service is commonly provided by clinicians who often have neither the time nor the skills to achieve a ready conversion of research knowledge to clinical practice. Practice, as a consequence, tends to remain relatively resistant to change, as is evidenced by the wide range of up-to-date knowledge and professional competence that is found among individuals who practice clinical neuropsychology. Everyone who has been in the field for any period of time has witnessed this variation, which is difficult to document objectively. In turn, that difficulty prompts the development of objective evaluation procedures, such as the ABCN examination, to determine individual levels of competence for professional practice. Furthermore, the scientific knowledge base on which clinical practice depends is expanding on a multidisciplinary basis so that interdisciplinary boundaries are becoming blurred, at least as they are related to the establishment of the necessary knowledge base for effective clinical practice.

Clinical neuropsychologists can no longer function competently without a working knowledge of behavioral neurology and cognitive neuroscience. The appended array of books and journals underscores the categorical scope of knowledge that is relevant to the practice of the specialty of clinical neuropsychology and the growing interdisciplinary emphasis in investigation, evaluation, and treatment of impaired brain functioning. The political, economic, and scientific/professional context of the times dictates the expectation that neuropsychological services will probably need to be provided at both a lower cost and a higher level of professional effectiveness in the future. Lower costs are likely to be dictated by national health reform because available resources will have to reach the entire population and not only those who are currently insured. Greater effectiveness will probably be necessitated by the increased competition for existing resources among the health professions, of which psychology is obviously not the most powerful. Clinical neuropsychologists, hopefully, will adapt to these changes by increasing the efficiency of their techniques and the transmission of the interpretations of findings by means of advances in computer-assisted technology and in telecommunications. Program evaluation research also likely will be required more of clinical neuropsychologists to demonstrate the effectiveness of particular assessment procedures, interventions, and therapies.

Although psychology has been grappling with the many implications of its own socialization as a profession, a gap between developments in the specialty of clinical neuropsychology and recognition of this specialty by the parent discipline appears to be closing since APA has established its own journal in neuropsychology, has initiated formal steps to recognize clinical neuropsychology as a specialty, and is moving toward the accreditation of specialty training programs in clinical neuropsychology, probably beginning at the postdoctoral level, which is the most characteristic level for the professional preparation of clinical neuropsychologists. The astounding growth of clinical neuropsychology, as a function of developments in the discipline as well as in other fields of knowledge and application, will require continued curriculum planning and revision and continued upgrading of objectives and program evaluation criteria in the areas of education, accreditation, and credentialing. The initiatives described earlier have produced curriculum models, external credentialing through board certification, and a foundation for the accreditation of specialty education programs. Convergence

of the aforementioned developments will necessarily require a definitive interdisciplinary orientation and increased technological sophistication in order to pursue the necessary knowledge and competence for effective practice in a cost-efficient, yet increasingly more competent, manner. Because clinical neuropsychology has demonstrated great promise and is likely to be the first new practice specialty to be recognized as APA moves in that direction, it should fare well in the future, at least as well as other specialties within psychology.

Clinical neuropsychologists are already engaged in reflections about the future and foresee major challenges in efforts of practitioners in the specialty to apply an already formidable body of basic and applied knowledge to actualize the possibilities presented by technological advances in this and other fields. Rourke (1991) enunciated a set of predictions regarding directions for research and application during this decade. He foresaw an expansion of research into the normal development of cognitive processes that are relevant to an understanding of brain–behavior relationships, the parallel monitoring of neurophysiological and behavioral phenomena, analysis of the component processes measured by neuropsychometric procedures, refinements in the statistical and mathematical analysis of neuropsychological data, the elucidation of personality and psychosocial factors to variation in neuropsychological performances, cognitive rehabilitation, credentialing, and other issues. The potential for further growth in the specialty that is suggested by his reflections and by the developments in recent decades point toward future actualization of the earlier expectations that experimental and clinical neuropsychology would become a major productive force within the discipline of psychology in the 21st century (Costa, 1983).

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REFERENCES

Albert, M. L. (1984). Henry Hécean, M. D., neurologist–neuropsychologist. *Archives of Neurology, 41*, 458–459.

American Board of Professional Neuropsychology. (1994). (Advertisement). *APA Monitor, 25* (6) 67.

American Board of Vocational Neuropsychology. (1994). (Advertisement). *APA Monitor, 25* (66) 67.

Belar, C. D., Bieliauskas, L. A., Larson, K. G., Mensh, I. N., Poey, K., & Roehlke, H. J. (1989). National conference on internship training in psychology. *American Psychologist, 44*, 60–65.

Benton, A. L. (1945). A visual retention test for clinical use. *Archives of Neurology and Psychiatry, 54*, 212–216.

Benton, A. L. (1964). Contributions to aphasia before Broca. *Cortex, 1*, 314–327.

Benton, A. L. (1969). Development of a multilingual aphasia battery: Progress and problems. *Journal of the Neurological Sciences, 9*, 39–48.

Benton, A. L. (1987). Evolution of a clinical specialty. *The Clinical Neuropsychologist, 1*, 5–8.

Bieliauskas, L. A., & Matthews, C. G. (1987). American board of clinical neuropsychology: Policies and procedures. *The Clinical Neuropsychologist, 1*, 21–28.

Bieliauskas, L. A., & Matthews, C. G. (1990). American board of clinical neuropsychology update, 1990. *The Clinical Neuropsychologist, 4*, 337–343.

Bornstein, R. A. (1988). Entry into clinical neuropsychology: Graduate, undergraduate and beyond. *The Clinical Neuropsychologist, 2*, 213–220.

Bray, D. W. (1984, August). *Assessment centers for research and application*. Psi Chi Distinguished Lecture delivered at the meeting of the American Psychological Association, Toronto, Canada.

Butters, N., Benton, A., Goodglass, H., Rourke, B. P., & Bakker, D. J. (1984, November). A testimonial to the bulletin and its editor Aaron Smith. *The INS Bulletin*, 75–76.

Cattell, R. B. (1963). Theory of fluid and crystallized intelligence: An initial experiment. *Journal of the Neurological Sciences*, *9*, 39–48.

Christensen, A. L. (1975). *Luria's neuropsychological investigation* (2nd ed.). Copenhagen: Munksgaard.

Costa, L. (1983). Clinical neuropsychology: A discipline in evolution. *Journal of Clinical Neuropsychology*, *5*, 1–11.

Costa, L., & Spreen, O. (Eds.). (1985). *Studies in neuropsychology: Selected papers of Arthur Benton*. New York: Oxford University Press.

Critchley, M. (1953). *The parietal lobes*. London: Edward Arnold.

Damasio, A. R. (1985). Norman Geschwind. *Archives of Neurology*, *42*, 500–504.

Division 40 Task Force. (1987). Reports of the Task Force on Education, Accreditation, and Credentialing. *The Clinical Neuropsychologist*, *1*, 22–29.

Division 40 Task Force. (1989a). Definition of a clinical neuropsychologist. *The Clinical Neuropsychologist*, *3*, 22.

Division 40 Task Force. (1989b). Guidelines regarding the use of nondoctoral personnel in clinical neuropsychological assessment. *The Clinical Neuropsychologist*, *3*, 23–24.

Filskov, S. B., & Boll, T. J. (Eds.). (1986). *Handbook of clinical neuropsychology* (2nd ed.). New York: Wiley.

Geschwind, N. (1965). Disconnexion syndromes in animals and man. *Brain*, *88*, 237–294, 585–644.

Geschwind, N., & Levitsky, W. (1968). Human brain: Left–right asymmetries in temporal speech region. *Science*, *161*, 186–187.

Golden, C. J., Hammeke, T. A., & Purisch, A. D. (1980). *Manual for the Luria–Nebraska Neuropsychological Battery*. Los Angeles: Western Psychological Series.

Goldstein, G. (1985). The history of clinical neuropsychology: The role of some American pioneers. *International Journal of Neuroscience*, *25*, 273–275.

Goldstein, K., & Scheerer, M. (1941). Abstract and concrete behavior. *Psychological Monographs*, *53* (Whole No. 39).

Goodglass, H. (1985). Aphasiology in the United States. *International Journal of Neuroscience*, *25*, 307–311.

Goodglass, H. (1986). Norman Geschwind (1926–1984). *Cortex*, *22*, 7–10.

Goodglass, H., & Kaplan, E. (1983). *The assessment of aphasia and related disorders*. (2nd ed.) Philadelphia: Lea & Febiger.

Halstead, W. C. (1947). *Brain and intelligence: A quantitative study of the frontal lobes*. Chicago: University of Chicago Press.

Harlow, H. F., Davis, R. T., Settlage, P. H., & Meyer, D. R. (1952). Analysis of frontal and posterior association syndromes in brain-damaged monkeys. *Journal of Comparative and Physiological Psychology*, *45*, 410–429.

Hebb, D. O. (1949). *The organization of behavior*. New York: Wiley.

Jacobsen, C. F. (1936). Studies of cerebral functions in primates: I. The functions of the frontal association areas in monkeys. *Comparative Psychology Monographs*, *13* (3, Whole No. 63), 3–60.

Jones, B. P., & Butters, N. (1983). Neuropsychological assessment. In M. Hersen, A. E. Kazdin, & A. S. Bellack, *The clinical psychology handbook* (pp. 377–396). New York: Pergamon.

Kaplan, E. F. (1983). Process and achievement revisited. In S. Wapner & B. Kaplan (Eds.), *Toward a holistic developmental psychology* (pp. 143–156), Hillsdale, NJ: Lawrence Erlbaum Associates.

Lashley, K. (1929). *Brain mechanisms and intelligence*. Chicago: University of Chicago Press.

Lezak, M. D. (1995). *Neuropsychological Assessment* (3rd ed.). New York: Oxford University Press.

Luria, A. R. (1966). *Higher cortical functions in man*. New York: Basic Books.

MacKinnon, D. W. (1975). An overview of assessment centers. (Tech. Rep. No. 1). Greensboro, NC: Center for Creative Leadership.

Matthews, C. G. (1987). Division 40: Task force report on computer-assisted neuropsychological evaluation. *The Clinical Neuropsychologist*, *2*, 161–184.

Matthews, C. G., Harley, J. P., & Malec, J. F. (1991). Guidelines for computer-assisted neuropsychological rehabilitation and cognitive mediation. *The Clinical Neuropsychologist*, *5*, 3–19.

Meier, M. J. (1981). Education for competency assurance in human neuropsychology. In S. B. Filskov & T. J. Boll (Eds.), *Handbook of clinical neuropsychology* (pp. 754–781). New York: Wiley.

Meier, M. J. (1987). Continuing education: An alternative to respecialization in clinical neuropsychology. *The Clinical Neuropsychologist*, *1*, 9–20.

Meier, M. J. (1992). Modern clinical neuropsychology in historical perspective. *American Psychologist*, *47*, 550–558.

Meier, M. J., Benton, A. L., & Diller, L. (Eds.). (1987). *Neuropsychological Rehabilitation*. New York: Guilford.

Meier, M. J., Strauman, S., & Thompson, W. G. (1987). Individual differences in neuropsychological recovery: An overview. In M. J. Meier, A. L. Benton, & L. Diller (Eds), *Neurological rehabilitation* (pp. 71–110). Edinburgh, Scotland: Churchill Livingstone.

Mendoza, J. E. (1993, October). *Clinical neuropsychology specialty licensure designation: Proposed regulations for the state of Louisiana*. Paper presented at the 13th annual conference of the National Academy of Neuropsychology, Phoenix, AZ.

Meyer, V. (1961). Psychological effects of brain damage. In H. J. Eysenck (Ed.), *Handbook of abnormal psychology* (pp. 529–565). New York: Basic Books.

Milner, B. (1954). Intellectual function of the temporal lobes. *Psychological Bulletin, 51*, 42–62.

Milner, B. (1964). Some effects of frontal lobectomy in man. In J. M. Warren & K. Akert (Eds.), *The frontal granular cortex and behavior* (pp. 313–334). New York: McGraw-Hill.

Milner, B. (1967). Brain mechanisms suggested by studies of the temporal lobes. In C. H. Milikan & F. L. Darley (Eds.), *Brain mechanisms underlying speech and language* (pp. 122–132). New York: Grune & Stratton.

Milner, B., Taylor, R., & Sperry, R. W. (1968). Lateralized suppression of dichotically presented digits after commissure section in man. *Science, 161*, 184–186.

Milner, B., & Teuber, H. L. (1968). Alteration of perception and memory in man: Reflections on methods. In L. Weiskrantz (Ed.), *Analysis of behavior change* (pp. 268–375). New York: Harper & Row.

Mishkin, M. (1982). A memory system in the monkey. *Philosophical Transactions of the Royal Society, B298*, 85–95.

Mishkin, M., & Petri, H. L. (1984). Memories and habits: Some implications for the analysis of learning and retention. In L. R. Squire & N. Butters (Eds.), *Neuropsychology of memory* (pp. 287–296). New York: Guilford.

Mishkin, M., & Pribram, K. H. (1954). Visual discrimination performance following partial ablations of the temporal lobe: I. Ventral vs. lateral. *Journal of Comparative and Physiological Psychology, 47*, 14–20.

Mishkin, M., & Ungerleider, L. G. (1983). Contribution of striate inputs to the visuospatial functions of parieto-preoccipital cortex in monkeys. *Behavioral Brain Research, 6*, 55–77.

Moses, J. L., & Byham, W. C. (Eds.). (1977). *Applying the assessment center method*. New York: Pergamon.

Pribram, K. H. (1986). Nonlocality and localization in the primate brain. In S. B. Filskov & T. J. Boll (Eds.), *Handbook of clinical neuropsychology* (Vol. 2, pp. 606–651). New York: Wiley.

Putnam, S. H., & DeLuca, J. W. (1990). The TCN professional practice survey: Part I: General practices of clinical neuropsychologists in primary employment and practice settings. *The Clinical Neuropsychologist, 4*, 199–243.

Putnam, S. H., & DeLuca, J. W. (1991). The TCN professional practice survey: Part II: An analysis of the fees of neuropsychologists by practice demographics. *The Clinical Neuropsychologist, 5*, 102–124.

Reed, J. (1985). The contributions of Ward Halstead, Ralph Reitan and their associates. *International Journal of Neuroscience, 25*, 289–293.

Reitan, R. M. (1964). Psychological deficits resulting from cerebral lesions in man. In J. M. Warren & K. Akert (Eds.), *The frontal granular cortex and behavior* (pp. 295–312). New York: McGraw-Hill.

Rourke, B. R. (1991). Human neuropsychology in the 1990s. *Archives of Clinical Neuropsychology, 6*, 1–14.

Sales, B., Bricklin, P. & Hall, J. (1984). *Manual on specialization: Principles proposed to the board of professional affairs*. Washington, DC: American Psychological Association.

Smith, A. (1980, June). How the INS began. *The INS Bulletin*, 3–4.

Sperry, R. W. (1958). Physiological plasticity and brain circuit theory. Behavior and evolution. In H. F. Harlow & C. N. Woolsey (Eds.), *Biological and biochemical bases of behavior* (pp. 401–424). Madison: University of Wisconsin Press.

Sperry, R. W., Gazzaniga, M. S., & Bogen, J. E. (1969). Interhemispheric relationships: The neocortical commissures, syndromes of hemisphere disconnection. In P. J. Vinkon & G. W. Bruyn (Eds.), *Handbook of clinical neurology* (Vol. 4, pp. 273–290). Amsterdam: North Holland.

Stuss, D. T. (1991). Interference effects on memory function in postleukotomy patients: An attentional perspective. In H. S. Levin, H. M. Eisenberg, & A. L. Benton (Eds.), *Frontal lobe function and dysfunction* (pp. 157–172). New York: Oxford University Press.

Talland, G. A. (1966). *Deranged memory*. San Diego, CA: Academic Press.

Teuber, H.-L. (1962). Effects of brain wounds implicating right and left hemisphere in man: Hemisphere differences and hemisphere interaction in vision, audition, and somesthesis. In V. B. Mountcastle (Ed.), *Interhemisphere relations and cerebral dominance* (pp. 203–208). Baltimore: Johns Hopkins University Press.

Teuber, H.-L. (1964). The riddle of frontal lobe function in man. In J. M. Warren & K. Akert (Eds.), *The frontal granular cortex and behavior* (pp. 410–444). New York: McGraw-Hill.

Teuber, H.-L. (1966). In J. C. Eccles (Ed.), *Brain and conscious experience* (pp. 182–216). New York: Springer.

Weinstein, S. (1985). The influence of Hans-Lukas Teuber and the psychological laboratory on the establishment and development of neuropsychology. *International Journal of Neuroscience, 25*, 277–288.

APPENDIX A

Adams, K. M., & Rourke, B. P. (1992). *The TCN guide to professional practice in clinical neuropsychology*. The Netherlands: Swets & Zeitlinger.

Benton, A. L., Hamsher, K. D., Varney, N. R., & Spreen, O. (1983). *Contributions to NP Assessment*. Oxford.

Bornstein, R. A., & Brown, G. G. (1991). *Neurobehavioral aspects of cerebrovascular disease*. New York: Oxford University Press.

Filskov, S. B., & Boll, T. J. (1981, 1986). *Handbook of clinical neuropsychology* (Vols. 1 & 2). New York: Wiley.

Finger, S., & Stein, D. G. (1982). *Brain damage and recovery*. New York: Academic Press.

Goldstein, G., & Ruthven, L. (1983). *Rehabilitation of the brain damaged adult*. New York: Plenum.

Goodglass, H., & Kaplan, E. F. (1983). *The assessment of aphasia and related disorders* (2nd ed.) Philadelphia: Lea and Febiger.

Grant, I., & Adams, K. M. (1985). *Neuropsychological assessment of neuropsychiatric disorders*. New York: Oxford University Press.

Hécean, H., & Albert, M. L. (1978). *Human neuropsychology*. New York: Wiley.

Heilman, K. M., & Valenstein, E. (1993). *Clinical neuropsychology* (3rd ed.). New York: Oxford University.

Levin, H. S., Benton, A. L., & Grossman, R. G. (1982). *Neurobehavioral consequences of closed head injury*. New York: Oxford.

Lezak, M. D. (1995). *Neuropsychological assessment* (3rd ed.). New York: Oxford University Press.

Luria, A. R. (1980). *Higher cortical functions in man*. (2nd ed.). Basic Books.

Margolin, D. I. (1992). *Cognitive neuropsychology in clinical practice*. New York: Oxford University Press.

Meier, M. J., Benton, A. L., & Diller, L. (1987). *Neuropsychological rehabilitation*. New York: Guilford.

Reitan, R. M., & Davison, L. A. (1974). *Clinical neuropsychology: Current status and applications*. New York: Hemisphere.

Reitan, R. M., & Wolfson, D. (1985). *The Halstead–Reitan neuropsychological test battery*. (2nd ed.) Tucson: Neuropsychology Press, 1993.

Rourke, B. P. (1991). *Neuropsychological validation of learning disability subtypes*. New York: Guilford.

Rourke, B. P., Bakker, D. J., Fisk, J. L., & Strang, J. D. (1983). *Child neuropsychology*. New York: Guilford.

Squire, L. R., & Butters, N. (1984). *The neuropsychology of memory*. New York: Guilford.

Strub, R. L., & Black, F. W. (1988). *Neurobehavioral disorders: A clinical approach*. Philadelphia: Davis.

APPENDIX B

Archives of Clinical Neuropsychology
Brain and Cognition
Brain and Language
Clinical Neuropsychology
Cortex
Developmental Neuropsychology
Journal of Clinical and Experimental Neuropsychology
Neuropsychologia
Neuropsychology Review
Neuropsychology
The Clinical Neuropsychologist

2

Interdisciplinary Relationships: Behavioral Neurology

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The study of the human mind has stirred the imagination of mankind for centuries. Although scientists have explored it, philosophers have argued about it, Hollywood has filmed it, and advertising has exploited it, the understanding of the mind still remains our most compelling, elusive, and challenging quest. In our current semantics *mind* is often replaced by *cognition, mental function, behavior,* or *mentation.* For the purposes of this chapter I use the term *behavior* to represent the functions of the human brain and its interactions with the environment and the rest of the body. Behavior implies the possibility for objective and subjective observation and investigation that are the bases for the disciplines I discuss.

The study of behavior may be approached through a myriad of different philosophies and methodologies. In this chapter I explore one of these fields, behavioral neurology, and focus on its interaction with neuropsychology. Behavioral neurology is the study of behavior that results from neurologic dysfunction. It uses nonstandard methods of investigation, whereas neuropsychology studies such altered behavior through the use of standardized measurement techniques. However, the differences and similarities between these two disciplines cannot be explained in such an oversimplified manner. The answers lie not only in the practices of today but stem from the history of each respective field.

HISTORICAL PERSPECTIVES

The first attribution of behavior to the brain was made by Herophilus (300 B.C.) and later by Galen (130–200 A.D.; Young, 1990). This view was not widely held, however. Instead, behavior was attributed to the spirit, an entity that remained separate from the body. It was Franz Joseph Gall (1758–1828) who first ascribed specific behaviors to specific regions of the brain. He championed the cause for the use of neuroanatomical studies in understanding