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Pattern and content of neuropsychological referral questions across 25 years of outpatient visits in a hospital-based clinic.

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University of Iowa

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PATTERN AND CONTENT OF NEUROPSYCHOLOGICAL REFERRAL
QUESTIONS ACROSS 25 YEARS OF OUTPATIENT VISITS IN A HOSPITAL
BASED CLINIC

by

Joshua Hopps

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of Philosophy
degree in Psychological and Quantitative Foundations (Counseling Psychology)
in the Graduate College of
The University of Iowa

December 2009

Thesis Supervisors: Professor Elizabeth Altmaier
Professor Dan Tranel

ABSTRACT

Much of the practice of clinical neuropsychology is performed in the role of consultant and although the neuropsychologist is dependent upon referrals made from outside sources, relatively little attention has been devoted to the investigation of the referral process. Surveys of clinicians and referral sources have reported breakdowns of referral sources by discipline and general topics of referral questions based on recollection, but direct analysis of referral patterns across the same period has not been undertaken. By examining the referral questions rather than neuropsychologists' or referral sources' recollection of referrals, this study expands what is known about referral content and patterns. To date, no other study has examined the content of referral questions to investigate the practice of clinical neuropsychology. In an effort to explain question content without relying upon recollection, a coding rubric was designed to capture the breadth of presenting problems and requests seen in the original referral questions.

Two-thousand-six-hundred referral questions were selected from the odd year over the 25 year period from 1983 to 2007, yielding a total of 2600 referral questions. Cochran's Kappa was used to conduct interrater reliability analyses in three stages across the entire rating process. Content analysis showed that 79.1% of all questions had at more than minimal content. The most common request was for assistance with diagnostic considerations, which was present in 66.4% of all cases. Assistance with differential diagnoses was requested in 27.4% of all cases with the majority of these composed of requests for assistance in differentiating between psychiatric and neurological or other medical considerations. There was evidence for a trend over time

in the gradual decline of requests for assistance with psychiatric differential diagnosis and requests for the MMPI from 1993 to the present. Memory problems and dementia are the most common presenting problems, although there is evidence of a slight decline in these evaluations beginning in 1997. Requests for specific recommendations, particularly those related to making recommendations regarding treatment planning were found to steadily increase across the sampling period. Limitations and implications for practice were discussed.

Abstract Approved: _____
Thesis Supervisor

Title and Department

Date

Thesis Supervisor

Title and Department

Date

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Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

Joshua Hopps

has been approved by the Examining Committee
for the thesis requirement for the Doctor of Philosophy degree in
Psychological and Quantitative Foundations (Counseling Psychology)
at the December 2009 graduation.

Thesis Committee:

Elizabeth Altmaier, Thesis Supervisor

Daniel Tranel, Thesis Supervisor

Timothy Ansley

Stewart Ehly

William Liu

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CHAPTER I

INTRODUCTION

Clinical neuropsychology has emerged over the last four decades of the 20th and the initial years of the 21st centuries as a discipline devoted to consultation and diagnosis in the area of brain-behavior relationships (Benton, 1992). Using instruments developed to assess cognitive, behavioral, and emotional functioning, clinical neuropsychologists endeavor to answer questions about the relationship between brain and behavior on an individual level at the behest of physicians, lawyers, psychologists, social workers, governmental agencies, educational institutions, patients and their families, and others (Lezak, Howieson, Loring, & Hannay, 2004). Although much of the business of the clinical neuropsychologist is dependent upon referrals made by one of the sources enumerated, relatively little attention has been devoted to the investigation of any aspect of the referral process. Surveys of clinicians (e.g., Sweet, Peck, Abramowitz, and Etzweiler, 2002) have reported breakdowns of referral sources by discipline and while these have been conducted over the past 25 or so years, analysis of referral patterns across the same period has not been forthcoming.

This study is focused on the history and development of the field of clinical neuropsychology and how it is changing to meet the demands of referral sources and patients. The future of neuropsychologists who primarily, or solely, function in the role of a consultant is bound to the source of referrals, and it is therefore vital to investigate from whence we have come in order to envision where and how we will proceed. The purpose of the study is to document the advancement of neuropsychology from merely providing psychological testing to establishing itself as a multifaceted discipline with a

significant diagnostic purview that is regularly relied upon to contribute to profoundly important decisions in the lives of patients. One method of examining changes in the role of practitioners as consultants is to examine the question posed to the neuropsychologist by the referring entity and track any changes over time in the content of the referral question. Analysis of the content of the referral question allows several inferences to be made: the purpose of the referral, the intent of the referrer about the type of assessment desired, and selection of procedures to be involved. To date, no other study has examined the content of referral questions to investigate the practice of clinical neuropsychology. In order to pursue the idea that referral questions can allow insight into the reasons neuropsychological evaluations are requested, the current study has analyzed the content and pattern of referral questions for a sample of outpatients in the Benton Neuropsychology Laboratory (BNL) over the past 20 years.

The main hypothesis of the proposed study was that referral sources would increasingly consult neuropsychologists in a diagnostic capacity rather than consulting about cognitive and/or emotional functioning in isolation. Thus, the number of referrals seeking diagnostic clarification would increase across the period under analysis as would the number of referrals seeking specific recommendations. Because the majority of referrals for neuropsychological evaluations originate with physicians, it was hypothesized that two trends would emerge that are products of increasing familiarity with neuropsychology. The first predicted trend was that the complexity of referrals would increase across time as referrers become more acquainted with services provided by neuropsychologists. This change would manifest through increasingly specific and complex questions as represented by the type and number of codes assigned to the

referral. In the same vein, it was predicted that as referrers become increasingly familiar with neuropsychology, they would become more likely to request specific assessment procedures, e.g., the MMPI, and to mention specific cognitive domains that are areas of concern for the patient. However, a second predicted trend was that a substantial and steady minority of questions would remain vague, e.g., “Please evaluate”. As referral sources become more familiar with neuropsychological evaluations, they may rely more heavily on the neuropsychologist to isolate the presenting problem and shape their own evaluation.

It would be an understatement to describe the neurosciences as rapidly advancing, and these advances have had a discernable effect on the practice of neuropsychology. Perhaps the most poignant example of the relationship between advances in neuroscience and clinical neuropsychology is the change in referrals upon the advent of neuroimaging. While there is likely to be unanimity among neuropsychologists that there was a profound shift in clinical focus from localization to documentation of functioning in various cognitive domains in the post-imaging epoch, a comprehensive literature review produced no systematic investigations of this shift. For the current study, it was hypothesized that there would be a decrease in questions about lesion localization, although it was predicted that there would not be complete extinction. Several additional hypotheses were related to emerging trends in the neurosciences and in society. It was predicted that there would be an increase in requests for recommendations for rehabilitation given emerging knowledge about neural plasticity and recovery of function following brain injury. The use of outdated terminology such as “functional versus organic” was predicted to decline, but not cease entirely. Finally, as the number of

adults reaching old age has climbed, neuropsychology has emerged as indispensable in understanding these individuals' functionality, and it was hypothesized that the number of referral questions focusing on issues specific to this population, e.g., driving, level of care, and supervision recommendations, would increase.

History of Clinical Neuropsychology:

Definitions and Development

There has been much written about the development of neuropsychology in the second half of the nineteenth century, with prominent contributions from Broca, Wernicke, Hughlings-Jackson, and other prominent "classical" neurologists. Less is written about the divergence of clinical neuropsychology from medicine (especially neurologists and neurosurgeons) during the first half of the twentieth century. The writing on the history of the move toward independence has generally focused on prominent cooperative relationships between physicians and psychologists (e.g., William Scoville and Brenda Milner), the mental testing movement, and early experimental psychology. In order to understand the history and foundation of clinical neuropsychology, these and other contributing factors will be explored as they merged across the twentieth century into the discipline recognized today as clinical neuropsychology.

Neuropsychology is generally defined as the systematic investigation of brain-behavior relationships with clinical observation and psychometrically defined behavioral examination (Barth et al., 2003). This definition differentiates clinical neuropsychology from clinical neurology and the mental testing movement that was nascent at the turn of the twentieth century. In addition to these progenitors, clinical neuropsychology is also

beholden to early efforts in experimental psychology as well as applied psychology as it developed in the post world war milieu. Clinical neurology is interested in brain-behavior relationships, but depends on examination with “internal norms” obtained through observation and experience, which are necessarily highly subjective.

The mental testing movement was interested in defining deficits and investigating the structure of intelligence, best exemplified by the series of tests published by Alfred Binet in 1905 at the behest of the French government in order to classify individuals not thriving in the country’s universal education initiative (Binet & Simon, 1905). These investigators were interested in measuring behavior with tests developed for their purposes and used statistical principles developed by Cattell, Spearman, and others, in order improve the reliability and generalizability of educational measurement (Dahlstrohm, 1983). The link to brain functioning was not addressed, however. Early experimental psychologists such as James, Jastrow, and Munsterburg developed measures of abilities that were designed to describe individual differences, most often in the domain of reaction time, but subsequently branched out into some cognitive areas (Boring, 1961). Finally, it was the applied psychologists who were confronted with the demands of treating and diagnosing individuals with brain injuries received in combat, who out of necessity began to implement and integrate these contributions into an increasingly coherent subspecialty of professional psychology.

In order focus the topic at hand, it is important to further elaborate the definition of neuropsychology given above (i.e., the systematic measurement of brain-behavior relationships). In all scientific fields, there exists a distinction between individuals who are devoted to theoretical and practical endeavors with the ideal that experimental

methods provide the foundation for the applied science as well as the direction for advancement and refinement of the collective understanding and practical application. In neuropsychology, the former are focused on experimental methods and the latter focused on clinical practice. The theoretical subfields are generally labeled *experimental* neuropsychology and *cognitive* neuropsychology and are focused on understanding neural mechanisms underlying cognition and behavior through experimental investigation of brain function, often with lesion methodology (in animals and humans) and, recently, neuroimaging. These methods are also employed to the same end by individuals who call themselves neuroscientists, behavioral neuroscientists, cognitive neuroscientists, neurologists, behavioral neurologists, neurophysiologists, psychiatrists, neuropsychiatrists, comparative psychologists, etc. In distinction, *clinical* neuropsychology is the term that denotes the application of psychometric measurement techniques to patient populations in order to provide an evaluation of cognition, emotion, and behavior as they relate to brain function. There are in all fields exceptional individuals whose work spans both areas, and this is perhaps more easily accomplished in neuropsychology than in other applied psychology subspecialties because of the quantitative nature of the clinical methods. It could be argued that clinical neuropsychology has been more successful than other areas of applied psychology in maintaining communication and collaboration between clinicians and researchers because of its foundation in psychometrics and the work of prominent scientist-practitioners.

Clinical neuropsychology (CN) is the focus of the current endeavor for four reasons: 1) the purpose of the current study is to investigate changes in the practice of CN across time; 2) a thorough history of CN has not been written, in contrast to excellent

historical descriptions of experimental neuropsychology (e.g., Benton, 2000); 3) the exploration of changes in clinical practice related to experimental advances want fuller description, and 4) unlike the methods of experimental neuropsychology, neuropsychological assessment of patients is not duplicated by any other discipline and is unique to CN, making it a worthwhile pursuit to consider the field as a separate, if interdependent, entity. The primary focus is describing the development of the practice of CN rather than neurology, early applied psychology, or early experimental psychology. Therefore, the history to be described will not reduplicate the contributions of the nineteenth century neurologist forefathers, which has been thoroughly described in the literature (see, for example, the work of Kolb and Whishaw [2003] and Finger [1994] for descriptions of the study of the brain beginning in antiquity), except where clinical observation begins to evolve into more systematic measurement laying the groundwork for, it will be argued, early CN. Similarly, the histories of the mental measurement movement and early experimental psychology will be described only as they relate to the emergence of the tools to be developed for use by clinical neuropsychologists (For reviews of these histories, the reader is referred to Matarazzo, 1973 and Cronbach, 1971).

The purpose of chapter two is to provide a history of CN beginning with origins, the mental measurement movement of the late nineteenth and early twentieth centuries, early experimental psychology, early applied psychology, and changes in health care after the world wars. The formative influence of the first generation of neuropsychologists will be discussed through the contributions of individual scientist-practitioners. Scientific advances in the neurosciences (particularly experimental neuropsychology) will be considered in relation to their influences on the practice of CN.

Schools of neuropsychological assessment and their origins will be discussed, as will the organizations, gatherings, and publications fundamental to the full differentiation of the field from its progenitors and its maturation to a recognized subspecialty of the American Psychological Association (APA) with a consensus training model. Refinement of the practice of CN will follow, with discussion of advances in collection and utilization of normative data, implementation of new tests from experimental psychology, along with incorporation of techniques from cognitive psychology. Adaptations in the field in response to the needs of patients and referrers (e.g., driving, capacity, forensic evaluations and testimony) will follow. Finally, controversies, including the training and board certification movement will also be discussed.

The subsequent chapter will describe the methodology of the study. The population to be sampled is outpatients seen in the BNL in the department of Neurology at the University of Iowa Hospitals and Clinics from 1983 to 2007. The BNL was established in the late 1940s and currently serves 2000+ patients per year, primarily with diagnostic and rehabilitation services. A database has been maintained over the past 25 years which tracks all patients' demographics, dates of evaluation, diagnostic categories, referral source, and several other variables. It is proposed that 200 patients will be randomly selected from the odd years beginning in 1983 and concluding in 2007. Patient demographic data, diagnostic code, and evaluation date will be collected and their referral question will be categorized and coded according to a rubric developed for the task. Briefly, the coding system is designed to encode the specificity of the question and the type of assessment requested, and referral questions can receive multiple codes. The proposed statistical analyses of the data include descriptive data and investigation of any

trends present across time. Frequency counts will be used to track changes in the occurrence and probabilities of referral categories across years. The fourth chapter will be a discussion of the results obtained followed in chapter five by an interpretation of the results and discussion of their meaning and implications.

The study will contribute to clinical neuropsychology by systematically investigating referral patterns as they change across time, allowing a broad view of the utilization of neuropsychological assessment by referrers, who essentially serve as gatekeepers to clinicians working as consultants. Taking a broad view will allow recognition of changes in the field and encourage a more proactive and reciprocal relationship between neuropsychologists and those who shape clinical practice with their referrals. If there are areas of assessment that are moribund, neuropsychologists may do well to shift their efforts. Similarly, some strengths of clinical neuropsychologists may be underutilized and identification of these to those outside the field should be emphasized. Conversely, if similar questions and requests repeatedly arise it can be inferred that this input is valuable in decision making, perhaps even when survey data of referral sources indicate minimal use of neuropsychological data in certain situations. Further refinement of these areas will ultimately lead to improved communication between health care providers, more and higher quality data available to those making healthcare, legal, and educational decisions, and a clearer view of how to be of most benefit to patients.

CHAPTER II

A HISTORY OF CLINICAL NEUROPSYCHOLOGY

Theories of the history of science abound (e.g., Kuhn; Popper) and psychology, always conscious of its externally classified status as a “soft” science, has debated the course of its own development. The early unity of the field with philosophy and relatively recent divorce is perhaps what prompted Ebbinghaus (1908) to write “Psychology has a long past, but only a short history” (p. 2). What were once termed as revolutions in psychology (e.g., behaviorism, cognitive.) have been retrospectively redefined as gradual shifts in a discipline that may be yet pre-paradigmatic (Leahy, 1992). The history of clinical neuropsychology presented here is in keeping with the view that frank revolutions in science are rare as are uniqueness and de novo ingenuity. Rather, the advancement of science in general, and clinical neuropsychology in particular, has occurred through incremental advances achieved by individuals, dialectical integration of thesis and antithesis, and pressure exerted by events external to science. The story woven in the proceeding section will be taken from disparate skeins: behavioral neurology, experimental psychology, applied psychology; individuals, movements, human events; innovation, reproduction, synthesis, and criticism.

Selection of a starting point and delimitation criteria were critical, because, as mentioned above, prominent scholars have placed the origins of the field of clinical neuropsychology in many places: Broca’s 1861 presentation of patient Tan or Halstead’s establishment of the first neuropsychological laboratory in 1935, to name only two of the most commonly cited. Because the core and unduplicated contribution of neuropsychology to the neurosciences is the psychometrically defined behavioral

examination, the advent of employing tests to measure brain behavior relationships was selected as the focus and starting point for this history. To fully describe this emergent application, it is important to acknowledge the fields which provided the tools that were ultimately integrated into the practice of neuropsychology. The neurologists of the nineteenth and early twentieth centuries initiated interest in brain-behavior relationships through in depth case studies; experimental psychology provided methods of inquiry and comparative studies of brain function; mental measurement provided clinical tools; applied psychology afforded access to settings and patients with unmet needs. However, this is not a history of any one of these disciplines and so these contributions are presented in brief in order to trace the emergence of clinical neuropsychology from the integration of these disciplines. In order to focus on *clinical* neuropsychology, no attempt will be made to summarize the manifold advances in understanding of brain-behavior relationships as they have mounted across time periods under consideration. Such would constitute an encyclopedic task and, as mentioned above, these histories are presented elsewhere with consummate skill. Rather, advances in the *practice* of neuropsychology will be the focus, and experimental advances will be discussed only insofar as they have directly influenced clinical practice, a not uncommon occurrence.

The position presented here is that the birth of clinical neuropsychology was protracted over a period of decades from the 1930s to the 1960s as applied psychologists used and adapted tools developed in the mental testing movement to address the critical contemporary question asked by psychiatrists and neurologists, “Is this deficit functional or organic?” To extend the metaphor forwards and backwards in time, the progenitors of the field met as human behavior came to be viewed as a measurable phenomenon (in

psychology/philosophy) and in parallel viewed as an outward indicator of brain function (in neurology/psychiatry). The gestation of clinical neuropsychology occurred as advances mounted in anatomical-clinical correlations of neural structures, mental measurement, and the professionalization of applied psychology. The current history will begin at this point because, falling outside the bailiwick of both psychologist and neurologist historians, the history of neuropsychology has been relatively neglected.

The *childhood* years of the field (approximately 1960-1975) saw the emergence of batteries, specialized tests, and clinical research that laid the foundation for the generation and interpretation of neuropsychological data. The rapid and sprawling growth in both research and clinical endeavors that followed over the subsequent decades can be considered the *adolescent* phase. The utility of the developmental metaphor has reached its limit, but has provided the framework and rationale for the history to follow. To recall and adapt the quotation from Ebbinghaus, the long past of clinical neuropsychology will be addressed in order to bring a sharper focus on its history. The evolution of theories of brain function in neurology will be discussed first, followed by experimental psychology, the mental testing movement, and applied psychology.

Brain Functioning in Neurology

The story of the evolution of neurology can be told as an academic battle between views of brain function: localizationists and antilocalizationists (known variously as mass action, equipotentiality, and so on.) While there were periods in which the academy was fairly evenly divided, much of the history of neurology before the advent of modern stereotactic neurosurgical technique was dominated by one or the other of these perspectives. In the early nineteenth century, Franz Gall became interested in brain

anatomy and function and described important aspects of functional neuroanatomy including the pyramidal decussation and the distinction between grey matter and white matter in the cerebrum (Fitzhugh & Bell, 1986). He also developed a theory of functional localization across the cortex, but his work derailed into phrenology which tainted his legacy and made him an easy target for his critics, who proposed a theory of distributed functioning. The distributed functioning or mass-action theory held that higher cognitive functions were the product of widely distributed processes which obviated localization of specific functions. Therefore, the amount of damage to the cortex was more important than the locus of the damage. The most influential proponents of the mass action view were the neurologists Pierre Flourens and John Hughlings-Jackson. Flourens was chiefly responsible for the downfall of phrenology, but his work was also subject to criticism as he lesioned the brains of pigeons to reach his conclusions about anti-localization in the human brain (Feinberg and Farah, 2003). The influence of Jackson was notable in Europe in the mid nineteenth century but did not reach the US until it was introduced by Henry Head in the 1920s. Jackson's brand of anti-localization was more complex and refined than his contemporaries. He described the function of the central nervous system as a functional hierarchy with increasingly complex functions handled by higher levels, the cerebral cortex being the most complex (Kolb and Whishaw, 2003).

The pendulum soon reversed with the work of Jean Bouillad in the 1820s, who proposed the lateralization of language and handedness, and Marc Dax, who proposed the left frontal lobe as the seat of language. In 1861, Paul Broca further localized the area that, when lesioned, had disrupted expressive language in a patient he had studied

thoroughly ante- and post-mortem. In retrospect, Broca's contribution to neurology was not localization of expressive speech (Dax reached the same conclusion over twenty years before; Benton, 1967); rather, it was the model of synthesis of clinical description, neuroanatomical description, and functional localization that was his legacy. The model of thorough description of a case or a series of cases was to dominate neurological research methodology for nearly a century (Farah & Feinberg, 2003). Broca was a strict localizationist and felt that a behavior was controlled by an area and a lesion to that area would impair a specific behavior.

Karl Wernicke was certainly in the localizationist camp, but his view was less strict. In addition to localizing the area of the cortex involved in receptive language, Wernicke's work was influential in isolating functional relationships between localized functions that are in different cortical areas connected by white matter. His idea of conduction aphasia (impairment of repetition with spared receptive and expressive language) as a result of disruption of the arcuate fasciculus, a band of white matter between Broca's and Wernicke's areas, is a prime example of his connectionist theory. The work of Broca and Wernicke in the localization of aspects of speech in the 1860s and 1870s is often cited as the advent of neuropsychology (e.g., Delis & Ober, 1986).

Further refining Wernicke's connectionist principles, his students Dejerine, Lichtheim, and Liepman explained phenomena such as alexia without agraphia (impaired reading with preserved writing), pure word deafness (intact hearing but words are not perceived), and apraxias (impaired sequencing of movements), respectively (Kolb and Whishaw, 2003). Comparative anatomical research also made a significant contribution. In the 1870s, Gustav Fritsch and Eduard Hitzig were able to map the canine motor strip

using electrical cortical stimulation in live animals and these results were replicated and extended into primates by David Ferrier.

The protracted and heated debate extended into the twentieth century with the anti-localizationist writings of the English neurologist Henry Head who criticized the localizationists as “diagram-makers” who grossly oversimplified deficits and forced symptoms into syndromes. Although the debate continued well into the twentieth century, the forum of interest shifted to the field of experimental psychology with the work of Karl Lashley.

Outside the localizationist versus mass action debate, in the 1860s clinical neurologists began to develop batteries of “tests” that comprised the neurological exam. Some of these were highly idiosyncratic, subjective, and impossible to generalize beyond the development site. Others became sophisticated through the development of set criteria for scoring and local normative information (Benton, 1967). The first of these to be published came at a time when there had been calls in neurology for more standardized testing by Wernicke, Fritsch, and Hitzig. Conrad Rieger published his extensive battery in 1888 and included tests of memory, reasoning, reading and calculation. His methods were generally ignored and were never translated into English. Psychologists were soon able to fill the void, although application of standardized mental testing to neurological patients would not occur until the 1930s.

The contribution of neurologists to the field of neuropsychology continued. Indeed some of the first individuals who defined themselves as neuropsychologists were neurologists by training; these individuals will only be mentioned here as their contributions will be discussed elsewhere. A common trait among these individuals is

the incorporation of psychological measurement techniques by establishing close working relationships with experimental psychologists. Kurt Goldstein developed tests of frontal lobe function while working with a psychologist. Norman Geschwind revived connectionist theory and elaborated its utility for behavioral neurology. Henri Hecaen studied lateralization of function and pioneered the study of the right hemisphere. Aleksandr Luria synthesized the rival theories of brain function and developed a set of techniques for qualitative neuropsychological evaluation. Their influence continues through to the present day due to their openness to training and working with psychologists. However, before these experimental psychologists began to collaborate with neurologists and neurological surgeons, experimental psychology had been developing ways to study mind and body for one hundred years. The next section will review their particular contribution to neuropsychology: the development of experimental tests.

Experimental Psychology

The case has been made that experimental psychology was one of the primary contributors to early efforts to study brain-behavior relationships with psychological methodology. The story of mental measurement often begins with Francis Galton as his interest began in what he termed “anthropometric studies”, but in truth this systematized human measurement was enabled by the work of individuals in the middle of the nineteenth century who straddled several fields: physiology, medicine, philosophy, and psychology. The history of these individuals will be discussed primarily for their contributions to the origins of clinical neuropsychology with passing attention to their larger influence.

As most others of its sort, this narrative will commence with the work of Ernst Weber (1795-1878), the German physician and professor of comparative anatomy. Weber is credited with providing support for the first systematic relationship between a physical and mental event, the just noticeable difference, which was defined as a constant fraction of the standard weight. His experiments involved manipulating perceptions of differences in weight while obtaining subjective ratings from his subjects. He also pioneered a technique, two-point discrimination, that remains in use today in neurological examinations, wherein a compass is placed on the skin of a subject and the distance between the styli is decreased to the point just before the subject is unable to identify that two points are touched. The procedure is repeated in different epidermal areas to measure differential sensation in the hands, legs, back, etc.

Later in his career, Weber would join with Gustav Fechner (1801-1887), the former physics professor who turned to the study of the mind after his vision failed. Fechner's goal was the application of the natural sciences to the study of man's inner world and after his work with Weber, he further refined the just-noticeable difference into what is now known as the Weber-Fechner law: In order that the intensity of a sensation may increase in arithmetical progression, the stimulus must increase in geometrical progression (Boring, 1961). Fechner was also innovative in his view of the mind-body interaction and saw the future of psychology as linking mental events to their physiological processes (Freeman, 1962). His method, known as psychophysics, sought to analyze the constant relationship between physical and psychological events and his three methods of sensory discrimination remain in use (Hergenhahn, 2001).

Brief mention must be made of two contributors to the early study and measurement of mental phenomena. While better known for his clinical work in reforming Parisian mental institutions after the fashion of Philippe Pinel, his teacher, Jean Esquirol (1772-1840) contributed greatly to diagnosis and differentiation of mental illness. He was the first to distinguish between mental retardation and mental illness, an obviously important distinction for treatment and education across the lifespan. In addition, through study and observation of his mentally retarded patients, he constructed what is thought to be the first classification of the severity of mental retardation (Hergenhahn, 2001). Edouard Seguin's (1812-1880) work with mentally retarded children gained notoriety in France and the United States. His contributions to measurement include temperature sensation, but his work in developing formal tests for classification of mental retardation had the most lasting effects (Tulsky, Sackolofsky, & Ricker, 2003). The formboard was the most popular among later examiners and was heavily used and adapted in the first half of the twentieth century. It involved placing shapes and pictures on a board according to certain groupings suggested by the examiner. Seguin used it as a measure of overall intellectual functioning in his studies, but it was later adapted as a measure of frontal lobe function.

Wilhelm Wundt's (1832-1920) influence on experimental psychology is well known and documented, and will not be belabored here. His students learned his methods for measuring sensation and reaction time as well as feelings and perceptions and these were disseminated across Europe and to the US. Of particular interest to early developments leading to clinical neuropsychology is that Wundt aimed his studies at uncovering the laws behind mental processes and interpreted his results accordingly

(Pintner, 1923). His eschewal of individual differences in favor of understanding process common to all minds did not long hinder other investigators, however, including his own student, James Cattell. Emil Kraepelin's study and implementation of Wundt's methodology were important to his development of his classification of mental illness. Kraepelin was also inspired to call for development and application of similar standardized exams to aid in patient evaluation and diagnosis (Hoch, 1904).

Perhaps not as important for the evolution of experimental psychology as Wundt, Herman Ebbinghaus (1850-1909) was nonetheless more important for the emergence of individual testing. His *On Memory* (1885) is likely the first systematic study of human learning and memory. He developed several methods for learning including a sentence completion task, nonsense syllable learning, digit memory, and rapid arithmetic. Using these, he studied memory in many ways and reached conclusions that were well ahead of his time. He differentiated between acquisition, retrieval, and recognition. The retention curve and the course of forgetting he described have been largely supported by contemporary research. His investigations on the influence of meaning on memory, and the effect of different presentations on memory presaged later developments in social and cognitive psychology by nearly a century. His conclusion that massed learning is inferior to distributed learning is echoed in classrooms around the world. He studied the effect of excessive practice (over-learning) on performances. In sum, with the methodology of Ebbinghaus and his contemporary Galton, experimental psychology turned with enthusiasm toward development of the mental test as a way to study mental processes and individual differences to a varying degree.

In the United States, mental tests were gaining footing through the work of several scholars. Joseph Jastrow set up an anthropometric booth at the 1893 Columbian Exposition in Chicago (Pintner, 1923). In the same year, a study was conducted of 1200 children who were given a battery of tests and teacher estimates of intelligence were collected as covariates (Gilbert, 1893, As cited in Pintner, 1923). The memory experimentation of Ebbinghaus was elaborated by Kirkpatrick (1893) who studied recall and recognition memory in three modalities: visual, verbal and motor. Significant inter-individual differences were observed as well as intra-individual differences between modalities. In what appears to be the first review of the literature of investigation of mental phenomena with mental tests, Augustus Hoch (1904) summarized studies of “apprehension”, speed of perception, performances under the influence of fatigue, alcohol, caffeine, and fasting. He also described the tests used in these experiments and discussed the usefulness of word association tests and a memory battery which included an early paired associate task. Hoch described methodological directions for the field: statistical analysis, and comparisons between groups of interest (he favored young and old).

During the period between 1885 and 1920, the number of mental tests increased for experimental purposes and these were used in investigated of various groups, with most developed for children. Tests were also widely developed to address political and social needs. The influx of southern and eastern European emigrants into the US through the Ellis Island immigration facility prompted efforts to reduce the number of persons entering the country and mental tests were applied. The outbreak of WWI prompted psychologists to come together and compile the Army Alpha and Beta tests and the Army

Individual Exam. At this point in history, review of the related experimental test literature becomes difficult because it is so closely associated with the mental testing movement. Later, experimental psychologists would have a profound effect on the development of clinical neuropsychology (e.g., Karl Lashley, Donald Hebb, and Roger Sperry), but their contributions will deal directly with brain behavior relationships, rather than merely being concerned with mental processes and behavior. Experimental psychologists discussed the promise of exploring the relationship between brain and behavior and to some, the “prime duty of psychology is to determine the definite relations between the two series of physical and mental phenomena” (Buchner, 1904, p. 62). Nonetheless, investigating mental tests and behavior in association with cerebral functioning did not emerge in the psychological literature until the early 1930s, although work was being done by Franz and others during this time. The concern with mental processes was a necessary aspect of the mental testing movement, the focus of the next section.

Mental Testing Movement

The origins of the mental testing movement are often traced to Francis Galton (1822-1911), the cousin of Charles Darwin. Perhaps because of the intellectual gifts of his family, Galton became interested in the study of intelligence, and propounded the view that it was an inherited property that had relatively little to do with environmental factors (Galton, 1869 *Hereditary Genius*). The publication of *Hereditary Genius* is cited as the advent of the nature versus nurture debate in psychology (Dahlstrom, 1985). Galton’s rather elitist definition of intelligence was an unfortunate beginning for the movement, as testing and testing theory were to be used (by Galton himself and others) as

an underpinning for “social Darwinism” and the Eugenics movements, which encouraged selective mating based on a restricted definition of intelligence. Backward projections of contemporary values aside, Galton was a pioneer in the measurements of individual differences, at a time when Wilhelm Wundt, the preeminent figure in the field, eschewed investigations of individual differences as irrelevant in his search to measure psychological constants (Hergenhahn, 2001). Among Galton’s ideological inspirators were Ernst Weber and Gustav Fechner who have been cited as paving the way for experimental psychology with their pioneering work on measurement of sensation (Crohnbach, 1971).

Galton, then, had seen the advent of the measurement of the senses as a credible topic of inquiry and he paired this new technology with his interest in intelligence, positing that intelligence was the sum of sensory acuity. Moreover, he took the position that intelligence was a single unitary factor rather than a multifaceted construct, thus striking the first blow in a debate over the nature of intelligence that persists to the present in some circles. He founded his anthropometric lab in 1884, examining height, weight, head circumference, strength, reaction time, sensory acuity, and so on, and used these measurements to infer the intelligence of the subject. Although Galton’s Darwinian-influenced view of intelligence was ultimately limited, it did initiate the mental testing movement that was to eventually provide a significant portion of the armamentarium of the clinical neuropsychologist. The considerable legacy of Galton for clinical neuropsychology also includes measurements of test- retest relationships and inter-relationships of tests as well as the concepts of median, regression to the mean, and correlational analysis (later formulized by Pearson; Boring 1961).

The first American on the mental testing scene was James McKeen Cattell (1860-1944) who studied under Wundt and Galton. He transferred Galtonian measurement to the US and is credited with initiating the term “mental test” in an 1890 publication (Freeman, 1962). His entrepreneurial spirit in publishing was prominent through his role in the founding of the journal *Psychology Review* in 1894 and his acquisition of the journal *Science* in 1890 (Zusne, 1984). He believed that psychology should differentiate from philosophy and take as its foundation experimentalism and measurement. As did Galton, Cattell held that sensory measurement was a proxy for measurement of intelligence, and he devised a set of 10 such tests to be administered to all undergraduates as predictive of their performance in college. The correlation between the senses and intelligence was shown to be spurious in 1901, ironically by his own student Wissler, when a criterion measure (success in college as rated by teachers) was analyzed with Pearson’s correlation coefficient showing poor intercorrelation among tests in Cattell’s battery and no relationship between the testing and academic performance (Cronbach, 1971). These results contradicted nearly 20 years of work in the field and rapidly dampened enthusiasm for mental testing in the US, which would not be revived for a decade. However, Cattell’s lasting legacy for clinical neuropsychology was achieved by hearkening back to the interest in publishing he had evinced in the 1890s. After leaving Columbia University Cattell established the Psychological Corporation in 1921. He recruited his friend E.L. Thorndike and they sought to publish and market psychological tests. Although the company was a prolific test producer through the remainder of the twentieth century (a significant portion of its early success was through its association with the Wechsler tests) it has been subsumed under Pearson.

Events external to scientific inquiry made the first of many appearances in the development of clinical neuropsychology when in 1903 the French government commissioned a panel to study the experiences of developmentally disabled children in the public school. Alfred Binet (1857-1911) had been working in the field of measurement of individual differences for over ten years, publishing on the study of intelligence. He rejected Galton and Cattell's linkage of sensory acuity with intelligence and, conceptualizing intelligence as multifaceted rather than unitary, sought to measure higher order processes such as memory, attention, comprehension, and visuospatial abilities. An initial attempt (with his colleague Victor Henri) at constructing a test battery failed in 1899, but after being appointed to the governmental advisory panel with his student Theodore Simon, he renewed his attempt in order to find a way to identify children in need of special education. The result was the 1905 Binet-Simon scale, the first measure of intelligence that sought a direct rather than a proxy (sensory) approach. The 30 tests were diverse (e.g., motor tests, mental abstraction.) arranged in increasing difficulty to provide a measure of intellectual development. A revision in 1908 sought to expand measurement beyond distinguishing normal from impaired by measuring the full range of intelligence. Age levels were also assigned to each item with the criteria of at least 75% passage rate of the subjects at a given age, which solidified the ordinal measurement of the scale.

Binet died just before the final revision was complete in 1911. Changes included adult data (15 year-olds; Dahlstrom, 1985) and introduced the concept of mental age, which he did not interpret as an overall measurement of intelligence. In an interesting foresight into the view of intelligence generally held in clinical neuropsychology today

(Lezak, 1994), Binet argued that intelligence is too complex to be represented by one score because it is the sum of many abilities with low to moderate intercorrelation. However, due to overall scores instantiated into the Binet-Simon tests after Binet's death, in the forms of William Stern's "mental age" and "intelligence quotient" and Lewis Terman's later refinements in the Stanford-Binet, the term IQ gained popularity (Hergenhahn, 2001). Also of note for clinical neuropsychology is Binet's interest in cognitive remediation, what he termed mental orthopedics, which included exercises to improve memory, attention, and judgment. He did not see his scale as an end to itself, but rather a way to identify weaknesses which could be remediated through formalized special education and mental orthopedics.

Henry Goddard (1866-1957) rose to prominence as the American heir to Binet's legacy. While director of the Vineland Training School, Goddard became interested in the study of the "feeble-minded" and in 1906 established a laboratory for the study of these individuals. His psychology internship training program at the Vineland School was the first (Freeman, 1963). He became aware of the work of Binet and Simon, and by 1911 he had translated their works into English. In retrospect, the efforts of Goddard were ambitious, short-sighted, and over-eager. His translations of the Binet-Simon scales were often literal without respect to the applicability of the item to linguistic or cultural differences. His broad efforts to train testers included individuals (mostly teachers) with minimal training in administration and scoring and no training in interpretation and reporting of results. He and others used mental tests to advocate for sterilization of "morons" and as a result 20 states ratified such laws. When asked to administer the testing program at Ellis Island, deportation rates increased nearly 600% in three years and

Goddard opined that 40-50% of immigrants were “morons” (Hergenhahn, 2001). The mixed nature of mental testing persisted.

Lewis Terman (1877-1956) became aware of the work of Binet through Goddard’s widely disseminated translation of the third revision of the Binet-Simon Scale and soon realized that the scale was not feasible in the US, because children performed unevenly across the age ranges. He reconstructed the scale so that the mean score was 100 regardless of age, added a measure of criterion validity (school performance) and published the initial version in 1912. In the 1916 revision, with the Stanford-Binet moniker, Terman incorporated Stern’s intelligence ratio (mental age over chronological age) and multiplied it by 100 to remove the decimal and the concept of IQ that was to become imbedded in the national psyche was set in motion. A subsequent revision of the Stanford-Binet was completed in Terman’s lifetime (1937) but by the publication of the 1960 version, the Wechsler scales had begun to eclipse the influence of the Stanford-Binet. Terman achieved widespread notoriety with success which attracted both positive and negative attention to psychology and mental testing. He engaged in a series of debates in print with the journalist Walter Lippman about the uses of tests and the inferences drawn from their administration (Hergenhahn, 2001). He also set a precedent for the forensic value of expert testimony of psychologists by testifying about the intellectual status of a defendant in a murder trial in 1918 (Boring, 1961).

The breadth of the mental testing movement reached its apex as psychologists scrambled to meet the needs of the armed forces at the outset of the US entry into the “Great War” in 1917. Robert Yerkes (1887-1956) was uniquely positioned to respond to the crisis for two reasons. First he was president of the 27 year-old American

Psychological Association (APA) at the time, and called a meeting of psychologists (including Goddard and Terman) to determine possible contributions of the APA. Second, his contributions to mental testing involved implementing a “point-scale procedure” for determining intelligence in which the individual’s score was the number of correct items, thereby removing the age factor from administration and scoring of the Binet tests because each subject took all items. It also made the tests more amenable to group administration, which would prove crucial to implementation of mental testing on a large scale.

The group collaborated to produce a preliminary set of tests for the army and Yerkes was made a major on the basis of their product. His mandate was to construct tests to classify personnel by their intelligence, to identify individuals with mental disabilities as well as those to receive officer training. The product was the Army Alpha. He surmounted a major hurdle, a 40% illiteracy rate, by constructing a nonverbal test he labeled the Army Beta (Matarazzo, 1972). These nonverbal tests were largely adapted from the experimental psychology literature (and later readapted and included in the Wechsler Scales; Dahlstrom, 1985). The program was discontinued in 1919 after 1.75 million tests were administered, ostensibly a success. However, very few individuals (.005%) were designated as mentally unfit and discharge recommendations were often disregarded. Moreover, due to the selection of a well educated standardization group by Terman, soldiers’ mean mental age was estimated to be 13 or less. Publication of the results (Yerkes, 1921) made these and other limitations (e.g., racial bias) more visible, and the results demonstrated that education and experience could play a significant role in performances on intelligence tests. However, the Army Testing Program was

important for several reasons: it accelerated test development; the tests were published and thus were widely disseminated to clinicians and researchers; and the collaboration of the prominent psychologists involved (Otis, Terman, Wechsler, Yerkes, and others) outlived the demise of the program.

David Wechsler (1896-1981) was a member of the Army testing program and was a student of Cattell, E.L. Thorndike, Charles Spearman, and Karl Pearson, and was thus exposed to the gamut of opinion on the nature of intelligence and the avant-garde in statistical analyses. Cattell induced him to join the newly formed Psychological Corporation, but Wechsler soon left and later became chief psychologist at Bellevue hospital. He found the Stanford-Binet tests inadequate and sought to assemble a battery of tests that represented the individual's "global capacity to act purposefully, to think rationally, and to deal effectively with his environment" (Wechsler, 1944, p. 3). He surveyed measures in existence and, based on their utility with his patients at Bellevue, they were adapted and included in his battery of tests (Dahlstrom, 1985). Familiar subtests which were adapted include block design (Kohs Block Design), digit span, vocabulary, and digit symbol. The initial version, the Wechsler-Bellevue, was published by Psychological Corporation in 1938. It abandoned the ratio IQ in favor of the deviation IQ with the assumption of normally distributed intelligence. In addition, the scale addressed differences in the nature of verbal and nonverbal tasks by including verbal and performance indices. His contributions have been relevant across the lifespan with his development of scales for preschool and school aged children as well as adults. The breadth of his work is represented by the publication of the Wechsler Memory Scale, the first battery directed at the assessment of memory. Each of these scales has been revised

numerous times to improve the standardization and normative sampling and they are by far the most commonly administered intelligence tests. However, the magnitude of restandardization has slowed progress and critics charge that the test battery has been slow to react to advances in cognitive theory.

Applied Psychology

In order to attain all the accoutrements of a profession, a given field must meet certain criteria. A prominent historian of psychology (Watson, 1977) named two, and left open the question of whether or not these were met by applied psychology. The first criterion was an agreed upon practice and the second was regulation of the competency of its members. Benjamin (2005) was more hopeful about the criteria he set out: certification or licensure, an ethical code, a national organization, journals, and standard training. With the endpoint operationalized, we turn to the beginning.

When the APA was founded in 1892, the members were all involved in academic pursuits, with a mix of psychological and philosophical interests (Hildreth, 1937). In fact in the US, there was very little activity in applied psychology or mental health at the time. Watson (1977) cites evidence of a handful of psychodynamic therapists working in the New York City area at the end of the nineteenth and into the early years of the twentieth century, but these were likely psychiatrists. There was, in fact, a fair amount of skepticism about the usefulness of an applied psychology among the prominent academicians of the time and, the prevailing sentiment was that it was necessary to draw a distinction between the pseudoscience of the past and the emerging scientific psychology. This skeptical view was common among the individuals in the hierarchy of the fledgling APA, and it is perhaps not surprising that early proponents of applying

psychological principles to the needs of the public met with resistance. Much of the resistance was behind the scenes and passive, emerging as slow movement on practice issues, forming committees to discuss relevant issues without any application of their recommendations, and inaction in response to later outcries from practicing psychologists. A notable exception to the disdain for applied psychology was the German psychologist Hugo Munsterberg (1863-1916) who served as the APA president in 1898 after working at Harvard with William James. Munsterberg felt that psychological investigation should focus on principles of use in the real world, and his emphasis on pragmatics often placed him at ideological odds with James. As part of applied psychology, he was an advocate for developing a model of psychological treatment based on the instillation of hope, reciprocal antagonism, and strengthening thoughts that opposed those at the source of the problem. Munsterberg was on the forefront of a group of psychologists in the 1890s and 1900s who were committed to the expansion of psychology into the public domain, to “throw light upon the problems that confront humanity” (Witmer, 1897, p. 116).

Throughout his career, Lightner Witmer (1857-1956) made impossible the attempts to forestall or ignore the practice of psychology. His first salvo in this struggle was the opening in 1896 of what is widely recognized as the first psychological clinic at the University of Pennsylvania. The early activities of the clinic were assessment and treatment of children with learning problems and were the focus of the first clinically focused journal of psychology *The Psychological Clinic*. Witmer was also responsible for the introduction of the term clinical psychology, which he qualified as perhaps an “odd juxtaposition of terms” to the ears of his audience during the address in which he

first mentioned the term (Witmer, 1896). His stated goal was the development of a “method of clinical psychology” through the application of the science of psychology to the individual. He was prescient in terms of what would later be deemed necessary for training of clinical psychologists in his establishment of the first training program in clinical psychology. For Witmer, the ideal practitioner would be grounded in the methods of experimental psychology and skilled in translating these to address an individual’s needs, thus he also introduced the scientist-practitioner training model. As his students spread across the country, they took Witmer’s clinical method with them and psychological clinics were founded at the University of Iowa in 1910 by Carl Seashore and in 1912 by J. Wallin at the University of Pittsburgh.

In spite of his early headway, Witmer’s influence is often seen as short lived by historians of the field (e.g., Watson 1977). They cite the demise of all of the clinics founded by his students with the notable exception of the Seashore Clinic. Moreover, estimates of the number of psychological clinics around the time of WWI range from 10 to 20 in 1914 (Finch and Odoroff, 1934; Wallin, 1919) to 24 in 1916 (Finch and Odoroff, 1934). In 1934, Witty and Therman counted 50 psychological clinics, the median age of which was 4 years. Most of these cannot therefore be accounted for by Witmer and his students, and Watson (1977) attributes these toward a more widespread push toward clinical psychology, somewhat reducing the direct role of Witmer’s influence. In addition, on the basis of his clinical experience, he began to shift toward studying the relationships between behavior problems and physical and neurological conditions. While notable for its relevance to the origins of the study of brain-behavior relationships, his position coincided with the rise of behaviorism and psychoanalysis in the US and was

deemed irrelevant by his colleagues. Finally, psychotherapy was jealously guarded by psychiatrists for another 60 years after Witmer began his clinical activities, and the primary activity of psychologists was psychological testing until after WWII.

Psychology did not have in place its own methodology and thus Witmer's efforts were perhaps too early to have a more widespread effect.

Shepard Ivory Franz (1874-1933) opened a psychology lab in 1904 at MacLean Hospital in Waverly, Massachusetts and conducted clinical research with his patients with particular emphasis on the clinical exam. He introduced a clinical exam in 1907 (Franz, 1908) which he viewed as routine and applicable across settings. He included standardization techniques with his exam and advocated the development and usage of standardized psychometric testing to supplement the clinical exam which he saw as a step toward a more systematic and scientific assessment (Hartman, 1995). The manual used for his comprehensive testing program of a patients in a psychiatric hospital (perhaps the first; Colotla & Bach-y-Rita, 2002) was published in 1912 and 1919 (Franz, 1912 & 1919) and included normative data, as well as tests of attention, memory, language, motor skills, and personality. Franz also completed pioneering work in the psychological rehabilitation of individuals following neurological trauma. Using his position at MacLean and later at the US Government Hospital for the Insane, Franz sought to bridge the "gap between experimental psychology on the one hand and neurology and psychiatry on the other" (Fernberger, 1933, p. 741). His success in this endeavor, his research on cortical ablation in animal models (especially his influence on his student Karl Lashley), and his advances in mental testing have caused a recent re-evaluation of his significance

for early neuropsychology, with several historians citing him as the first experimental and clinical neuropsychologist (Colotla & Bach-y-Rita, 2002).

In the years before WWI, clinical psychologists were employed by universities, courts, psychiatric hospitals, and correctional facilities (Finch and Odoroff, 1939). Their primary function was psychological testing (most often of children) with training and research comprising a small portion of psychologists activities. Psychotherapy was not yet a part of the clinical duties of the psychologist. Beginning with Wundt, the focus of psychologists was on functions of the “normal mind”. Ironically, it was a neurologist who is credited with the popularization of the psychological study of psychopathology. Morton Prince worked as an advocate for psychology and its potential contribution to the study of “insanity” (Benjamin, 2005). He was particularly interested in the role of clinical psychology in treating individuals with psychopathology. Through the founding of the *Journal of Abnormal Psychology*, he was able to familiarize psychologists in the US with the European work in the field and provide an outlet for publication of scholarship in the area. His legacy for applied psychology is further solidified by his role in the founding of the Harvard Psychological Clinic in 1927 (Murray, 1956). In spite of his efforts, there were very few psychologists employed in hospitals before WWI and most, if not all, were employed as mental testers (Benjamin et al., 2003). Before applied psychology assume the professional duty of psychotherapy further refinement of testing would be necessary. Mental testing remained rudimentary until first Binet and then WWI spurred development and refinement of tests. There was much to be done in this regard.

There was a fair amount of experimental testing being conducted in the US in the years before the dispersal of the Binet-Simon tests in 1906. At the urging of William

James, Witmer and others the APA formed a committee to regulate mental test practice in 1896. It was conceived by its proponents as an opportunity to build solid methodology through sharing of data collected with more standardized instruments. However, others were concerned about broader application of these tools and the regulation aspect of the committee's agenda was inserted. Perhaps because of these cross-purposes, the mental test practice committee was rather impotent and was dissolved in 1899 (Watson, 1977).

When Goddard began to popularize the Binet-Simon tests in the US, the committee was resuscitated in 1907. Over the next decade, English translations were widely distributed, often to individuals with little or no training in its administration and no experience with its interpretation. This development was met with widespread concern from academic and clinical psychologists alike. In one of the earliest and most inclusive compilations of existing mental tests, Whipple (1915) proposed qualifications that mental test examiners should possess. A group of practitioners submitted a petition to the APA to adopt standard qualifications for mental testing, but the petition was largely ignored when a very loose competency statement was issued (Resnick, 1997). None of these efforts were effective and the APA mental testing regulation committee was disbanded in 1919.

In what was tantamount to an uprising, practitioners formed independent American Association of Clinical Psychologists (AACP) in 1919 and proffered criteria for certification of "consulting psychologists". With only 25 certifications after several years, certification movement was deemed a failure and was terminated. In the face of this failure, the AACP was reorganized into the APA clinical section in an attempt at bringing their goals in synchrony. However, numerous requests in the vein of regulation

and reform of applied psychology were ignored by the APA. The first ethics code in psychology was created in 1933 by the Association of Consulting Psychologists after years of inaction by the APA. A similar pattern repeated itself several times over the next twenty years with several clinically focused organizations merging until an independent and relatively powerful American Association for Applied Psychology formed in 1937. The AAAP was established to advocate to national and state governments, respond to an ongoing guild struggle with psychiatry, and raise awareness among the public about how psychology could be a part of society.

Estimates of the numbers of practitioners from the period between the wars show a dramatic rise from 24 in 1916 to 694 in 1938 (Finch & Odoroff, 1939), although this is likely an underestimate as there was no way for the researchers to identify those practicing who were not associated with the APA. Hildreth (1937) estimated that there were 1200 psychologist practitioners in 1932 and 1500 in 1937. Nearly all of these individuals were solely engaged in assessment in clinics, courts, and psychiatric hospitals. Independence was often limited, even in the core activity of psychology, mental testing. According to Hildreth, psychologists were often functioning as mental testers, administering the exam and handing the results to a psychiatrist for interpretation.

It is well known that the mental health field was woefully unprepared for the demands of WWII and that there was an unprecedented movement toward improving training and increasing numbers of psychologists. It was no longer feasible for psychiatrists to treat each patient with psychotherapy and psychologists' duties came to include psychotherapy, marking the beginning of the supplantation of psychological assessment as the primary activity of psychologist. In another sense, psychological

assessment was opened up in new directions as more and more psychologists worked in hospitals with armed forces personnel who had sustained brain injuries. The study of the effects of penetrating head injuries had been undertaken after WWI by a select few, but with improved treatment and survival rates, more soldiers were available for study. Access to these sorts of brain injuries was essential for neuropsychologists in Europe and the US to develop tests of specific deficits. The number of psychologists working in hospitals increased from 255 in 1952 (Mensch, 1953) to 2336 in 1981 (Matarazzo, Carmody, & Gentry, 1981). Their duties had broadened to include psychotherapy, but the primary role of psychologists in hospital settings remained in assessment until the 1980s (Benjamin, 2005).

The Emergence of Clinical Neuropsychology

A debate in the literature between prominent clinical neuropsychologists emerged in the late 1980s and early 1990s that took the form of responses and rejoinders with the usual scholarly ad hominem attacks while maintaining a posture of benevolent superiority (Hartman, 1991; Loring, 1991; Mapou, 1988; Reitan, 1989). The debate was noteworthy for its participants (including perhaps the best known living neuropsychologist, Ralph Reitan) as well as its subject: the early days of neuropsychology. Reitan rejected the commonly held notion, presented in this case by David Hartman, that the focus of early clinical neuropsychology was the “three Ls”: lesion identification, lateralization, and localization. Reitan placed the weight of his opinion behind the idea that clinical neuropsychology had in fact emerged in response to psychologists’ attempts at measuring brain damage and had done so largely through the efforts of Ward Halstead (and himself). Hartman (1991) responded by discussing the initial efforts at examining brain-

behavior relationships that predated the establishment of Halstead's neuropsychology laboratory at the University of Chicago Hospitals and Clinics in 1935. In fact, both views as presented above were correct (the origins of psychological and psychometric evaluation of brain-behavior relationships antedated the contemporary connotation of the term clinical neuropsychology by some sixty years) but incomplete.

The thesis of the following section is that clinical neuropsychology initially emerged during the period after WWI as clinical psychologists attempted to address the needs of patients with brain damage and respond to the demands of their referral sources to distinguish 'functional' patients from 'organic' patients. In the between war period, psychologists were primarily functioning in the psychiatric setting and developed approaches that conformed to these expectations. Beginning with Ward Halstead and Donald Hebb in the 1930s, neuropsychologists began to gain footing in neurology units and to investigate phenomena associated with neurologic disease. It is postulated that two branches of clinical neuropsychology developed independently and functioned in parallel for several decades, with "neurological" neuropsychologists focusing on development of special tests of various cognitive abilities and the "psychiatric" neuropsychologists focusing on tests that discriminated "brain damaged" individuals from psychiatric and normal populations. In the early days, three principal factors limited clinical psychologists in their ability to address these needs: a mutually exclusive view of functional and organic symptomatology and etiology that stemmed from the prevalent view of brain function; rudimentary research of brain behavior relationships; assessment instruments limited in focus and scope. These limitations will be addressed in turn.

Brain Function Theory

Before the nineteenth century, theories of brain functioning were all but the same as conceptualization of the mind-body problem (see below). In fact it was not a great while before the nineteenth century that mental functions became unanimously attributed to the brain (Finger, 1994). The struggle to reconcile mind and body is an ageless one that has been popularly reintroduced into the contemporary neurosciences by the work of Damasio (*Descartes' Error*, 1994) who begins with the dualistic position of Descartes and traces the effects of his position through scientific thinking to the modern day. In general there is a continuum of views on the issue anchored at either end by monism and dualism. The monists believed that mental functions are inseparable from the body while the dualistic position held that mental functions were independent of anatomy and physiology and therefore did not reside in any specific structure; rather they were distributed or interacted with the body at several points (Finger, 1994). These issues were certainly in the bailiwick of psychologist-philosophers of the nineteenth century, but only later became relevant for American applied psychology when psychopathology became a valid area of investigation at the beginning of the twentieth century when European work in the area was transplanted to the US by a neurologist, Morton Prince (Murray, 1956). In the pre-behaviorism era, experimental and theoretical psychologists were quite interested in physiological and neurological issues, including prominent individuals such as Thorndike, Spearman, James, and others. Although there has been much debate about causation and correlation, there was an inverse relationship between the rise of behaviorism and psychoanalytic theory on the one hand and applied psychology and brain-behavior interest on the other hand. Although there are several

important exceptions, the revival of interest in brain-behavior relationships was only slowly gaining impetus until WWII and neurosurgery provided patient samples for investigation.

Brain Functioning in Psychiatry

At the beginning of the nineteenth century, psychiatry was viewed as marginal to the medical profession because of the few “treatments” available, segregation in an asylum and bloodletting were the most efficacious (Finger, 1994). The work of Philippe Pinel and Benjamin Rush brought a more humane view of the “insane” with renewed efforts toward relieving the suffering of denizens of mental institutions. However, treatment remained sorely limited, in part because of the poor differentiation of psychiatric disorders. Perhaps because of the confluence of the marginalization of psychiatry (also known as Alienism at the time), the apparent intractability of mental illness, and the prevailing dualistic view of mind and body, psychiatric illness was viewed as independent of physiology and emerging from a derangement of normal mental function. The initial successes in psychiatric treatment served to undergird this dualistic perspective because they were achieved in the areas of “hysteria” and “hypochondriasis” when Jean Marie Charcot hypnotized women with physical and emotional symptoms and when Sigmund Freud and Josef Breuer confronted the hysteria of Anna O with the “talking cure”. It thus became important to know if individuals who were exhibiting both neurological (e.g., paralysis) and psychiatric symptoms had pathology that was, in the argot of the day, organic or functional. For the most part these two domains were mutually exclusive until the 1920s. Psychologists were not yet

prepared to address the differential diagnostic question, but their services would be called upon once their armamentarium was expanded to include mental tests.

Psychiatric nosology was greatly advanced by the scholarship of Emil Kraepelin (e.g., 1913) who is well known originating the term “dementia praecox” that has been refined many times over the years to the current construct schizophrenia. His work was prescient for the field of psychology through his criticism of loose psychiatric exams based on faulty constructs. His call for standardized methods of examination anticipated later developments in mental testing and psychological diagnosis. With the inestimable benefit of the intervening accumulation of over 100 years of knowledge, Kraepelin’s nosology is rudimentary, but his work served as the catalyst for a drive toward diagnostic precision that is currently manifested in the DSM-IV TR and the committees laboring toward the DSM-V revision. In the 1920s Joseph Bleuler provided the initial refinement of dementia praecox and also sought to incorporate consideration of organic etiology in psychiatric diagnosis and in mental symptoms that accompanied neurological conditions. However, psychiatric diseases remained unaffected by the treatments of the day, and mental illness continued to be attributed to psychopathology (independent of physiology) or resistance. Thus, psychiatrists were interested in differentiating those patients with organic pathology from those with functional pathology with the rationale that medical treatment was more appropriate for organic etiology and psychotherapy and inpatient care were more appropriate for those with functional etiology.

The Status of the Localization Debate

The beginnings of the localization debate in nineteenth century neurology have been discussed, but it is important to consider the status of the debate in the first half of

the twentieth century in the formative years of neuropsychology. The protracted and heated debate extended well into the twentieth century with the anti-localizationist writings of the English Neurologist Henry Head who criticized the localizationists as “diagram-makers” who grossly oversimplified deficits and forced symptoms into syndrome. Karl Lashley, also often cited as the catalyst of neuropsychology (e.g., Hebb, 1983), was perhaps the most effective scholar on the side of mass action/equipotentiality in the first half of the twentieth century. His work with animal models provided evidence supporting Flourens’ conclusion, namely that size of the lesion was of more import than lesion location. D.O. Hebb, Lashley’s eminent student, cited him as both the father of neuropsychology and the cause of a twenty-five year silent period in the study of brain-behavior relationships from 1920 to 1945 (Hebb, 1983).

The confusion of the field of neuropsychology about its origins is exemplified in this ambivalent embracing of a putative father-figure and through attributions of its origins to members of both sides of the localizationist debate. This confusion cannot be solely attributed the spurious generalization from animal models. The late 1930s saw several published studies (e.g., Hebb, 1939a & 1939b) involving psychometric testing (IQ) of individuals who had undergone partial frontal and temporal lobectomies. These showed that there was little evidence for change in intellect following surgery, much to Hebb’s barely concealed consternation. These results were interpreted by many as direct support for anti-localizationist theory, rather than limited assessment tools as Hebb suggested. Clinical neuropsychology could not fully emerge until rapprochement was achieved between localizationists and proponents of equipotentiality.

In the clinical endeavor (neurology, psychiatry, as well as psychology) in the early part of the 1900s, the mass action/equipotentiality camp held sway and the attempts to study brain behavior relationships during this period were interpreted accordingly. The clinical manifestation of mass action theory was the unitary theory of brain damage, which held that the locus of damage to the brain was less important than the amount of damage. Thus, lesions of varying locality should not have a great differential effect on higher cognitive functions, and brain damage was generally thought to manifest with relatively uniform symptomatology and variability in symptoms was related to the amount of damage to the cortex. Early brain damage tests were usually aimed at functions of the frontal lobes (Goldstein, 1942; Halstead, 1940a) but later expanded to include a variety of constructs. Ward Halstead's battery was developed to tap several constructs he believed important to assess and localize brain damage and was therefore an advance over other techniques. In terms of clinical relevance, localization of brain damage was helpful, but it was often deemed sufficient to answer the more general question of whether there was any brain damage at all without further characterization of the deficits. Indeed many authors have stated that, based on clinical lore, the most common referral question for the first fifty years of neuropsychology was some variation of distinguishing between "functional and organic" (e.g., Parson, 1970).

Brain Behavior Research

Clinical neuropsychology could not differentiate from clinical psychology until psychologists working with neurological patients began to incorporate the neuroscience of the day into their approaches, and their research methodology advanced enough to dispel the theory of unitary brain damage generally held in psychiatry. There were

several fundamental flaws in brain behavior research before the 1960s. The most common and problematic was the inclusion of a group of “brain damaged” subjects in studies. Brain damaged proved to be a hopelessly vague term and included different syndromes and diseases ranging from epilepsy to multiple sclerosis to head injury. Neither were time of onset, course, etc., considered resulting in recent injuries and advanced dementias being included in the same group of “brain damaged”. The outcome criterion in these studies was often the percent of subjects correctly identified as belonging to their respective groups. The diagnosis of a physician, often a psychiatrist or neurologist, was taken as the final word in classification. It was not learned until later that the diagnostic process in psychiatry and neurology was plagued with poor inter-rater reliability largely due to vague and spurious diagnostic categories. It is therefore no surprise that etiologic heterogeneity did not yield a set of consistent findings for psychologists to build upon. Instrumentation of these studies was also limited for reasons that will be discussed below.

Neurosurgical Evidence

Evidence of brain surgery composes some of the earliest signs of interest in the brain. Skulls dating back to ancient Egypt have been unearthed demonstrating trephening, rudimentary brain surgery, and the Edwin Smith papyrus documents surgical procedures performed on the brain (Finger, 1994). Modern brain surgery has made great strides in advancing understanding of brain behavior relationships through use of cortical stimulation, stereotactic devices, etc. However, not all contributions resulted in the long-term advancement of theories of brain functioning. A distinction must be drawn between

two movements in brain surgery in the early twentieth century that were influential in early neuropsychological research.

The first is within the auspices of traditional neurological surgery, where advances were largely made through surgical treatment of intractable epilepsy. Thornton Wilder is of particular importance for the development of neuropsychology because of his refinement of the cortical stimulation technique, his pioneering lobectomies for individuals with epilepsy, and his cooperation with psychologists in the study of his patients. Early psychometric studies of individuals who had undergone frontal or temporal lobectomy (Hebb 1939a & 1939b) were limited in their instrumentation and gave misleading evidence that intellectual functioning and/or mental tests were not related to frontal lobe functioning. However, Brenda Milner's groundbreaking work with Penfield's temporal lobectomy patients demonstrated a relationship between anterograde memory and the anterior temporal lobes, which was subsequently expanded to a material specific relationship between left temporal-verbal and right temporal-spatial.

In retrospect, the second trend in brain surgery was an ignominious period in the development of the mental health professions. Psychosurgery, also known as prefrontal leucotomy and popularly as frontal lobotomy, was pioneered by Egaz Moniz to treat severe mental depression and anxiety and popularized in the US by Walter Freeman. Moniz garnered the Nobel Prize for the technique, although motions have been made to posthumously rescind the award. As the popularity of psychosurgery increased in the 1940s several variants of the technique arose. Later analysis of these techniques shows that it is likely that disparate parts of the frontal lobe were damaged, ranging from Broca's area to the orbitofrontal cortex (Finger, 1994). Because a great number of

individuals were “treated” with psychosurgery, a ready sample was available for brain interested psychologists employed in psychiatric settings to study the effects of frontal lesions on behavior. However, it is perhaps generous to say that the procedure was inexact and there was no possibility for a homogeneous treatment group

Problems with Early Testing of Brain-Behavior Relationships

The development of the mental testing movement has been addressed and only a few relevant points will be discussed. Most of the well known tests in the pre-WWII period were developed to measure intelligence, specifically in children. One obvious problem soon emerged and another was present, but would not become apparent until decades later. First, the shortcomings of using a test constructed for and normed on children was apparent to the workers in the field. An upward extension of the normative data to cover adults only partly addressed this liability because the content and format of the test items was overly simple for adults and churlish examinees often took exception at what appeared to be condescension (Franz, 1919). The second problem was more subtle and eluded investigators until more careful studies of the frontal lobes with well developed tests could be undertaken. Initial studies on the effects of damage to the frontal lobes by Halstead, Hebb, Rylander, and Goldstein yielded very mixed results, with the preponderance of evidence falling in favor of the conclusion that focal and extensive damage to the frontal lobes had little relationship to intellectual functioning. The problem arose when these mixed findings were widely interpreted as supportive of mass action/equipotential theory and the resultant unitary theory of brain damage, which will be described below. There was a caveat added by some investigators, namely that

this pattern was true for intellectual functioning *as measured by existing intelligence tests*.

In efforts to expand the psychologist's repertoire, tests were revived that had been used for myriad applications in the past. These ranged from very early formboard tests (Seguin, 1846) to adaptation of idiosyncratic psychiatric or neurologic exam techniques (e.g., Goldstein and Scheerer, 1942; Rieger, 1888, as cited in Benton, 2000) and included nonverbal tasks developed for illiterate armed forces personnel (Army Beta; Yerkes, 1921). Some of these instruments became widely used in spite of the difficulty in adapting standard procedures and objective scoring methods (e.g., the Weigl sorting test from the Goldstein-Scheerer battery, 1942). It is now universally acknowledged that personality change often accompanies brain injury and this was known during the pre-WWII period as well. However, in what will doubtless be seen as puzzling to the contemporary observer, personality tests were used to diagnose brain damage as well. The commonest personality instrument used for diagnosing brain damage was the Rorschach Inkblot test, based largely on the work of Piotrowski (1937). Halstead began to collect existing tests from a wide variety of sources and through extensive study of patients with brain damage, he narrowed his battery to ten tests and derived a brain damage index based on the number of tests failed. Although his work moved well beyond the unitary theory of brain damage, his early writing and later inclusion of an Impairment Index as a summary score for the battery allowed others to use the tests as a brain damage index.

Not all researchers were solely focused on the identification of brain damage. An important concept was put forward in 1939 by Harriet Babcock that was to be used in

testing for organicity as well as in more developed neuropsychological assessment. She despaired at the abandonment by psychologists of the study of the “relationship between psychology and neurology”. She conducted a longitudinal study of what was then known as mental deterioration, which was thought to be one of the more common forms of organic brain damage, and developed a theory of how different mental functions would be affected based on age, type of disease, etc. Using a thoroughly described battery of tests that sampled memory, attention, and planning, she found that vocabulary tests seemed to be relatively preserved even in the face of severe impairments in all other domains. Analysis of the discrepancy between vocabulary and tests of other functions would yield an index of mental deterioration. Because of their apparent resistance to change over time, “hold tests” emerged as a common way to estimate premorbid intellectual functioning. Although Babcock’s hold tests were later challenged, other tests have been investigated and word reading ability is commonly used as a measure of premorbid intellectual functioning today. Attempts to use common tests advanced somewhat when Wechsler-Bellevue scales were analyzed to identify subtest patterns that were associated with brain damage.

As the pressure mounted on psychologists to discriminate functional and organic patients, tests were adapted or developed as screening measures of overall brain damage. Investigations of “brain damage” were undertaken as attempts to identify a test or set of tests that tapped overall brain function without any distinction made for different abilities. In fact the most commonly used omnibus tests of brain damage were those that required several skills that would today be interpreted as attention, executive function and visuospatial ability. What emerged was a unitary theory of brain damage that had at its

core common symptoms of brain injury: deficits in frontal-executive functioning. The most influential scholar in the frontal lobe damage and its relationship to unitary brain damage theory area was Kurt Goldstein who, at least in the early years of his work, identified the core symptom of brain damage as “impairment of the abstract attitude” (Goldstein & Gelb, 1920). He and his colleagues developed a battery of tests, cited by some as the first battery of neuropsychological tests (G. Goldstein, 1992), including an especially influential sorting task, that they used to study groups of brain damaged individuals. While the tests were not standardized according to the psychometric standards of the day, they filled a wide gap for psychologists working in settings where they encountered individuals with known or suspected brain injury. Goldstein’s theory and instruments generated a great deal of research activity and instruments based on his unitary theory of brain damage proliferated. In spite of advances in test use and development, research in the area was hindered by a number of flaws that hindered the transition to clinical neuropsychology.

While it is unclear what extent they were influenced by Goldstein, two additional scholars were influential in establishing the unitary brain damage theory, Karl Rylander and Ward Halstead. Rylander’s longitudinal work with veterans of World War I (1939) gave him access to individuals with penetrating head injuries that would not become widely studied until after WWII. He also developed tests intended to tap frontal lobe function because he also viewed these as the most common sequelae of head injury. Rylander recognized the necessity of standardized tests for empirical study and was a vocal proponent of their development and dissemination. Both Rylander and Goldstein wrote in German which somewhat delayed their impact upon Americans working in the

field. However, Ward Halstead's endeavors are evidence that Americans were not idle. Having established his lab at the University of Chicago Hospitals in the department of psychiatry, he broadened his contacts to include prominent researchers in neurology and neurosurgery.

Also at the University of Chicago at this time were Heinrich Kluver, Paul Bucy, and EL Thorndike. Halstead's early work was inspired through familiarity with the animal model decortication studies that would later make Kluver and Bucy famous. He adapted existing sorting tasks from the psychometric literature and studied sorting behavior in brain damaged individuals (1940b). Although his participants were a mixed etiological lot, his results pointed to a common disturbance which he attributed to frontal lobe damage. He expanded these and other results into a theory of biological intelligence that was seated and orchestrated by the frontal lobe. His attempts at defining his theory were not well received because of their vagueness and limited potential for operationalization. Even Halstead's most ardent and prolific advocates have been unable to incorporate his theory of biological intelligence into their work (Reitan, 1994). However, his early efforts set an emphatic precedent in the US and his test collection held sway for many years for psychologists beginning to build a clinical conceptualization of brain-behavior relationships. The distilled message from these scholars to clinicians was a unitary theory of brain damage.

Even a mere glance at publications dealing with clinical study of brain and behavior from the 1940s through the 1960s shows scientist-practitioners working furiously at implementing the unitary theory of brain damage. Multiple tests were developed as screening instruments to detect brain damage, particularly in psychiatric

populations, based on the idea that if any brain damage was present anywhere in the brain, focal or diffuse, it would manifest through impairment in a certain test performance. Although some of these tests died a hard death over decades well after prominent calls to cease usage, some benefits accrued from the study of brain damage using screening instruments. Well-established tests were studied for their ability to discern brain damaged individuals from those with merely functional impairment (e.g., Spreen & Benton, 1965). Statistical techniques were introduced into the field to compare the diagnostic effectiveness of tests of brain damage to other tests as well as neurodiagnostic tests (e.g., electroencephalogram). However, the fundamental flaws in the theory, reasoning, and utility in distinguishing “functional from organic” made tests of brain damage targets for criticism.

In what appears to be the first review of studies of brain damage, Seymour Klebanoff (1945) cast doubt upon the use of single tests of brain damage. He identified the Goldstein and Scheerer sorting test, the Bender-Gestalt, the Shipley-Hartford Scale, and the Hunt-Minnesota (Hunt, 1943) as the most commonly used single tests of brain damage. Graham and Kendall (1946) suggested assessment of a broad range of “susceptible functions” an alternative approach to developing a single-most efficient test to identify brain damage. In a scathing critique, Yates (1954) criticized single tests of brain damage for not meeting basic validity criteria and for ignoring flaws in every step of test construction and usage which he identified and elaborated upon at length. The Hunt-Minnesota and Shipley-Hartford Scales consisted of few items and required a quarter of an hour for administration. The evidence to support their use was equivocal even from the labs where they were developed and they were soon discredited in the

literature, but continued to be used until the 1960s (Spreen & Benton, 1965). The Bender-Gestalt (BG) involves copying a series of geometric figures and was developed as a personality test. Several scoring systems were used and the BG began to gain momentum as an effective screening device for organic impairment. Other tests became associated with screening for organicity, including the Kohs Block Design (the source of the Wechsler Block Design subtest), and the Benton Visual Retention test, which involved copy and or immediate recall of a series of geometric figures.

In spite of mounting evidence that single tests were not reliable as a manner of identifying brain damage (e.g., Haynes & Sells, 1963, Parker, 1957; Spreen & Benton, 1963) clinical psychologists continued using them for this purpose. In fact, a search of recent literature on screening tests for brain damage topic revealed no less than seven articles written in the 1980s expressly to criticize the continued use of a single test to screen for brain damage (primarily the BG). These publications are not surprising given that books targeting therapists continued to emerge in the 1970s with the purpose of providing general practitioners with the tools needed to assess “organic impairment” (*Assessing Organic impairment*, McFie, 1975; *Neuropsychodiagnosis*, Small, 1973).

It is clear, then, that neuropsychological research was being conducted by Ward Halstead, Harriet Babcock, Gosta Rylander, and Donald Hebb in the 1930s, although it would not be labeled as such until the term neuropsychology became popular. Neuropsychology was apparently coined by Sir William Osler and used in an address he delivered in 1913 (Bruce, 1985). Karl Lashley is credited with making the term well known in experimental circles. Hans-Lukas Teuber was the first to use it in reference to clinical activity in a 1950 chapter entitled *Neuropsychology* in a book dedicated to the

topic of advances in psychological testing (Stringer & Cooley, 2002). The term does not come into use in the literature until the 1960s and even then only rarely until the late 1960s. For example in his twenty nine page review of psychological deficits and brain damage, Ralph Reitan (1962) uses the word only once, when referring to the name of his laboratory. In their landmark study and critique of testing for organicity in 1965, Spreen and Benton use the word only once, in the final paragraph when referring to the future in the area, whereas neuropsychological assessment is used frequently in Benton's 1967 review of tests of brain damage.

The emergence of the use of the term neuropsychology can be attributed to several factors, all of which served to differentiate clinical neuropsychology from clinical psychology. Two neuropsychological journals were founded in the mid 1960s: *Neuropsychologia* in 1963 and *Cortex* in 1964, giving a forum for communication in the field. Secondly, the International Neuropsychological Society began in its early form at an informal meeting at the APA conference in 1965, giving those involved in practice and/or research an avenue for contact with peers. Finally, the refusal of clinical psychologists to desist in what has been viewed by scholars as baseless and unethical practice made it necessary for neuropsychologists to separate themselves so that neuropsychological assessment could be differentiated from organic brain damage assessment and so more productive research could be pursued.

McFie (1960) addressed the problem of neurologists' views of neuropsychology, which he assessed as disinterest at best and pessimistic at worst. The cause of neurologists' discouraging views was attributed to the two models of brain functioning held by practitioners at the time: the unitary theory of brain dysfunction and the

subdivision of function theory. Much of the criticism in the literature was focused on the former and use of the alternative model and methodology was urged. However, clinicians were under pressure from psychiatrists to label patients as functional or organic, they felt that their methods were expedient and adequate, and busy schedules allowed no time for the acquisition of additional training that would be necessary to conduct neuropsychological assessment in the fashion recommended. This debate has changed in specifics, but its general form remains a contentious topic in clinical neuropsychology. Organizations provided the structure for clinical neuropsychology to continue its development into a recognized specialty, the next phase for the field.

The Role of Organizations in the Development of Clinical Neuropsychology

European neuropsychologists were quicker to organize than their American colleagues. The French neurologist/neuropsychologist Henri Hecaen had begun a series of conferences in 1962 held yearly in various cities in continental Europe (Zangwill, 1984). Papers were presented in the native tongue of the author and simultaneously translated into French or German. This collegiality sparked a period of productivity due to more substantial communication between contemporaries, including Ennio De Renzi, the founder of *Cortex*, and Oliver Zangwill, known for his work on the right hemisphere. After several years involvement of Americans became a focus, with Arthur Benton figuring prominently, as he had established a working relationship with De Renzi in the publication of *Cortex* (Boller, 1999). The stirrings of organization were not far behind in the US. At an impromptu gathering of neuropsychologists at an APA meeting in 1965, Louis Costa suggested an American organization similar to that found in Europe (Costa,

1976) and his suggestion was consummated one year later with the formation of the International Neuropsychological Society (INS) by Herbert Birch and Raymond Dennerll.

In spite of initial fervor, little occurred over the next several years to solidify an organizational structure (Meier, 1992). Annual meetings continued at the APA conferences, but the early presidents were better known for their research than their interest in the new organization. A formal program was prepared for the APA meeting in New Orleans during Arthur Benton's presidency in 1973. The attendance at the meeting was more than one hundred and comments of the attendees were extremely positive.

In spite of new momentum in the early 1970s, there was little interest on the part of the APA in providing a place for neuropsychologists, and INS remained the only organization in the field until the formation of the National Academy of Neuropsychology (NAN) in 1975. NAN was founded with the purpose of more directly addressing the needs of practitioners in the field of clinical neuropsychology. Soon thereafter the journal *Brain and Language* was formed joined in by 1979 the *Journal of Clinical Neuropsychology*. These journals, in addition to *Cortex* and *Neuropsychologia*, allowed for the centralization of studies on brain-behavior relationships which had previously been spread among experimental and clinical psychology journals (Martin, 1998).

It is evident that the continued practice of brain damage testing by under qualified practitioners was viewed with some urgency by neuropsychologists in the 1970s. Symposia held at APA meetings by INS in 1976 and 1977 addressed appropriate training and credentialing of clinical neuropsychologists, and resulted in the formation of a task

force in 1977 headed by Manfred Meier. The Taskforce on Education, Accreditation, and Credentialing (TEAC) was charged with drafting guidelines for predoctoral, internship, and postdoctoral training, credentialing recommendations, and guidelines for accreditation of training programs. It soon became apparent that these issues could only be fully addressed by working through the APA and Louis Costa chaired a steering committee to form a division of clinical neuropsychology. Division 40 was formed in 1980 and board members quickly moved to form a joint Division 40/INS TEAC taskforce (JTEAC). The JTEAC published several sets of guidelines (Meier, 1981a, 1981b, & 1987) addressing all three aspects of its charter.

Manfred Meier elected to set in motion a parallel strategy to raise standards of the practice of neuropsychology when he formed a committee to establish the American Board of Clinical Neuropsychology (ABCN). Clinical neuropsychology was formally associated with the American Board of Professional Psychology (ABPP) in 1982 and the ABCN was designated to develop eligibility criteria and competency based examinations (Meier, 1992). ABPP recognized clinical neuropsychology as a subspecialty of psychology in 1989. The first ABCN/ABPP diplomates were awarded in 1983 (Yeates & Bieliauskas, 2004).

These events were not viewed passively by practitioners in the field who were separated from academia. Generally speaking, members of INS and Division 40 were scientist-practitioners and more likely to be involved in research than members of NAN and those strictly involved in professional practice. Concern arose amongst these individuals that adoption of new training guidelines would exclude many of those who were practicing in the field. The American Board of Professional Neuropsychology

(ABPN) was formed in 1982 by neuropsychologists who were ABPP/ABCN diplomates. They acknowledged the need for establishing competency in the field, but took a broader view of training that could provide the necessary knowledge. A common model for specialization in clinical neuropsychology advocated by the ABPN is intensive weekend workshops covering neuroanatomy, neuropathology, and neuropsychological assessment. This model allows practitioners with busy schedules to receive exposure to neuropsychology without having to leave their employment and return to a formal training program. Critics roundly attacked respecialization through seminars as superficial, lacking in clinical supervision, and enabling practice outside of competencies (Bieliauskas, 1999). This debate has continued unabated until the present day.

The debate notwithstanding the ABCN continued to refine their bylaws and testing procedures and by 2004 had awarded 500 diplomates. Their incremental growth prompted organizations to refine their definitions of a neuropsychologist (e.g., Barth, et al, 2003; Division 40, 1989). They cited the recognition of clinical neuropsychology as a subspecialty of psychological practice by the APA in 1996 as an additional factor making necessary reform of training guidelines (Bieliauskas, 1997). Later that year the Clinical Neuropsychology Synarchy (CNS) was formed that is composed of representatives from Division 40, NAN, ABCN, and internship and postdoctoral training directors. The result of several CNS meetings was the Houston Conference, which came to be a milestone in the development of universal standards for the practice of neuropsychology. The policy statement adopted the scientist-practitioner model and defined a clinical neuropsychologist as an individual who has received education and training in brain behavior relationships. Eleven areas of specialized education and training were explicitly

stated and these were to be obtained preferably beginning at the doctoral level, and continuing in internship and postdoctoral training. Accreditation criteria for clinical neuropsychology postdoctoral programs were delineated and internship training at an accredited site was mandated for those commencing graduate school after the recommendations of the conference went into effect, if they wish to identify themselves as neuropsychologists and pursue ABCN certification. Continuing education was defined as an expected activity of clinical neuropsychologists, but was excluded as a method for respecialization in the field.

NAN and Division 40 endorsed the Houston Conference policy statement and acrimonious debate ensued, generating articles entitled “Mediocrity is no standard” and “where’s the beef”. Entire issues of journals were devoted to exchanges about the effects of the conference policy statement. Members of the ABPN charged that no representatives from their organization were included, and the delegates to the conference were not representative of neuropsychologists at large (over 75% were affiliated with a university; Reitan, et al., 2004). The move toward more stringent standards for specialization in clinical neuropsychology appears to have gained the advantage, but the debate is unresolved and is a source of internal strife for NAN in particular (NAN Management Report, 2005). The AACN has continued its efforts to refine the definition of a neuropsychologist and acceptable standards of training and practice. In 2007 the AACN (AACN Board of Directors, 2007) issued a comprehensive set of practice guidelines concerning education and training, work settings, Ethical and clinical issues, and methods and rocedures for evaluating tests, conducting assessments, reporting, and

providing feedback. Debates about competency and training begs the question: Who is practicing clinical neuropsychology and what is their practice like?

The Practice of Clinical Neuropsychology in the
United States 1978-2008

It has been argued thus far that clinical neuropsychology began to move itself away from clinical psychology toward a type of assessment that was based on sound psychometric practices, stringent test development procedures, and study of brain-behavior relationships. Evidence has also been given that those who did not possess the training or experience did not desist, but continued in assessment of “organic brain damage” through the 1960s, 1970s, and 1980s. These individuals might not have been considered neuropsychologists by their academic colleagues, but little is known about how they considered and represented themselves. What is known can be inferred from the prevalence of weekend workshops to provide training in neuropsychological assessment (Bigler, 1981). In addition, as the professional identity of neuropsychologists grew and spread, curiosity arose about practice in the field and survey methodology was implemented to answer the questions raised above: who are clinical neuropsychologists and what services do they provide.

The first survey of clinical neuropsychology was conducted in 1989 (Craig), and examined the practice of clinical neuropsychology in publically funded psychiatric hospitals. Of the hospitals surveyed, only 16.8% had a fulltime neuropsychologist and 5.3% had a part-time neuropsychologist on staff. One-third of psychologists responding had obtained some training in neuropsychological assessment, primarily with the Halstead-Reitan Battery (HRB). Psychologists at these hospitals received an average of

twelve assessment referrals per week, nearly one-third of which were brain related (“organic brain syndrome”, OBS). Just over one-third of the tests in use had been not described in Lezak’s test compendium published in 1976. The most popular test for identification of brain damage in psychiatric patients was the Bender-Gestalt. Thus, 80% of “neuropsychological assessment” was carried out in hospitals without a neuropsychologist and 70% in hospitals without a psychologist on staff who had *any* training in neuropsychology. Many of the tests in use had not been recognized as tests useful in a neuropsychological battery and the most popular instrument had been widely panned for use in diagnosis of a vague syndrome, OBS. However, it appears that the referrals received from the staff psychiatrists were often related to ruling out OBS.

A survey of members of NAN, INS, and Division 40 was conducted soon thereafter (Hartlage and Telzrow, 1980) and found that 54% of respondents were affiliated with hospitals, with private practice comprising a significant minority of members. Over half described their test battery as consisting mainly of the HRB and the age appropriate Wechsler test. The BG was the fourth most frequently used test. Participants also named the most influential neuropsychologists: 1) Reitan, 2) Halstead, 3) Benton, 4) Luria, and 5) Charles Golden (the primary author of the Luria-Nebraska Neuropsychological Battery (LNNB), an attempt at standardizing Luria’s methodology). However, no description was given about the activities of the respondents and referral questions were not described.

A follow up survey was conducted to gauge changes in the field and more data were included in the survey questionnaire to allow respondents to describe their practice (Seretny, Dean, Gray, & Hartlage, 1986). Respondent data were broken down by

membership showing a general increase in the number of private practitioners in both Division 40 (from 20% to 34%) and NAN (from 18% to 46%) with a concomitant reduction in the proportion of neuropsychologists with a hospital affiliation. This change was interpreted by the authors as an increase in the numbers of psychologists already in the field adding neuropsychological assessment to their practice. Referrals primarily emanated from neurology and psychiatry, with neurosurgery, psychology, and primary care physicians rounding out the top five. While the two most commonly used tests (Wechsler Scales and HRB) were static, the LNNB and Wide Range Achievement Test (WRAT) were new additions to the top five with the BG the fifth most commonly used test. A different population was sought in a 1988 survey which targeted all of those listing neuropsychology as an area of practice in the National Register of Health Services Providers in Psychology. (Slay and Valdivia, 1988) An surprisingly high 24% of all providers endorsed offering neuropsychological services. Their survey revealed that 90% relied upon independent training to obtain their expertise.

In the first of several salary surveys of members of Division 40, Putnam (1989) found that 39% of respondents worked in a hospital system, 37% were in private practice, and 24% were affiliated with a university training program. These findings echoed the trend of rising numbers of private practitioners drawing roughly even with the number of neuropsychologists employed in hospitals.

Thus by the late 1980s several surveys of psychologists offering neuropsychological services had been conducted, with results primarily focusing on employment settings and test usage. At this stage, practitioners of clinical neuropsychology were relatively evenly divided between hospitals and private practice,

with a fairly rapid increase in private practitioners were offering neuropsychological services. Testing continued to be focused on assessment in the unitary brain damage model, but evidence suggests that this was at the behest of referrals from physicians.

In a replication of the methodology of an earlier survey, Guilmette, Faust, Hart, and Arkes (1990) attempted to sample broadly, drawing from the membership lists of NAN, INS and Division 40. Service providers in private practice continued to increase in number, although they tended to be less active in the field, with one-third of the sample conducting less than one neuropsychological assessment per month. Test usage was again sampled and the more qualitative Boston process model and flexible batteries had gained some momentum in test use, while the fixed batteries (Halstead-Reitan and Luria-Nebraska) had declined in usage. The Bender Gestalt was no longer in the top ten, indicating that its use as a screening test for brain damage was waning in popularity. However, the modal referral question continued to relate to “ruling out organic dysfunction”, followed by assessment of work capacity, recommendations regarding educational planning, establish a cognitive baseline, and advice regarding rehabilitation. Referrals came primarily from neurologists, then psychiatrists, general physicians, and psychologists. While assessment methodology was moving away from tests traditionally used to assess for unitary brain damage, physicians continued to phrase their referral questions according to the unitary brain damage theory. However, other referral questions began to emerge that focused on treatment planning, requesting specific recommendations, and epoch based questions.

A 1990 survey of the constituents of Division 40 noted a 502% increase in membership across the 1980s (Putnam and DeLuca, 1990). Work settings were

examined and private practice and hospital settings remained roughly even (37% and 43% respectively), and 29% were involved in both settings. Content of referral questions was addressed an increase in the diversity of patient presenting problems was reported. Recollection of common themes in referral questions was solicited and the most frequently requested recommendations regarding medical treatment, rehabilitation, and forensic matters. Head injuries, seizures, and strokes were the most common presenting problems. With this study, surveys began to more systematically describe the practice of neuropsychology rather than only on who was practicing neuropsychology. The practitioners sampled in this study did not cite organic brain functioning as a common theme for referrals, perhaps related to the exclusion of members of NAN from the study.

Usage of test batteries was a common survey topic in the 1990s. Sweet and Moberg (1990) compared ABPP/ABCN diplomates to non-diplomates and noted few differences. Roughly half in each category described their battery as flexible, while a higher proportion of diplomates (21% vs. 13.6%) reported using a standard fixed battery. Referrals again flowed primarily from neurology and psychiatry in both groups. The most comprehensive neuropsychological test usage survey up to that time was conducted by Butler, Retzlaff, and VanDerploeg (1991). The most common testing approaches were eclectic/flexible battery (34%) and HRB (25%) and most practitioners assessed memory, speech and language, visuospatial, psychomotor, executive, and personality functions. The ten most commonly used tests were the Wechsler Scales, Wisconsin Card Sort, Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1978), Rey–Osterrieth Complex Figure Task (ROCFT; Rey, 1941), Trail Making Test, Grooved Pegboard Test (GPT; Matthews & Klove, 1964), Wechsler Memory Scale-Revised (WMS-R; Wechsler,

1987), Token Test (De Renzi & Vignolo, 1962), and Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1989).

A twelve year follow-up survey of psychologists in psychiatric hospitals found that the percentage of hospitals with full- and part-time neuropsychologists on staff had roughly doubled (Slick and Craig, 1991). In addition, the amount of training of these individuals had increased as well. Nonetheless, approximately 60% of hospitals were still without a staff neuropsychologist. They noted that the use of the Bender Gestalt had declined, while use of the Wisconsin Card Sort, and the Boston Naming Test had risen. However, when asked to describe referral questions, psychologists reported that questions relating to distinguishing functional from organic etiology were the mode and comprised one-third of all referrals.

Through the mid 1990s, surveys of the practice of neuropsychology had described the range of practitioners well, but less was known about their activities. There is evidence of variability in responses based on which group was sampled. Samples drawn from groups with traditionally strong academic and institutional ties (i.e., Division 40) generally reported that most of the assessments conducted were on patients with neurological presenting problems and referral questions primarily focused on requesting recommendations regarding treatment planning. Samples drawn from a larger population generally reported more referral questions focused on unitary brain damage theory and “ruling out” organic brain functioning. All efforts at measuring the practice of neuropsychology in the survey format are reliant upon recall of the respondent about referral question content, common presenting problems, and what tests were given.

The work of Sweet, Moberg and colleagues has figured prominently in the description of the state of practice in the field of clinical neuropsychology, with no less than seven surveys coming from this group beginning with the 1990 study described above. They have conducted follow-ups at five year intervals, allowing close monitoring of changes in practice settings and activities. However, they have focused little on the content of referral questions and the types of presenting problems commonly seen in practice. In a sample of members of NAN and Division 40, Sweet, Moberg, and Westergard (1996) noted an 8% increase in clinicians endorsing private practice as their primary employment, making this group the majority of those offering neuropsychological services. The top referral sources were neurology, psychiatry, law, rehabilitation, and neurosurgery. Flexible batteries increased in popularity (60%) while completely flexible testing and standardized batteries declined in use (25% and 14% respectively). The follow-up in 2000 (Sweet, Moberg, & Suchy) showed that private practitioners again comprised a majority (58%) and the percentage of neuropsychologists working in the medical setting declined to 20%. This change was again interpreted as a stable number of hospital positions with and great increase in private practitioners offering neuropsychological assessment. Flexible batteries were implemented by 70% of participants with flexible and standardized approaches splitting the remaining 30%. There was no change in the most common referral sources.

In a survey comparing private practitioners to their institutionally employed colleagues, Sweet, Moberg, and Suchy (2000) found several important differences between the groups in their sample. Legal and psychiatric referrals supplanted neurology as the most common referral source for private practitioners. Psychiatry and neurology

had reversed positions in number of referrals in institutional settings. Flexible batteries were more common in institutions than in private practice (75% vs. 63%) while standardized batteries were more likely to be used in private practice than in institutions (21% vs. 10%).

In 2002 NAN and Division 40 elected to combine their efforts into an organizationally sanctioned joint survey of their membership (Sweet, Peck, Abramowitz, & Etzweiler). This sample reported their employment setting as 38.7% in private practice, 29.9% in institutional settings, and 29.1% working in a combination of the two. Data on referral questions was included after being excluded from prior survey by the Sweet group. Respondents listed the most common referral questions in their practice by recollection and no frequency data were provided. Diagnosis was most common followed by treatment planning, pre/post testing, baseline testing, and forensic questions. A 2006 follow-up survey (Sweet, Nelson, and Moberg) showed some variability in practitioners' employment setting with a slight increase in institutional employment (41.5%) with a concomitant decline in private practice (23%), and combined (29%). The topics of the most common referral questions remained unchanged.

A broader survey of assessment practices targeted members of INS in addition to members of NAN and Division 40 (Rabin, Barr, & Burton, 2006). Sixty-two percent of their sample worked in private practice, 34% in hospital settings, 17% in rehabilitation, and 36% in multiple settings. Referral sources returned to their traditional order with neurology and psychiatry the most common, followed by psychology, law, and primary care physicians. Of the nearly forty percent of respondents employed in a hospital, neurologists were cited as their primary referral source. When asked to recall the content

of their referral questions, determination of diagnosis was the most frequently endorsed (70.7 % of respondents), followed by assistance with treatment planning (48.3% of respondents), forensic determinations (31.8% of respondents), educational planning (29.6% of respondents), and capacity to work (27.9% of respondents). Other common referral questions were related to establishing a cognitive baseline, performing pre-and post-intervention assessment, assessing capacity for independent living, and lesion localization. Rabin and colleagues asked respondents what types of information was important in formulating their assessment. Medical/psychiatric history was used most frequently (94.9%), closely followed by neuropsychological test data (93.3%), and referral data (91.1). Thus information provided in the referral is nearly as influential in formulating the assessment as is the data.

Several surveys of physician's perception of neuropsychological services have been conducted. The first such survey (Tremont, Westerveldt, Javorsky, Podolanczuk, & Stern, 2002), identified understanding of physicians' expectations about the neuropsychological evaluation as an important factor in providing satisfactory consultation services to all parties. The sample was comprised of physicians referring for hospital based outpatient neuropsychological assessment. The most common referral objective to receive assistance with diagnosis, either conformation of a diagnosis (21.1%) or establishment of an initial diagnosis (50.2%). When asked about diagnostic concordance, over 97% of referring physicians agreed or mostly agreed with the neuropsychologist's diagnosis and recommendations. The physicians generally valued the conclusions and strongly agreed with the stated recommendations.

A similar survey of physicians' use of inpatient neuropsychological services (Bishop, Temple, Tremont, Westerveldt, & Stern, 2003) found similarly high satisfaction levels. The study included a review of discharge summaries and found very high usage of neuropsychological findings. References to the assessment were found in 78% of cases, with frequent references to specific results (48% of cases), and recommendations (68% of cases). Placement decisions were consistent with recommendations from the neuropsychological report 80% of the time. A broader survey of 5000 physician members of the American Medical Association was conducted in 2006 (Temple, Carvalho, & Tremont). Nearly 90% of respondents had referred a patient for a neuropsychological evaluation. The most commonly endorsed reasons for referral were for assistance with establishing a diagnosis (64.5%) and to establish a cognitive baseline (60.2%). Less common were referrals for specific recommendations (36.4%), competency and capacity questions (29.8%), and for a second opinion (21.4%). A very high level of satisfaction was reported, with 89.9% of referral questions deemed as being addressed satisfactorily. Comfort level for report recommendations was also assessed and in general nearly 96% were comfortable of very comfortable with the recommendations made. However, less comfort was endorsed for some specific recommendations including referral to a subspecialist (68.9%), recommendations for neuroimaging or other lab work (55% and 50%), and medication recommendations (32.8%). Several referral barriers were identified including a lack of familiarity with the field (particularly in primary care physicians), proximity of services, and inapplicability to their patient population.

While surveys of the field began thirty years ago, the descriptions have yielded a clearer picture of who is providing neuropsychological services rather than what services are provided. Referral questions can be used to examine practice in the field of neuropsychology because the question content allow inferences to be made about the purpose of the referral, the intent of the referrer about the type of assessment desired, and selection of procedures to be involved. Referral sources and their questions have addressed in several surveys over the past twenty five years. Studies conducted from the 1970s to the early 1990s reported referral questions relating to ruling out organic dysfunction. Beginning in the early to mid 1990s, neuropsychologists reported that the most common referral questions related to assistance with diagnosis, recommendations regarding treatment planning, and epoch based questions. Survey data of physician referrers for neuropsychological services also noted assistance with diagnosis and epoch based questions as the most frequent.

A shortcoming of survey methodology necessarily relies on retrospection and estimation in all facets, which has apparent limitations when being asked to recall information about all patients seen over the past year. Participants' level of investment in providing accurate responses likely ranges from the conscientious (perhaps a quick search of a database) to the busy (extemporaneous impressions). An in-depth study of the form and content of referral questions has not been conducted and is a logical step given their importance to the livelihood of the field. Given that estimates of clinical neuropsychologists' work settings have consistently placed 40 to 60% in hospitals, selection of a hospital based practice as a place to derive a sample will be relevant to the majority of practitioners on the field.

The purpose of this study is to assess the changes in the practice of neuropsychology by collecting and analyzing referral questions over a period of twenty five years from 1983 to 2007. This will allow a broad view of the utilization of neuropsychological assessment by referrers without relying upon the recollection of either the consultant or the referral source. The section to follow will set out the methodology used to select and analyze the referral questions.

CHAPTER III

METHOD

Participants

Two-thousand six-hundred participants were selected from all outpatients seen at the Benton Neuropsychology Laboratory (BNL) in odd years between and inclusive of 1983 and 2007. This comprised approximately 12.89% of the outpatient visits that occurred during the thirteen years sampled. Two hundred participants were selected at random from the thirteen odd years in the identified interval using a random number generator. A total of thirty-eight referral questions were discarded due to illegibility and replaced with a legible question selected with the random number generator. One-half of the discarded questions came from the first three years examined (1983, 1985, and 1987) with one-half coming from the latter ten years sampled. The participants were 49.93% were male (n=1319) and 49.61% female (n=1281). The mean and median age of the sample is 55.32 and 56 years, respectively, with a range from 18-99 years of age. The modal age of referral was 79 years (n=61) followed closely by 48 (n=60), and 70 years of age (n=59). See Figure 1 for a frequency count by age. The BNL was established in the late 1940s and currently serves 2000+ patients per year, primarily with neuropsychological assessment and rehabilitation services. It is situated in a hospital in which there has been a second neuropsychology service since 1998. In addition there is a Veterans Affairs Medical Center in close proximity with a neuropsychology service, thus limiting the number of veterans seen in the BNL. Inclusion criteria were a completed outpatient neuropsychological evaluation in an odd year beginning in 1983 and continuing

through 2007. Each patient seen in the BNL was referred for the service based on clinical need and all data used were collected in the process of clinical care.

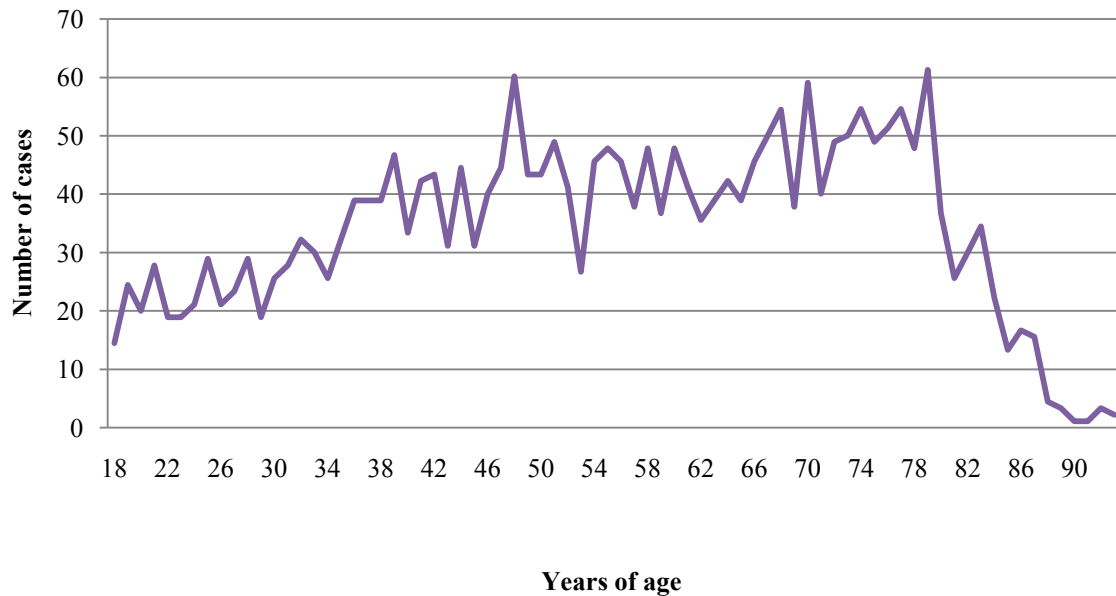


Figure 1. Participants: Number of Cases by Age

Referral Question Analysis

The purpose of the study is the characterization of referral questions for neuropsychological evaluations using four factors derived from a literature review. The review was conducted to elicit data on common themes of referral questions; however, only survey data on a priori categories, impressions, and clinical lore were found.

Several lists of common referral questions from well recognized sources on neuropsychological assessment (Lezak, 1994; Lezak, Howieson, Loring, & Hannay,

2004), from publications focusing on the issue of referrals (Guilmette, Faust, Hart, & Arkes, 1990), and clinical practice surveys (Rabin, Barr, & Burton, 2006, Sweet & Moberg, 2001) were consulted. Four components of referral question evaluation were identified. First, *classification of information* given by the referrer about patient diagnosis and history is important because it often determines the length, depth, and focus of the clinical interview and testing. Secondly the practitioner must identify the *type of assessment* requested: establish a baseline, evaluate recovery after rehabilitation, etc. The type of assessment may be explicitly stated by the referral source or determined by the information the referrer provided. Thirdly, *specific requests and needs for testing* are evaluated, such as a thorough assessment of emotional and personality functioning (MMPI-2) in addition to neurocognitive functioning or establishing an IQ (WAIS-III) to support continued disability benefits. Again, the request may be direct or may follow from the referrer's problem description. Finally, explicit requests and implicit needs for *specific recommendations*, such as placement and level of supervision, driving ability, specific treatment planning, and others, are addressed.

The inference involved in ascertaining the meaning of an implied request bears clarification, and several fabricated, but typical, examples may prove beneficial. Discussions of each will follow with the relevant referral question component provided in parentheses.

“83 y/o male, retired farmer. Lives alone on the farm and son reports concerns of memory problems for 1 year, giving money to telemarketers, and a recent fender bender. MRI shows mild-mod small vessel disease. Please evaluate.”

In a request for an evaluation of dementia, information about course and severity may direct the clinician to select a dementia rating scale in severe and advanced cases, while concerns of mild cognitive impairment in a well educated individual may necessitate redundant assessment of all cognitive domains. Patients with dementia (classification of information) often receive serial evaluations and a broad and thorough baseline will facilitate judgment of interval change on follow-up (type of assessment). Likewise the inclusion of information that points to the second most common type of dementia (vascular) makes it important for the neuropsychologist to address the issue of differential diagnosis (Alzheimer's Disease [AD] versus vascular) as the diagnostic considerations may affect treatment planning as will severity of overall impairment (request for testing). Descriptions of the patient's living situation and possible deficits in instrumental activities of daily living necessitate specific recommendations without explicit requests for input (specific recommendations). All of these dementia related considerations were determined from the question without specific mention of dementia. Knowledge on the part of the neuropsychologist of the effects of dementias on motor, cognitive, and emotional functioning will prompt her to include recommendations on living situation, driving, etc. However, even though these recommendations may be included in the final report, these cannot be classified as inferred from the referral question unless it is broached in the referral in some manner.

"45 y/o woman w/ Hx of spells. Significant stress including marital difficulty and unemployment due to spells. Please evaluate."

Although little more is given here than background information, in order to produce a relevant report, the experienced clinician must infer that the role of emotional

and personality functioning in this woman with a possible seizure disorder should be assessed as well as cognitive functioning (information classification, type of assessment, and request for testing). If the second sentence were absent, it is likely that the neuropsychologist would perform a similar evaluation based on clinical experience, but as above, it cannot then be said to have been deduced from the referral question. The term “spells” denotes unexplained events that the specialist was unwilling or unable to characterize as seizure activity and issues of primary and secondary gain are raised for consideration in the recommendation section (specific recommendations).

“32 y/o woman recently diagnosed with multiple sclerosis. Concerned about motor changes and difficulties at work. Please evaluate.”

Again, no specific requests are made for type of evaluation or specific tests, but the experienced and reasonable clinical neuropsychologist may infer that a baseline should be established for serial testing as MS is most often characterized by a variable and extended course (type of assessment). Cognitive and motor changes should be evaluated with specific recommendations provided about the patient’s ability to perform her current job, obtain and maintain any type of employment, and possibly a statement of opinion about eligibility for disability benefits. These types of requests were not explicitly stated and must therefore be inferred from information provided if the neuropsychological report is to address the patient’s situation.

Pilot Study

In order to construct a framework for classification of the referral question (and intent of the referral source), a brief pilot study was conducted. Forty patients were randomly selected from the BNL database, 2 from each of the past 20 years, and their

referral questions were copied verbatim. These questions were then analyzed by two experts in neuropsychological assessment and the principle investigator for the content and purpose of the referral. Unstructured judgments were obtained from each of these raters and several categories emerged and are presented in Table 1.

Table 1. Pilot Study Ratings

<ol style="list-style-type: none"> 1. Please Evaluate (without elaboration or with demographics only) 2. Please Evaluate, Diagnosis (or rule out or differential) Specified <ul style="list-style-type: none"> ○ Dementia <ul style="list-style-type: none"> ○ Type ○ versus Depression ○ r/o or vs. Normal ○ Organic v. Functional ○ Memory ○ Toxin ○ CABG ○ Learning & Developmental Disorders ○ Psychological conditions <ul style="list-style-type: none"> ○ Depression ○ Anxiety ○ Somatization ○ Other ○ Cognitive Disorder, NOS 3. Epoch based Evaluation <ul style="list-style-type: none"> ○ Presurgical ○ Early stage disease process ○ Recovery 	<ul style="list-style-type: none"> ○ Interval Change <ol style="list-style-type: none"> 4. Assess capacity <ul style="list-style-type: none"> ○ Decision making ○ Driving ○ Return to Work ○ ADL NOS 5. Please help establish medical diagnosis <ul style="list-style-type: none"> ○ Specific differential 6. Forensic 7. Specific procedures <ul style="list-style-type: none"> ○ Measure IQ/MR Diagnosis ○ Localization and Lateralization ○ w/ MMPI ○ WADA test 8. Please evaluate regarding medical treatment <ul style="list-style-type: none"> ○ Candidate for specific intervention ○ Transplant 9. Recommendations <ul style="list-style-type: none"> ○ Treatment Planning ○ Placement ○ Update recommendations
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Post hoc analysis of categories supported the four tasks of the neuropsychologist in evaluating the referral question presented above.

- Classify the information given about diagnosis and patient history (categories 1 and 2).
- Identify the type of assessment requested (categories 3-6).
- Identify specific requests for testing (category 7) and
- Identify requests for specific recommendations (categories 8 and 10).

Several adaptations to the categories were made based on hypotheses, establishing a rating procedure, and BNL procedures involved in coding data. First, based on the hypotheses stated above, a “question of interest” category was added to incorporate a method of collecting data on changes in language, constructs, and trends in referrals over time. For example, a category for questions mentioning “organic” versus “functional” was included along with a category for tallying requests for evaluations for pseudodementia and dementia versus depression. Repeat evaluations, mention of neuroimaging data, and mention of cognitive testing data were also included. In addition, a category was added to tally mentions of specific cognitive domains which address hypotheses relating to complexity of questions and referrers’ knowledge of clinical neuropsychology. Second, the categories were rearranged to make rating more parsimonious as well as to enable multiple and contingency ratings. Several categories relating to different forms of recommendations (capacity, fitness for a medical intervention, and recommendations) were combined under one category in order to streamline rating. Finally, the rubric for rating the diagnostic information provided in the referral question was modified accordingly from the pilot study data.

The data generated in the pilot study were intended to provide an initial general approach to rating rather than comprehensive coverage of all presenting problems. Because of the small number of cases, the diagnoses represented are necessarily narrow. Moreover, the BNL has a diagnostic coding system designed and modified to be inclusive of the range of diagnoses seen. Each case is rated upon completion of evaluation and reporting and entered into the BNL database. This diagnostic coding has been in place for approximately 25 years and has had one rater throughout (Daniel Tranel). Therefore, in order to include a comprehensive diagnostic system that is established in the clinic setting and will allow complementary data analysis, the Coding Categories for the Benton Neuropsychology Laboratory (Tranel, 1991) was adopted. A section was added to the diagnostic coding containing general medical conditions frequently encountered in the neuropsychological clinic but not diagnosed by neuropsychologists (e.g., diabetes, coronary artery disease, sleep apnea, non-CNS cancer; Lezak, Howieson, Loring, & Hannay, 2004) as well as a psychiatric section consisting of the major headings in the DSM-IV. These categories were intended to represent the full range of presenting problems and to allow representation of broadening awareness of clinical neuropsychology beyond the traditional referral sources in neurology and psychiatry. The modified final outline of rating categories is presented in Table 2.

Table 2. Referral Question Rating

I. Is there a substantive question?	
II. Is a diagnosis stated? If yes, what?	
A. Neurological	
1. Cerebrovascular disease	
a. Cerebrovascular accident	
i. Infarct	
ii. Hemorrhage	
iii. Subdural hematoma	
b. TIA	
c. Small vessel disease	
d. Aneurysm	
2. Dementia	
a. degenerative	
b. vascular	
c. NPH	
3. Seizure disorder	
4. Head trauma	
5. CNS tumor	
	6. a. Encephalopathy
	b. Confusional state
	c. Delirium
	7. CNS infection (HSE, AIDS)
	8. Neurosurgical intervention (TLE)
	9. Movement disorders (PD, HD)
	10. Demyelinating disorders
	11. Developmental neurological
	12. Headache
	13. Spells
	14. Carbon monoxide
	15. Neurological NOS
	16. Hydrocephalus
B. Behavior/Cognitive Domain	
1. Memory	
a. MCI	
2. Language	
3. Visual/Visuospatial	
4. Executive Functions	
5. Attention/concentration	
6. Processing Speed	
7. Orientation	
	8. Mood
	9. Personality
	10. Cognitive Disorder, NOS
	11. Motor
	12. Anosognosia
	13. Calculation
	14. Behavioral change
C. Psychiatric	
1. Developmental	
a. Mental retardation	
b. Specific LD	
c. Right Hemisphere LD	
d. ADHD	
i. Adult	
e. Other (e.g., autism spectrum)	
2. Personality	
3. Mood disorder (Bipolar, schizoaffective)	
	4. Psychotic disorders
	5. Depression
	6. Anxiety
	7. Adjustment dis./stressors
	8. Personality disorder
	9. Substance Abuse
	10. Somatization
	11. Other
D. GMC	
1. Coronary artery disease	
a. CABG	
	b. MI
	c. Carotid endarterectomy

- d. Hypertension
- 2. Cancer
- 3. Organ Failure
- 4. HIV/AIDS
- 5. Congestive Heart Failure
- 6. Sleep disorders
- 7. Diabetes
- 8. Toxin

- 9. Lupus
- 10. Post Surgical/Tx change
- 11. Chronic pain
- 12. Somatic complaints
- Table 2 - continued
- 13. Other (specify)

III. If a diagnosis was stated, was a differential diagnosis stated?

- A. Neurological
- B. GMC
- C. Psychiatric
- D. A or B. vs. C

IV. Are specific tests or procedures requested?

- A. Diagnosis
- B. Differential diagnosis
- C. MMPI
- D. Assess IQ
- E. WADA
- F. Localize & Lateralize
- 1. Seizures
- 2. Other
- G. Dementia/memory evaluation
- H. Beck Depression Inventory
- I. Other

Table 2 - continued

V. Forensic Question

VI. Epoch Based Evaluation

- A. Baseline
- B. Interval change/re-evaluation
- C. Recovery
- D. Pre-intervention
- E. Post-intervention

VII. Are specific recommendations requested?

- A. Capacity/Competency
- B. Treatment planning
 - 1. Surgical
 - a. Resection
 - b. Transplant
 - c. DBS
 - 2. Rehabilitation
 - 3. Neurological
 - 4. Psychiatric
 - 5. Medical
- C. Driving
- D. Employment/return to work
- E. Capacity for ADLs
- F. Supervision, independent living, placement
- G. Benefits, e.g., disability
- H. Update Recommendations
- I. Other (Specify)

VIII. Are specific cognitive domains or mood/personality descriptors used?

- A. Memory
- B. Executive Functions
- C. Language- aphasias
- D. Processing Speed
- E. Orientation
- F. Visuospatial
- G. Mood
- H. Personality

IX. Complexity

- A. Symptom Tally
- B. Category Tally
- C. Please evaluate plus presenting problem description without a question.

X. Other Questions of Interest

- | | |
|---------------------------------------|--|
| A. Organic vs. Functional/psychogenic | E. Serial Evaluation |
| B. V/P Split | F. Neuroimaging mentioned |
| C. Pseudodementia | G. MMSE or other cognitive test data mentioned |
| D. Dementia vs. Depression | |
-

Rating Procedure

After participants were randomly selected from the BNL database, the referral form was collected along with the evaluation date and patient sex and age. The referral question was then coded according to the rubric presented in Figure 3 below. The referral coding began by entering Table 3 at phase I and answering the question: “Is there a substantive question?”. This category is meant to track referrals that are cursory and vague. An insubstantial question is defined as “please evaluate”, or equivalent phrasing (e.g., “please perform neuropsych eval”), by itself or in combination with demographic data. No other codes may be applied. If a question was rated as insubstantial, rating was complete. Substantive questions are defined as those which contain information specific to the patient that communicates any of the following: the patient’s history, diagnosis, status, or concerns; the referrer’s decision process or requests of the neuropsychologist.

When substantive questions were encountered, the rater proceeded to phase II: “Is diagnostic information stated?” If this question is answered in the negative, the rater proceeded to phase IV. If this question was answered in the affirmative, a code was

recorded. Phase II includes the adaptation of the diagnostic coding categories of the BNL (Tranel, 1991) described above. The categories are Neurological, Behavioral/Cognitive, Psychiatric, and General Medical Condition. A code was given in phase II if a specific diagnosis is named, if a request to rule out a specific diagnosis is stated, or if a pathognomonic sign (e.g., “extreme anxiety after a recently being involved in a motor vehicle accident with a fatality”) or a characteristic cluster of signs and symptoms (e.g., “Pt. has gait disturbance, urinary incontinence, and memory problems”) was stated in absence of a specific diagnosis. The Behavior/Cognitive section of phase II was included for diagnostic information that fits into one of three conditions: 1) neuropsychological deficits and syndromes that are associated with brain damage (e.g., aphasia) 2) signs and symptoms that are considered “soft signs” of brain dysfunction (e.g., “memory problems” or “problems multitasking”), or if data provided are in the neuropsychological domain but do not meet diagnostic criteria elsewhere. Multiple codes can be given to referral questions. To return to the sample referral question involving the woman with “spells” and significant stressors, no neurological diagnostic code can be given but the description of her emotional functioning would warrant the code of adjustment disorder/stressors in the psychiatric section.

For referral questions receiving a code in phase II, phase III was next considered: “Was differential diagnostic information stated?” This rating phase is somewhat more complex because, as shown above in the sample dementia question, differential diagnostic questions can be implied without explicitly naming the diagnostic title. For instance, the fabricated dementia question above mentioned memory problems and a sign of a subcortical dementia (small vessel disease). Since AD must always be considered in an

individual over 65 who presents with memory problems, a differential diagnosis must be made and a code would be given in phase III. If both diagnoses are neurological (e.g., AD versus vascular dementia) or psychiatric (Asperger's Syndrome versus Schizoid Disorder) or general medical, the appropriate code would be given. A code was also included for a contrast of interest, namely, how frequently were referrals made when one diagnosis was a general medical or neurological condition and the other was psychiatric.

Phases IV through X should be considered in each case with a substantive question. Phase IV allowed for categorization of explicit requests for specific tests and procedures, including diagnosis, differential diagnosis, localization, lateralization, Wada testing, MMPI-2 administration, etc. Phase V is a category used to demarcate forensic evaluations. Phase VI allowed for categorization of epoch based evaluations when such considerations are plainly stated, including baseline exams, measurement of interval change in serial exams, recovery, pre-intervention, and post-intervention.

Phase VII allowed the rating of recommendations that are explicitly requested (e.g., "is pt a good candidate for an insulin pump?" or "placement of DBS [deep brain stimulation] in consideration") or implied. Implied requests for recommendations were defined as statements of symptoms that impair or potentially impair independent functioning (ADL or IADL), symptoms noted to affect job performance or potentially effect decision making, and mention of a decision point in treatment planning.

The next two phases were designed to provide measures of the complexity of the referral questions and the referrer's awareness of clinical neuropsychology. Phase VIII consisted of the domains measured in neuropsychological assessments. Each time a question made mention of a neuropsychological domain, a code was assigned. Phase IX

was comprised of two tallies: the number of symptoms described (in any of the four diagnostic domains) and the number of codes assigned to each referral question.

The final rating phase (X) included a series of questions selected for their representation of trends that have played an important role in neuropsychological assessment. These questions relate to the now defunct false distinction between organic and functional deficits, the trend in requests for lesion lateralization and localization after the advent of neuroimaging, the number of assessments request on the basis of memory complaints, and the relative frequency of repeated neuropsychological evaluations.

Table 3. Referral Question Rating Form

001	Is there a substantive question?
002	Is a diagnosis stated?
100	Neurological
101	Cerebrovascular Disease
102	Cerebrovascular accident
103	Infarct
104	Hemorrhage
105	Subdural Hematoma
106	TIA
107	Small vessel disease
108	Aneurysm/arteriovenous malformation
110	Dementia
111	degenerative
112	vascular
113	NPH
120	Seizure Disorder
130	Head Trauma
140	CNS Tumor
151	Encephalopathy
152	Confusional state
153	Delirium
160	CNS infection (HSE, AIDS)
170	Neurosurgical intervention
180	Movement Disorders (PD, HD)
190	Demyelinating Disorders
191	Developmental Neurological
192	Headache
193	Spells
194	Carbon monoxide (CO)
195	Neurological NOS
196	Hydrocephalus
200	Behavior/Cognitive Domain
201	Memory
202	MCI
210	Language
220	Visual/Visuospatial
230	Executive Functions
235	Attention/concentration
240	Processing Speed
250	Orientation
260	Mood
270	Personality
280	Cognitive Disorder, NOS

Table 3 - continued

290	Motor
291	Anosognosia
292	Calculation
293	Behavioral Change
300	Psychiatric
301	Developmental
302	Mental retardation
303	Specific LD
304	Right Hemisphere LD
305	ADHD
306	Adult
307	Other (e.g., autism spectrum)
308	Mood Disorder (Bipolar, schizoaffective, etc)
309	Psychotic disorder/symptoms
310	Depression
320	Anxiety
330	Adjustment Dis./stressors
335	Personality Disorder
340	Substance Abuse
350	Somatization
360	Other
400	GMC
015	Medication/Treatment effects
020	Are specific tests or procedures requested?
021	Diagnosis
022	Differential Diagnosis
023	MMPI
024	Assess IQ
025	WADA
026	Localize & Lateralize
027	Seizures
028	Dementia/Memory eval
029	Other
030	Beck Depression Inventory
031	Forensic Question
040	Epoch Based Evaluation
041	Baseline
042	Interval Change
043	Recovery
044	Pre-intervention

Table 3 - continued

045	Post-intervention
050	Are specific recommendations requested?
051	Capacity/Competency
052	Treatment planning
053	Surgical
054	Resection
055	Transplant
056	DBS
057	Rehabilitation
058	Neurological
059	Psychotherapy
060	Medical
061	Driving
062	Employment
063	Capacity for ADLs
064	Supervision/independent living/placement
065	Benefits, e.g., disability
066	Update Recommendations
067	Other (Specify)
068	Prognosis
069	Academic
080	Complexity
081	Symptom Tally
082	Category Tally
083	“Please evaluate” plus description/Dx w/o a question.
090	Other Questions of Interest
091	Organic vs. Functional/psychogenic
093	V/P Split
095	Pseudodementia
096	Dementia vs. Depression
098	Serial evaluation
099	Neuroimaging data mentioned
100	MMSE or other test data mentioned

CHAPTER IV

RESULTS

Rater Reliability

The principle investigator served as the sole rater for all referral questions. In order to provide an assessment of rater reliability, an individual with significant experience in neuropsychological assessment, and no knowledge of the hypotheses, was presented with the referral question rating scale, its rationale, and several training exercises. All referral questions to be analyzed were selected, printed or copied, all information dating the question was removed with a hole punch, and the question was logged in a Microsoft Excel spreadsheet. A random number generator was used to identify the questions to be selected for rating by the primary investigator and another rater well acquainted with neuropsychological assessment (Ann Axelson). The rating process was divided into three sections, and 20 percent of each section was selected for the interrater reliability analysis. After each section was complete, the ratings were analyzed for reliability in order to reduce drift across the rating process and allow for clarification of the variables. The next reliability check was performed after 60% of the rating was completed, with the final reliability check after all rating was complete. Interrater agreement was assessed with Kendall's Kappa, generating a measure of rater agreement for each variable in each of the three phases of rater reliability. The minimum value for the obtained K is defined as 0.70. The Statistical Package for the Social Sciences (SPSS) was used for computation of the statistical analyses. A total of 526 referral questions were selected and analyzed by both raters. Kendall's kappa for measurement of agreement was generated for each variable, and thus a total of 126 kappas

were calculated for each of the three phases. Those falling below the threshold of .70 agreement were identified to be referred back for review of the initial criteria and discussed by the raters (Table 1). After the initial phase, analysis with Kendall's kappa identified seven of the 126 variables as falling below the identified threshold: 111-degenerative dementia, 195-neurological NOS, 196-anosognosia, 230-executive function, 45-post intervention assessment, 52-treatment planning, 59-recommendations regarding psychotherapy, and 65 recommendations regarding eligibility for benefits. These variables were examined and it was found that on low frequency items, even very small levels of disagreement are sufficient to cause the kappa to fall below the threshold, thus percentage agreement has been presented below in Table 4. The second rating phase was completed and four variables were identified that fell below the Kappa threshold: 191-developmental neurological, 270-use of personality terms, 45-post intervention assessment (a repeat below-threshold variable), and 83-"Please evaluate" with minimal description and no question. These variables were reviewed and discussed according to the procedure outlined above. In the final rater reliability phase no variables fell below the target Kappa.

Table 4. Variables below the Kendall's Kappa threshold (.70) in the three rating phases

	Phase 1			Phase 2			Phase 3		
	Variable ¹	κ	% agreed ²	Variable	κ	% agreed	Variable	κ	% agreed
Variables below identified Kappa threshold (.70)	111	.655	97.5	191	.662	99.5			
	195	.445	96.5	270	-.005	99			
	196	.495	99	45	.639	96.5			
	230	.656	98	83	.686	92.5			
	45	.67	93.5						
	52	-.014	97						
	59	.495	99						

Note: ¹ Please see text or Figure 3 for variable description.

²Percentage agreement in variable rating

Substantiveness of Referral Questions

Each question was rated for the presence of substantive content intended to guide the neuropsychological evaluation. If no such information was present it was coded as “no substantive question” (002). If a symptom is given, the question is deemed to be substantive and the question is not coded in this category; however, demographic or identifying information was not considered to be substantive for the purpose of guiding a neuropsychological evaluation. Examples of such referrals include “please evaluate”, “please evaluate this 41 year old man”, and “MMPI”. As can be seen in In Figure 2 below, the number of questions with no substantive content peaked in 1983 or 10 (5% of total questions that year) and reached or exceed 5 in 1987, 1991, and 2005. There were 42 such questions across the entire sample, which represents 1.6% of total questions. A separate code (083) was used to track referral questions that asked for an evaluation with minimal added information, such as a single complaint, a single symptom, or a request for a specific procedure in isolation. Examples include, “Please evaluate this 71 year old with

memory problems” and “MMPI, chronic lower back pain”. These comprise a greater number of the total questions than those with no content, as seen in Figure 2. The peak, beginning in 1999, is related to a system that was implemented late in the year which generated automatic referrals (066) when a follow-up evaluation was recommended in the written report of the initial or prior evaluation. For example, in the case of a patient with a neuropsychological profile suggestive of early Alzheimer’s disease, one of the recommendations in the written report may be for a follow-up exam in 12-18 months in order to assess for any progressive cognitive decline. At a set period before the date for the follow-up exam, the referrer would receive a completed referral form filled out with a request for reevaluation. If the referral source agrees that a reevaluation is indicated, she or her completes and signs the form and the evaluation is scheduled. Since the content of these automatic referrals is predetermined and not composed by the referral source, it is useful to remove these questions to examine the type of content generated by referral source. However, these questions were not removed from the sample or analyses altogether because they represent an important indicator of how referral sources use neuropsychological services. It can be seen in Figure 4 that the two minimal content lines diverge contemporaneously with the sharp rise seen in automated referrals as automated referrals began in the latter part of 1999. Thus in the five years sampled with automated referrals in place (1999-2007), these follow-up referrals comprised 13.7% of the sample while referral questions with minimal content comprised 11.3% of the sample. When the no content (001) and minimal content (083) categories are combined across all years and the automated referrals are removed, the reduced content questions account for 20.9% of all referral questions rated.

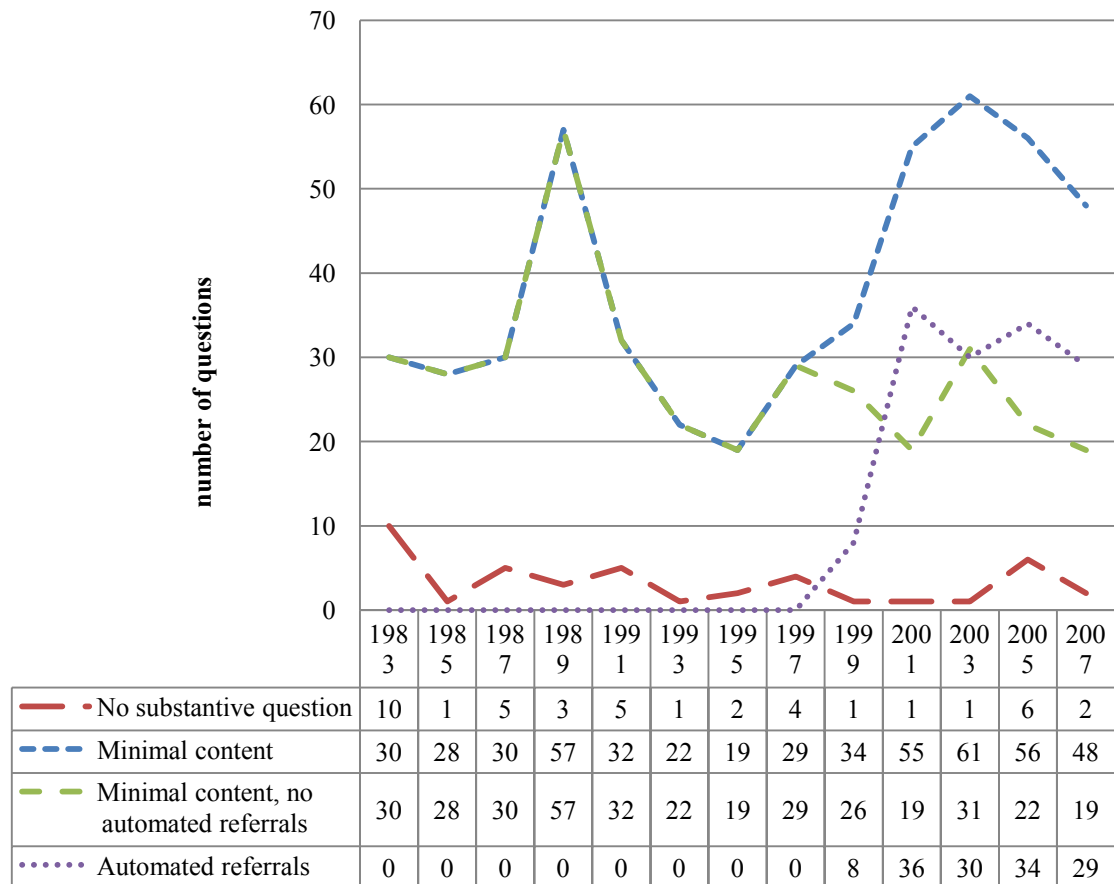


Figure 2. Number of Questions with Minimal or No Substantive Content by Year

Complexity of Referral Questions

Several variables were included in order to gauge the complexity of the referral question. The greater the tally in these variables, the greater the attempt by the writer of the referral question to convey data to guide the neuropsychological evaluation. One symptom is not as informative as relating a symptom cluster; requesting a recommendation about ability to perform independent self care is more targeted than merely providing diagnostic information. These variables include (Figure 5) a symptom tally (081), a category tally (082; i.e., a tally of different areas of content, including

provision of diagnostic information and requests for specific recommendations), use of neuropsychological assessments in diagnosis and differential diagnosis, requests for procedures (e.g., establish a cognitive baseline, administer and interpret an MMPI) and recommendations, epoch based questions (assess cognitive change on re-evaluation, assess cognitive status after epilepsy surgery), and inclusion of neurodiagnostic (99; e.g., MRI, EEG) and cognitive testing (100) and information.

Symptom and Category Tallies

The mean tally of symptoms is the average of the number of symptoms included in each referral question within a given year. Similarly the mean tally of categories is the within year average of the count of categories included in each referral question; these categories are: a substantive question (001), specific diagnostic information provided (002), differential diagnosis requested (010), specific procedures requested (020), epoch based evaluations (040), specific recommendations requested (050), and the use of cognitive/behavioral/mood terminology (070). The mean symptom tally across all years indicates that the average number of symptoms given in referral questions across all years is 2.76 (SD=1.7), while the average category tally across years is 4.83 (SD=1.64).

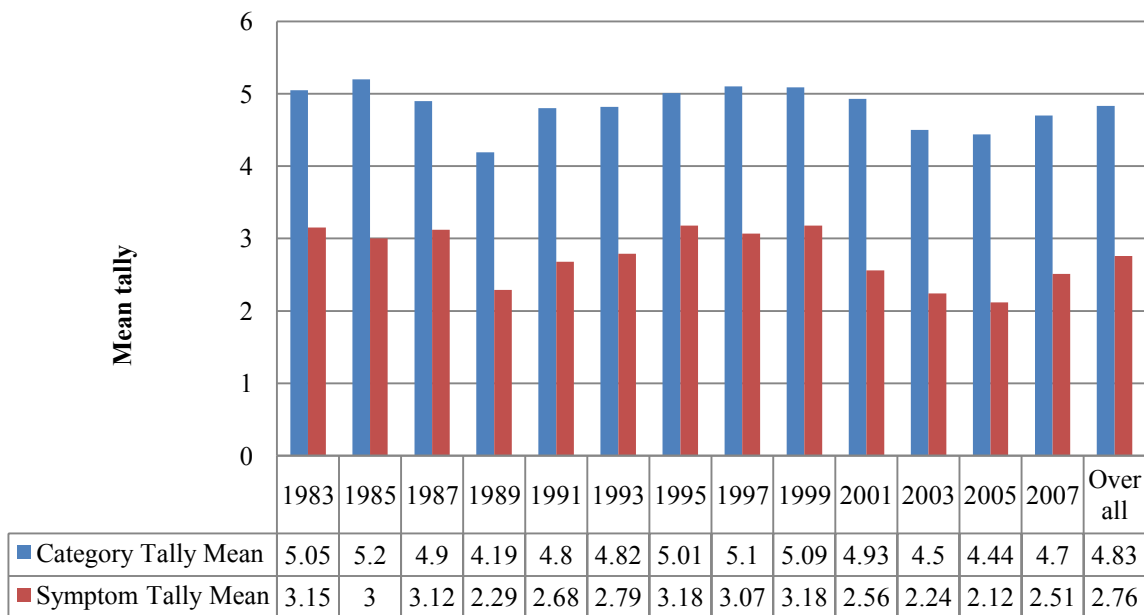


Figure 3. Mean Tally of Symptoms and Categories by Year

Since the automated referrals mentioned above are approved by the referral source but they do not determine the question content, the mean symptom and category tallies are artificially lowered since they comprise nearly 14% of the questions in the last five years sampled. Figure 4 illustrates the effect of removing the automated referrals from the symptom tally average.

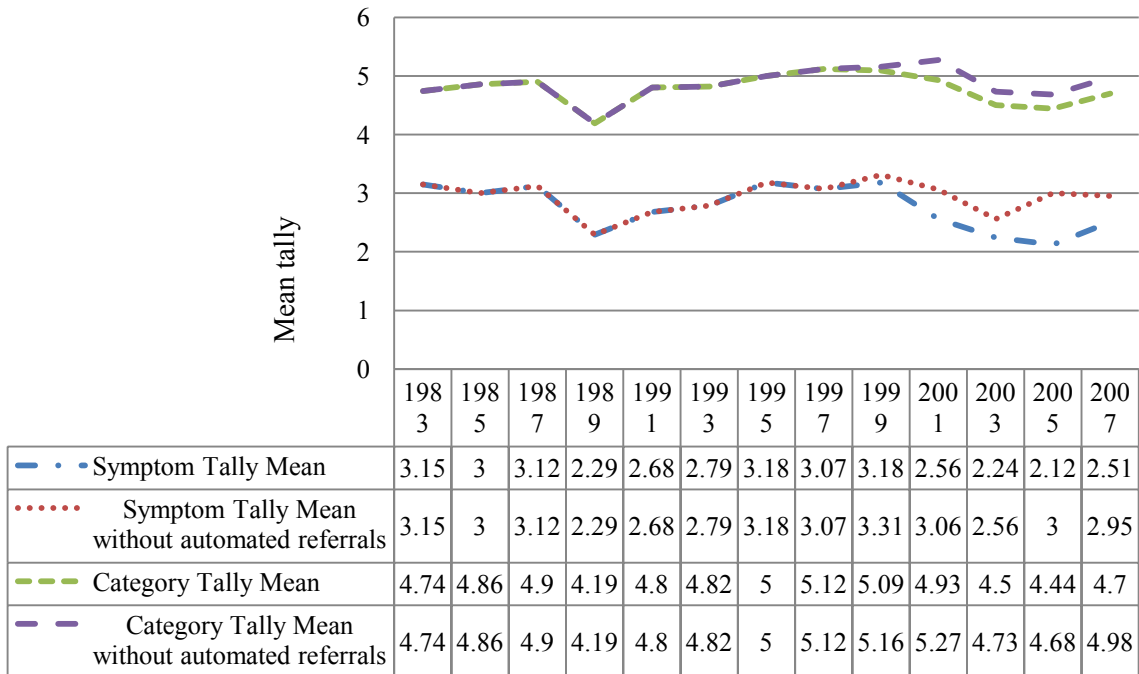


Figure 4. Mean Tallies of Symptoms and Categories with Automated Referrals

Removed

Diagnostic Considerations in Referral Questions

If a referral question listed symptoms without a diagnosis or if a diagnosis was described as suspected or provisional, the question was coded as requesting assistance with diagnosis (021). If more than one diagnosis was given as possible or contributory, the question was coded as requesting assistance with differential diagnosis (022). Across all years, an average of 80 referral questions per year ($\bar{X}=80.23$, $SD=20.37$) pertained to the establishment of an initial diagnosis, and another 54 ($\bar{X}=54.7$, $SD=15.6$) had differential diagnostic considerations. Figure 5 tracks the number of cases with diagnostic considerations by the year.

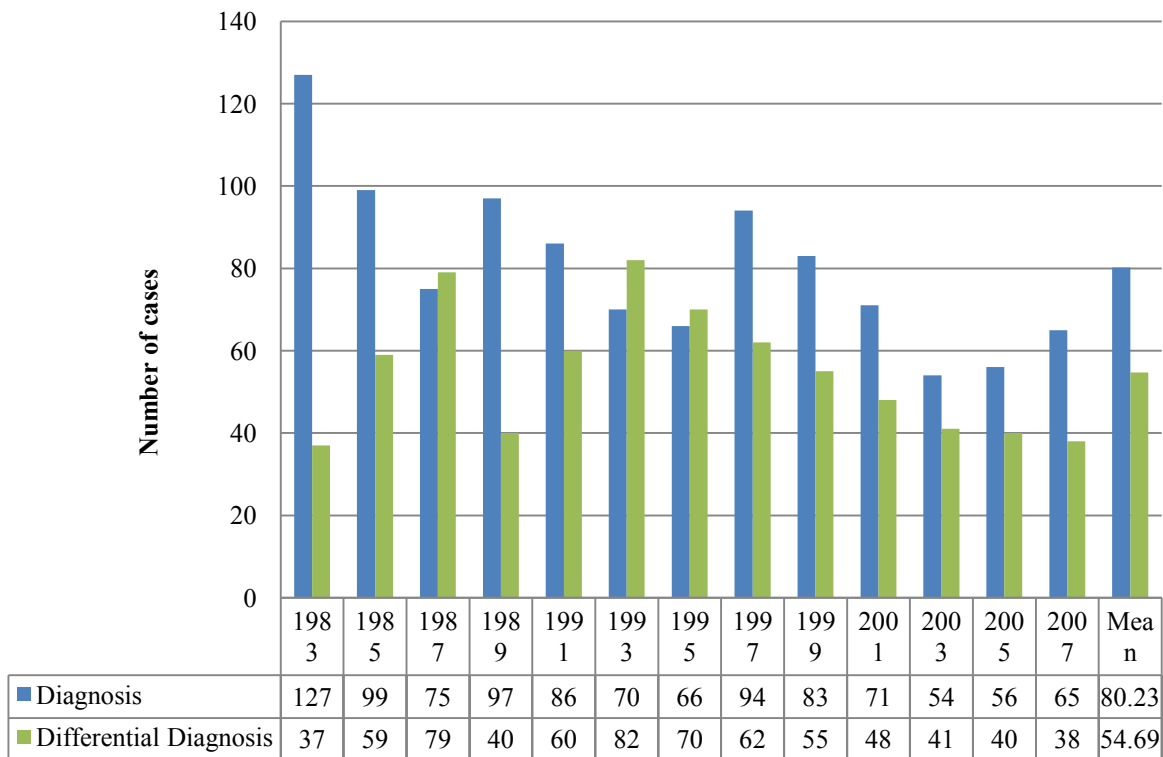


Figure 5. Number of Cases per Year with Diagnostic Considerations

A total of 67.47% of all referral questions were coded as requesting assistance with diagnosis or differential diagnosis. An additional 19% of all referrals were for reevaluations, which were excluded from coding as requesting assistance with diagnosis. Fourteen percent of questions remain, which is composed of cases with an established diagnosis present upon referral. Figure 6 shows the percentage of overall cases by diagnostic consideration.

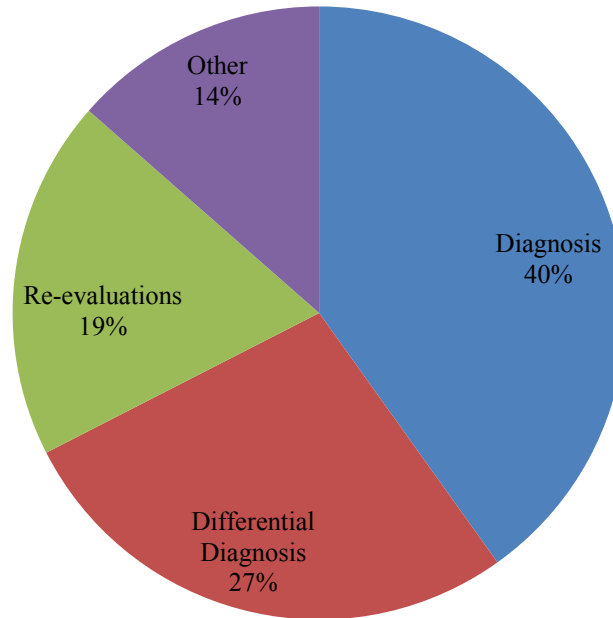


Figure 6. Percentage of Cases with Diagnostic Considerations

Categorical Analysis of Diagnostic Data Provided by
the Referral Source

In order to investigate what type of diagnostic information is provided most often, four categories were used to catalogue the data given by the referral source to present the case in the referral question. Each sign or symptom given in the referral question was coded in the categories presented above in Table 3, under the broad headings of 1) neurological diagnostic data, 2) cognitive/behavioral/emotional descriptor, 3) psychiatric diagnostic data, or 4) a general medical condition. Since most referrals had more than one symptom listed in the question, it is possible for any or all of the categories to be coded in any given referral question. Thus, a question: “please assess lingering depression and

memory difficulties following TBI in MVA 18 months ago” would be coded under the neurological domain (130-head trauma), the cognitive/behavioral/mood domain (201-memory), and the psychiatric domain (310-depression). Across all years sampled, neurological information was most commonly presented, an average of over 120 times per year ($\bar{X}=121.77$, $SD=10.92$) with cognitive/behavioral/ emotional data close behind, at 115 times per year ($\bar{X}=115.08$, $SD=16.04$). Figure 8 presents the percentage of cases in the overall sample which provided diagnostic data in the four categories while Figure 7 graphs the diagnostic data provided by year.

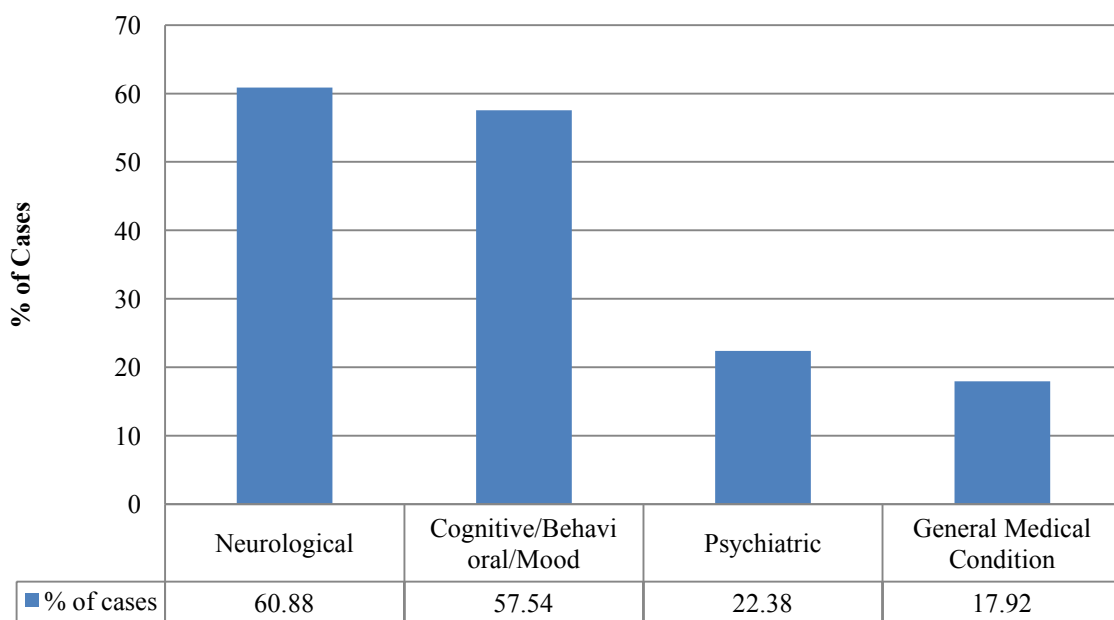


Figure 7. Type of Diagnostic Information Provided in Referral Questions

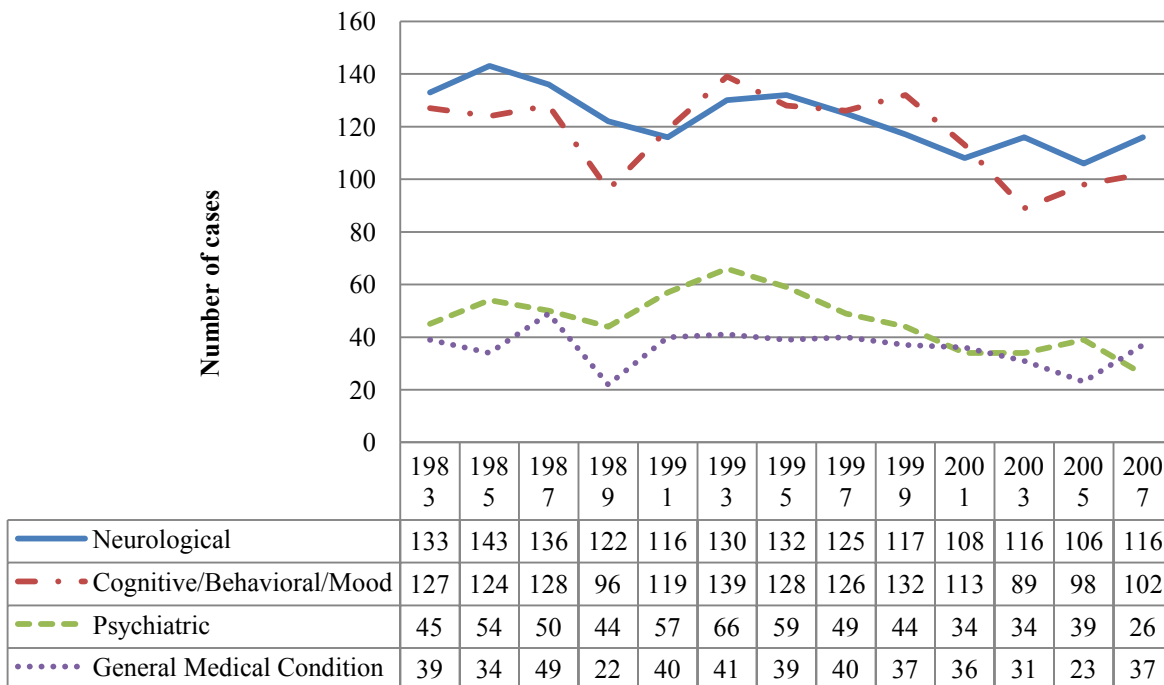


Figure 8. Questions per Year by Diagnostic Information Provided

As already mentioned, most cases presented diagnostic data in two or more of the four categories described. Over one-third of referral questions presented information in two diagnostic categories, with 17% presenting information in three or all four diagnostic categories. However, the most common pattern was to provide diagnostic information in only one category. The composition of the most common configurations will be discussed next.

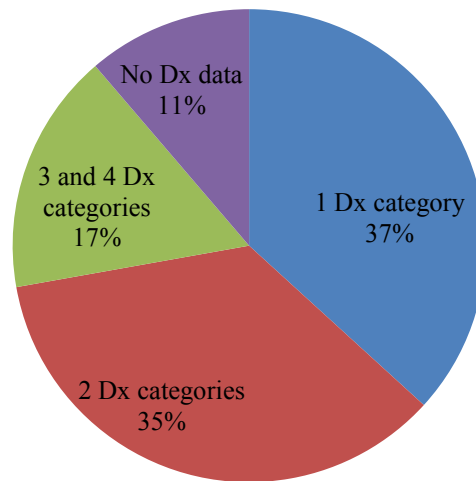


Figure 9. Number of Categories in Which Diagnostic Data Were Presented

The modal pattern of diagnostic information was providing neurological and cognitive/behavioral/mood descriptors (22.08% of cases $\bar{X}=44.15$ cases/year, $SD=7.2$), with provision of only neurological data close behind at 20.77% of cases ($\bar{X}=41.54$ cases/year, $SD=7.2$). Providing only cognitive/behavioral/mood descriptors comprised 10.92% of referral questions ($\bar{X}=21.85$ cases/year, $SD=4.02$), cases with cognitive/behavioral/mood descriptors combined with data from the neurological and psychiatric categories comprised 7.69% of the sample ($\bar{X}=15.38$ cases/year, $SD=4.84$), and cases with cognitive/behavioral/mood descriptors combined with data from the psychiatric category made up 5.08% of the sample ($\bar{X}=10.15$ cases/year, $SD=4.16$). Figure 10 depicts the pattern across time of data provided in these five most common configurations.

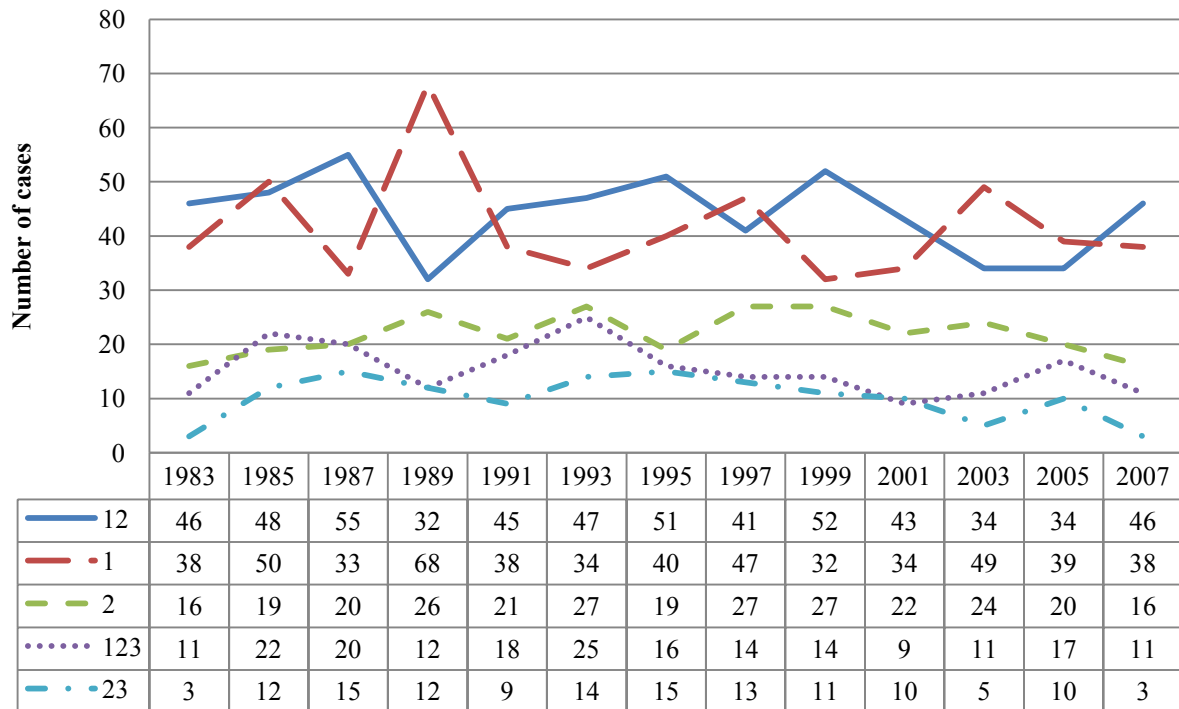


Figure 10. The Five Most Common Diagnostic Category Configurations Found in Referral Questions*

*Note: 1- Neurological, 12-Neurological and cognitive/behavioral/mood, 2- Cognitive/behavioral/mood, 123- Neurological, cognitive/behavioral/mood, and psychiatric, 23- Cognitive/behavioral/mood, and psychiatric

Differential Diagnosis

Further analysis of questions with requests for aid in differential diagnosis was planned by coding the areas of potential diagnosis: neurological (011), psychiatric (013), a general medical condition (GMC; 012), neurological or GMC versus psychiatric (014). For example: “67 y/o woman with memory problems and recent depressed mood. R/O dementia versus pseudodementia” would be coded neurological versus psychiatric (014), whereas “77 y/o with memory problems and extrapyramidal signs. R/O AD vs DLB.” would be coded as a neurological differential diagnosis (011). If both potential diagnoses were in one of the areas, that code was given, but if the diagnoses were in different areas

intended to find a psychiatric versus other medical diagnosis, the contrast code (014) was given. As can be seen in Figure 11, the contrast across diagnostic areas was the most common, accounting for over 66% of all differential diagnosis questions, an average of 39 questions per year sampled ($\bar{X}=39.62$, $SD=14.33$).

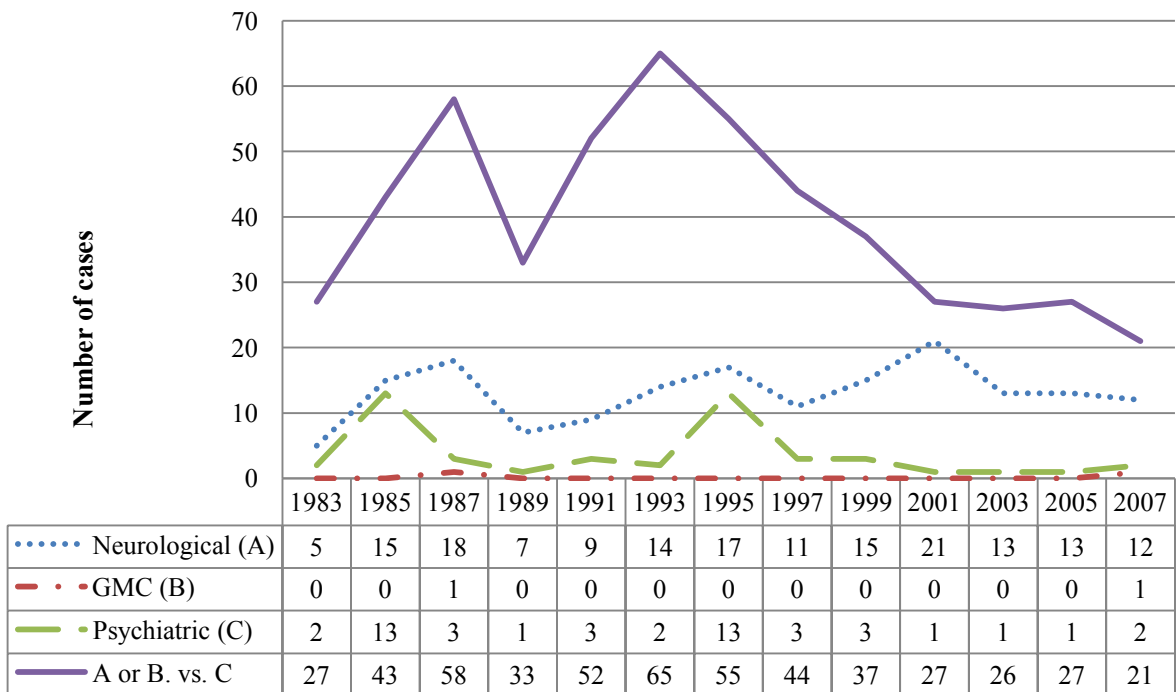


Figure 11. Number and Type of Requests for Differential Diagnosis Assistance by Year

An example of the most frequent cross diagnostic domain contrast is the question of dementia and depression. Seventy five cases with dementia (13.24% of all dementia cases) given as a diagnostic consideration also mentioned difficulty with depression, and 84% of those specifically requested differential diagnostic assistance between the two diagnoses. These were nearly evenly divided between naming dementia and depression as differential diagnosis (52%) and discussing the possibility of pseudodementia (48%; See

Figure 12). An additional example of cross domain differential diagnostic consideration is the request for establishing the etiology as “functional” or “organic” (see Figure 13), although this contrast lacks the precision of discussing specific diagnostic considerations, it was present in 2% of all cases.

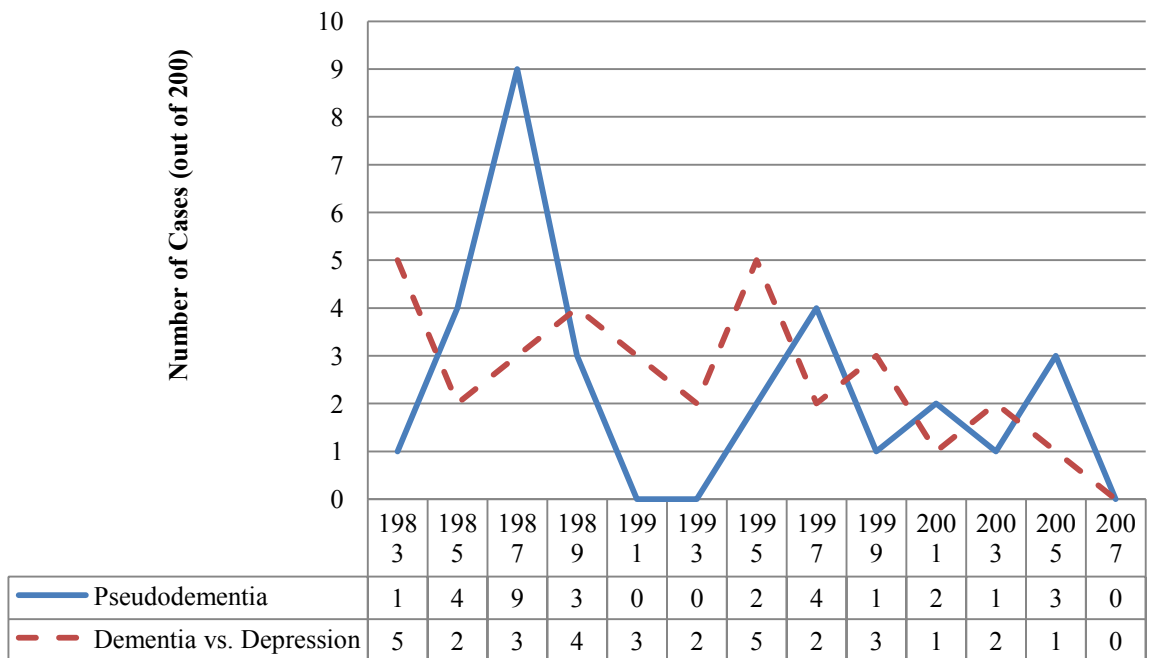


Figure 12. Depression and Dementia

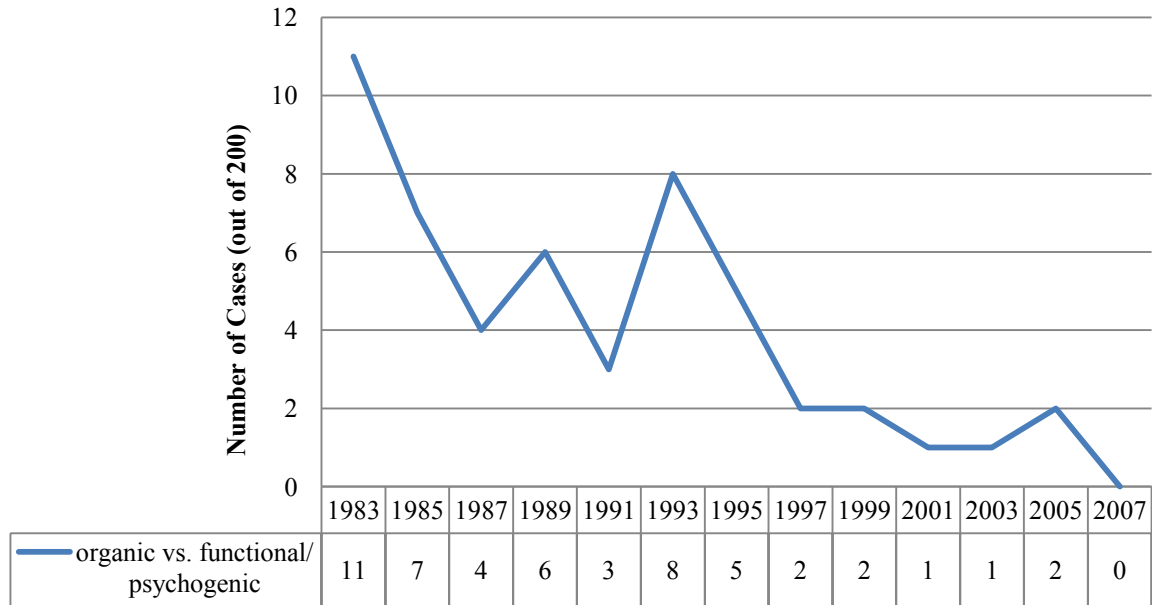


Figure 13. Differential Diagnosis: Organic Versus Functional/Psychogenic

Within domain neurological differential diagnosis was the second most commonly requested, comprising nearly 22% of differential diagnosis questions, or 13 questions per year on average ($\bar{X}=13.08$, $SD=4.42$). The individual variables making up the four diagnostic areas will be considered next.

Frequency of Diagnostic Data Variables

The most commonly presented symptom in each year and across all years was memory difficulty which was present in nearly one third of all referral questions (32.54%; $\bar{X}=65.08$ cases per year, $SD=9.94$) and 41.13% of referral questions not deemed as having low content based on the criteria above. The second most common symptom was description of mood dysfunction which occurred in 15.65% of all referral questions ($\bar{X}=31.31$ cases per year, $SD=10.48$) and nearly 20% (19.82%) of questions not having low content. Across all four diagnostic categories, the most common diagnosis offered for

consideration was dementia, defined broadly to include all types, which was included in 21.73% of all referral questions (\bar{X} =43.46 cases per year, SD=12.01) and over one-quarter (26.62%) of questions not having low content. When cerebrovascular disease was construed broadly to include all type of stroke, transient ischemic attacks, aneurysms, and small vessel disease, it became the next most frequent diagnostic consideration offered in referrals, comprising 10.31% of all questions (\bar{X} =20.62 cases per year, SD=6.2). Only slightly less frequent was depression which was 10.21% of all questions (\bar{X} =20.23 cases per year, SD=6.02). Figure 14 presents these variables over time. The most frequent diagnostic considerations and symptoms will be considered within each of the four diagnostic categories.

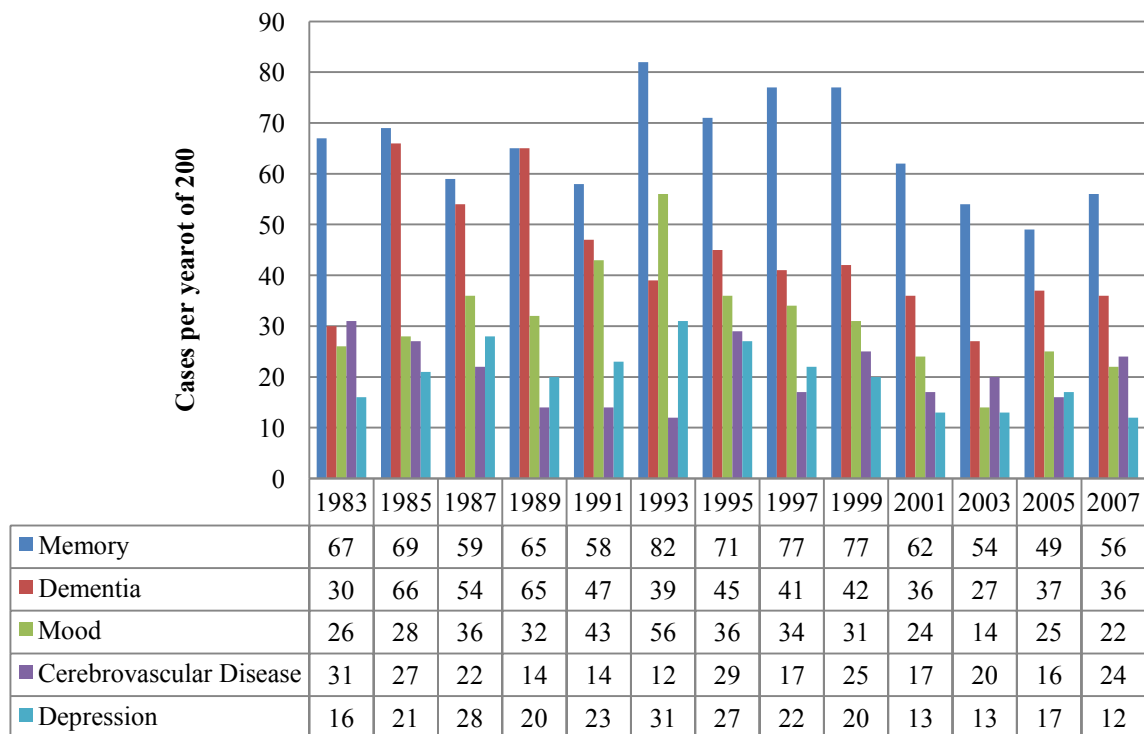


Figure 14. The Five Most Common Presenting Problems

Within the neurological domain, dementia was the most frequent presenting problem discussed in the referral question with head injury coming second (8.19% of all cases, \bar{X} =16.38 cases per year, SD=6.02), all types of stroke coming third (5.88% of all cases, \bar{X} =11.77 cases per year, SD=2.31), closely followed by seizure disorders (5.81% of all cases, \bar{X} =11.62 cases per year, SD=4.63), and movement disorders (5.38% of all cases, \bar{X} =10.77 cases per year, SD=4.3). Figure 15 presents these five presenting problems across all years sampled.

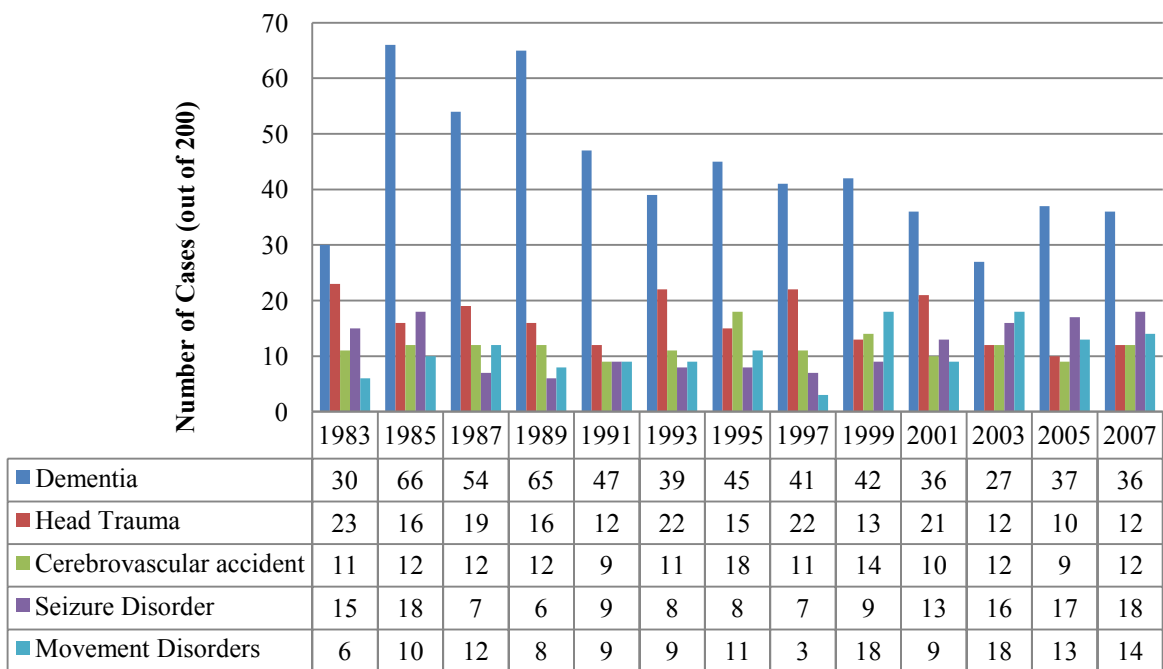


Figure 15. The Five Most Common Neurological Presenting Problems

Within the cognitive/behavioral/mood symptom domain, memory was the most frequent presenting problem with mood coming second. Motor problems were present in

7.58% of cases (\bar{X} =15.15 cases per year, SD=6.04), closely followed by language symptoms (7.00% of all cases, \bar{X} =14.00 cases per year, SD=4.67), and attention/concentration problems (5.04% of all cases, \bar{X} =10.08 cases per year, SD=3.52). Figure 16 charts these five presenting problems across all years sampled.

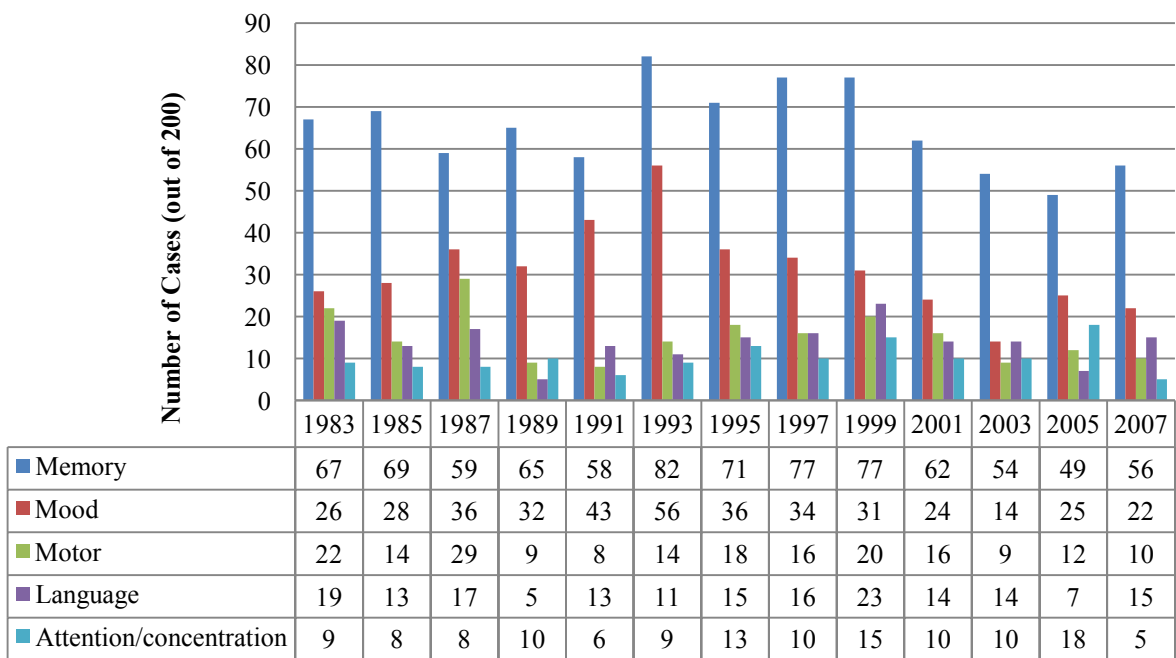


Figure 16. The Five Most Common Cognitive/Behavioral/Mood Presenting Problems

Within the psychiatric domain, depression was the most frequent presenting problem with anxiety a distant second (2.92% of all cases, \bar{X} =5.85 cases per year, SD=2.92). Substance abuse was the next most common psychiatric diagnostic consideration, occurring in 2.46% of all cases (\bar{X} =4.92 cases per year, SD=2.4), closely followed by somatization (2.42% of all cases, \bar{X} =4.85 cases per year, SD=2.79), and a

specific learning disorder (2.12% of all cases, \bar{X} =4.23 cases per year, SD=2.89). Figure 17 depicts these five presenting problems across all years sampled.

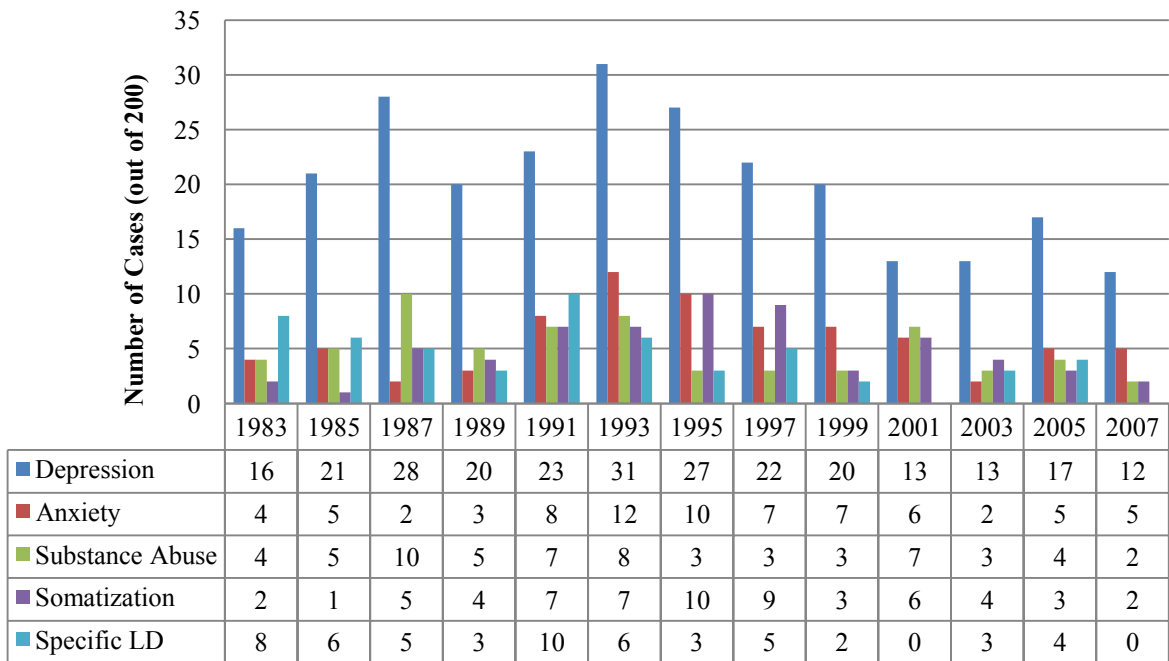


Figure 17. The Five Most Common Psychiatric Presenting Problems

As reflected in Figure 11, the general medical condition domain was the least commonly used diagnostic category and frequency was the most evenly distributed, with just over 3 cases per year differentiating the most common from the eighth most common. The most frequently provided variable in referral questions was a decline in functioning following a medication or surgical intervention, which comprised nearly 3% of all questions (2.92%; \bar{X} =5.85 cases per year, SD=3.13) and 16.03% of general medical presenting problems. Chronic pain was present in 2.88% of all cases (\bar{X} =5.77 cases per

year, $SD=2.39$) and 15.82% of general medical presenting problems, with sleep disorders next, comprising 2.44% of all cases ($\bar{X}=4.92$ cases per year, $SD=2.99$) and 13.5% of general medical presenting problems. Cardiovascular disease was fourth most frequent (2.31% of all cases; 12.65% of general medical presenting problems; $\bar{X}=4.62$ cases per year, $SD=2.22$) and somatic complaints was in the fifth position (1.58% of all cases; 8.65% of general medical presenting problems; $\bar{X}=3.15$ cases per year, $SD=3.11$). Figure 18 presents these five presenting problems across all years sampled.

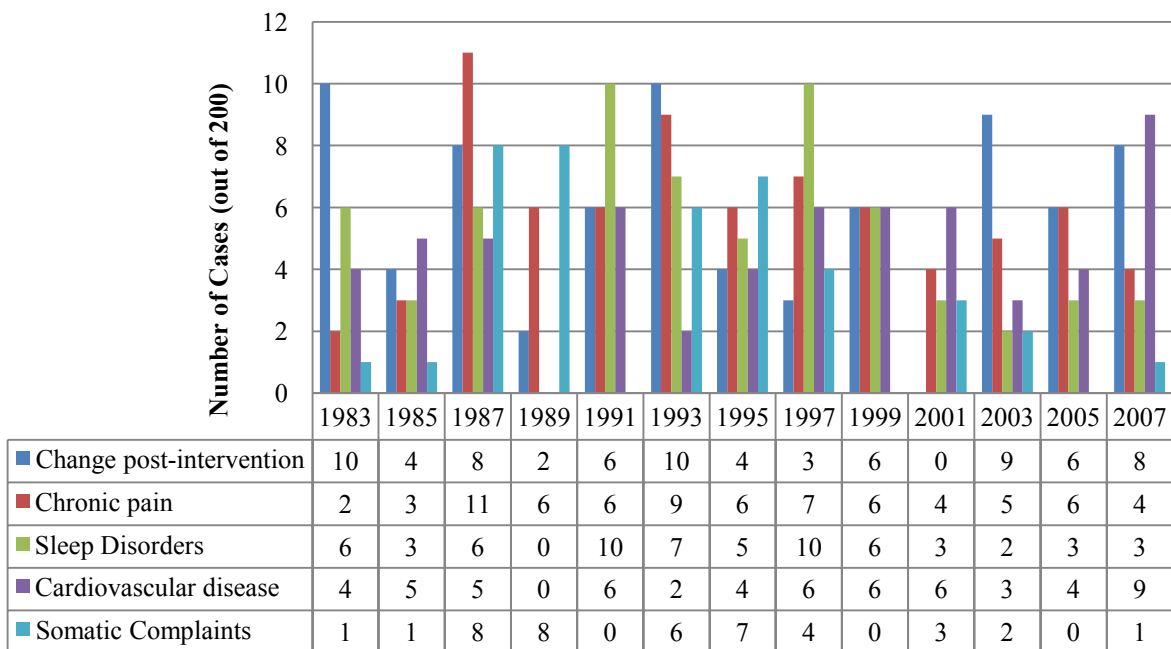


Figure 18. The Five Most Common General Medical Presenting Problems

Requests for Specific Procedures

Two types of requests were catalogued under the requests for procedures heading: requests for a type of assessment (e.g., dementia/memory evaluation, establish IQ, serial examination, independent medical examination) and requests for a specific test (e.g., MMPI, Beck Depression Inventory). These requests were present in nearly 65% of all cases (64.77%; \bar{X} =129.54 cases per year, SD=18.37). The most frequently requested assessment type was a dementia/memory evaluation, which comprised nearly one-third of all questions (32.35%; \bar{X} =64.69 cases per year, SD=13.89) and 50% of all specific requests. A request for a serial evaluation was made in 19% of all cases (\bar{X} =38 cases per year, SD=16.81) and 29.33% of specific requests. The most common test requested was the MMPI (9.69% of all cases, 14.96% of all specific requests; \bar{X} =19.38 cases per year, SD=11.69) with the BDI next most common test (1.04% of all cases; 1.6% of all specific requests; \bar{X} =2.08 cases per year, SD=2.99). The fifth most commonly requested specific procedure, to establish an IQ, was present in 1% of all cases and comprised 1.54% of all specific requests (\bar{X} =2.00 cases per year, SD=2.2). Although requests for forensic exams were included in the data collection methodology, the BNL practice of providing an independent examination and keeping the report separate from the medical record resulted in no legal referrals being sampled. Figure 19 tracks the five most common procedure requests across all years sampled.

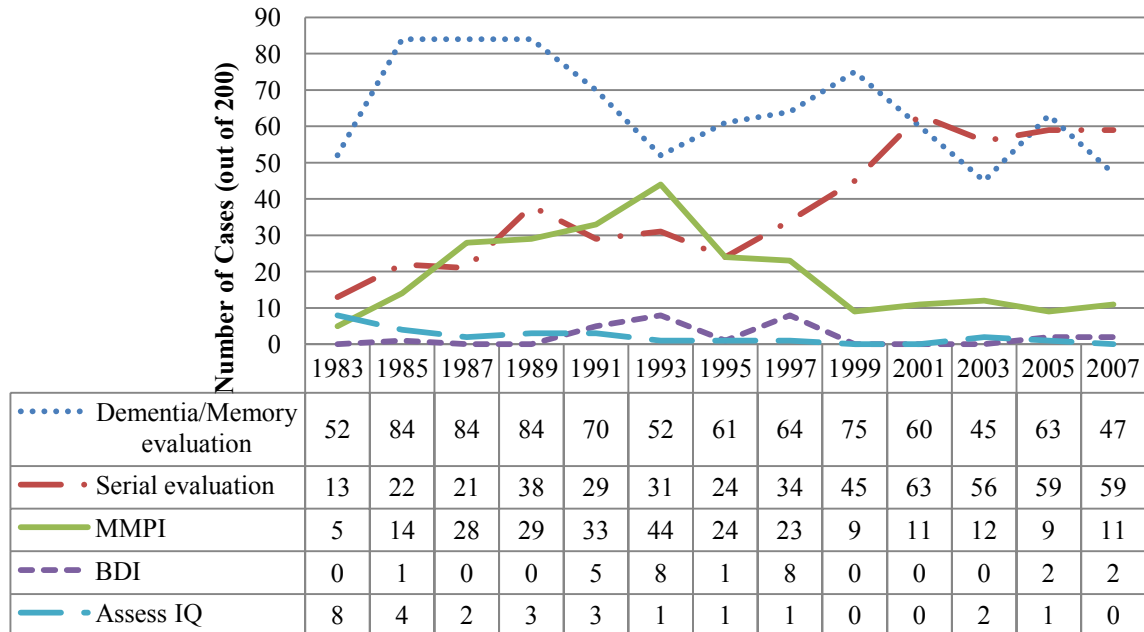


Figure 19. The Five Most Common Requests for Procedures

Requests for an Epoch-Based Exam

An epoch-based exam relates the context of the requested assessment to a period of time, either past or future. For example, interval change (code 042) assumes a prior exam and directs the assessment toward what changes in functioning, if any, have occurred since the last exam. Establishing a baseline and a pre-intervention exam (codes 041 and 44, respectively) are focused on measuring current functioning as a point of comparison for future evaluations to gauge decline or improvement over time or the effectiveness of an intervention, whether pharmacological, surgical, or rehabilitative. Epoch-based questions were present in 28.64% of cases (\bar{X} =56.92 cases per year, SD=22.63). The most commonly requested epoch-based evaluation was interval change, which comprised 17.08% of all questions (\bar{X} =34.15 cases per year, SD=17.45) and 60%

of all epoch referenced requests. A request to establish a cognitive baseline was made in nearly 5% of all cases (4.62%; \bar{X} =9.23 cases per year, SD=4.19) and comprised 4.62% of epoch-based requests. A pre-intervention evaluation was the next most commonly requested epoch referenced request, occurring in 4.08% of all cases and comprising 14.32% of all epoch based requests (\bar{X} =8.15 cases per year, SD=6.57), with post-intervention the next most common (1.65% of all cases; 5.81% of all specific requests; \bar{X} =3.31 cases per year, SD=2.87). The fifth most commonly requested epoch based exam was for recovery-specific questions (1.04% of all cases; 3.65% of all epoch questions; \bar{X} =2.08 cases per year, SD=2.56). Figure 20 portrays these five epoch referenced requests across all years sampled.

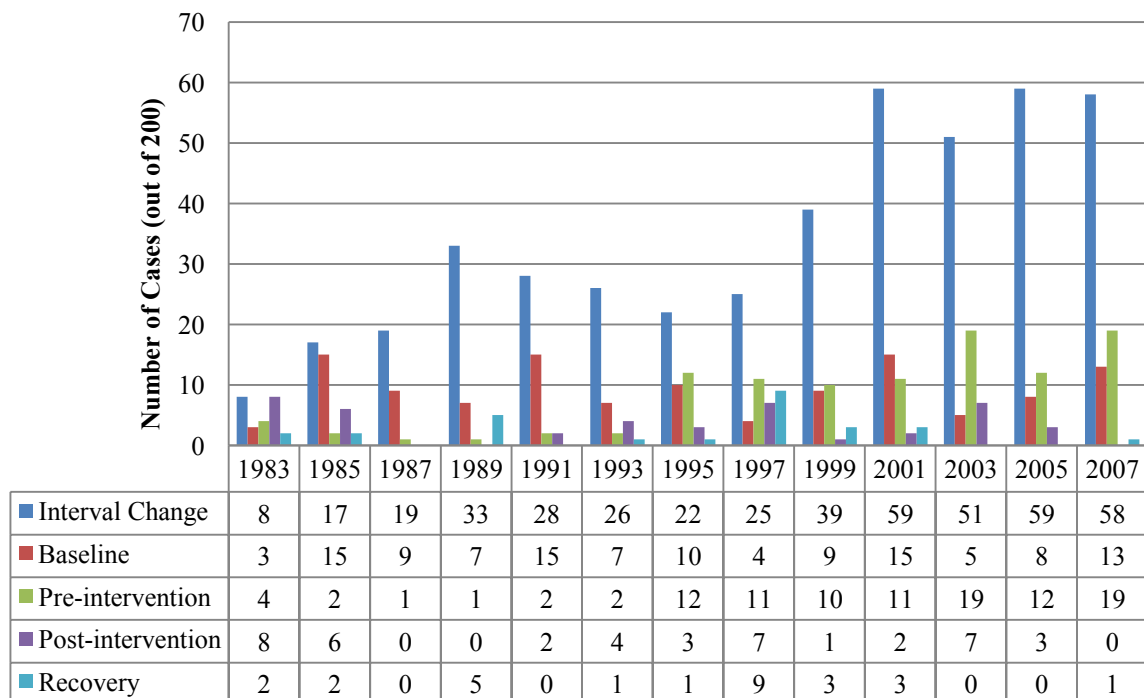


Figure 20. The Five Most Common Requests for an Epoch Based Exam

Specific Recommendation Requests

Requests for specific recommendations were coded using codes 051-069 listed in Figure 3 above. For the analyses below, variables 054 (resection), 055 (transplant), and 056 (deep brain stimulation) were collapsed under variable 053 (surgical), and variable 066 was omitted as it was found to only be coded for automatically generated referral questions. Specific recommendation requests were present in 30.15% of cases ($\bar{X}=60.31$ cases per year, $SD=36.28$). Recommendations regarding suitability for a surgical procedure were the most commonly requested, occurring in 3.23% of all questions ($\bar{X}=6.46$ cases per year, $SD=5.81$) and comprising 10.71% recommendation requests. Requests for recommendations on the level of supervision or capacity of the patient for independent living were made in 3.19% of all cases ($\bar{X}=6.38$ cases per year, $SD=3.97$) and made up 10.59% of recommendation requests. The next most common request was for recommendations regarding driving privileges, occurring in 2.5% of all cases and comprising 8.29% of all recommendation requests ($\bar{X}=5$ cases per year, $SD=4.81$), with rehabilitation the next most common (2.23% of all cases; 7.4% of all recommendation requests; $\bar{X}=4.46$ cases per year, $SD=3.26$). Recommendations regarding employment (e.g., return to work) were the fifth most commonly requested (2.08% of all cases; 6.89% of all epoch questions; $\bar{X}=4.15$ cases per year, $SD=2.19$). Figure 21 presents these five recommendation requests across all years sampled.

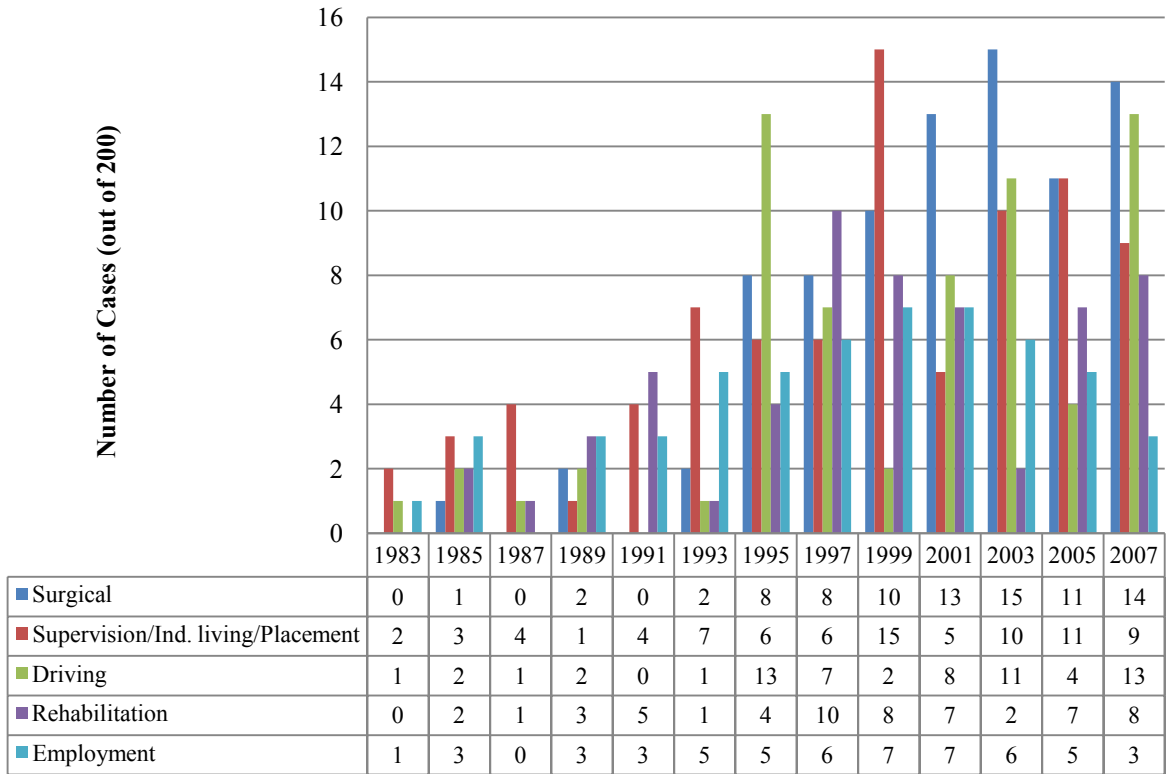


Figure 21. The Five Most Common Requests for Recommendations

Provision of Ancillary Data

In addition to providing data mapping on to specific diagnoses, referral sources provided data related to used to make diagnostic decisions, namely data accumulated in their own evaluation process. The frequency of providing neuroimaging information and information about past performances on cognitive testing were tracked using variables 099 and 100, respectively. Neuroimaging was discussed in 5% of all cases while previous cognitive testing (e.g., MMSE) was discussed in 4.27 % of all cases. Figure 22 tracks these variables across all years sampled.

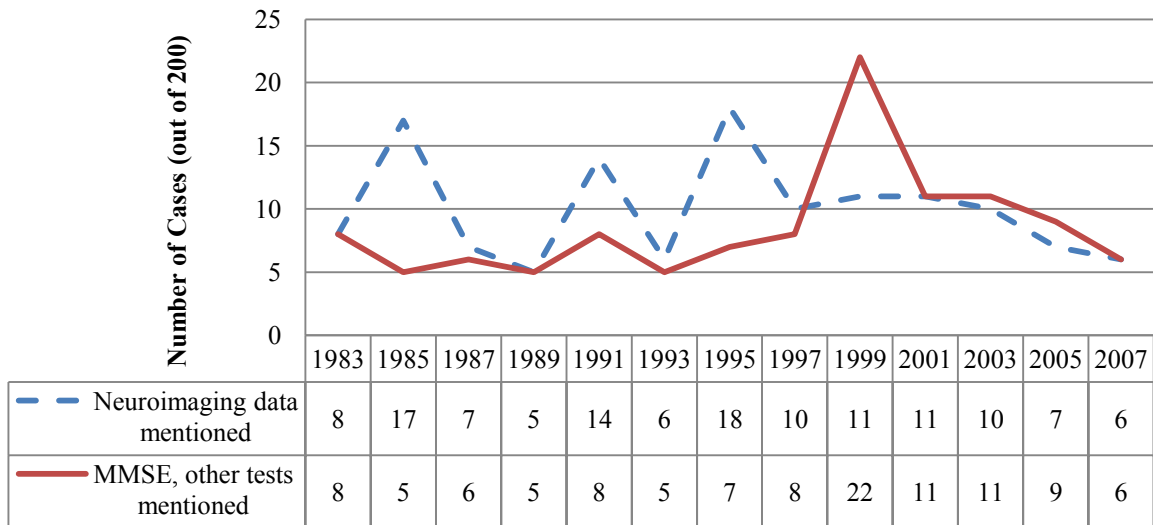


Figure 22. Frequency of Provision of Neuroimaging and Cognitive Testing Data

CHAPTER V

DISCUSSION

By examining the referral questions rather than neuropsychologists' or referral sources' post hoc recollection of referrals, this study expands what is known about referral content and patterns. In spite of the fact that neuropsychologists generally function solely in the role of consultant, a systematic analysis of the referral stream has not until now been undertaken. Previous studies addressing frequency of types of referral questions in adult clinical neuropsychology have relied on survey methodology in which respondents were asked to recollect what percent of their referrals fell within items on a provided list. This introduces potential bias and/or error in recollection on the part of the respondent (be they referrer or neuropsychologist), and may constrain responses by forcing them into a provided category. In an effort to explain question content without relying upon recollection, a coding rubric was designed to capture the breadth of presenting problems and requests seen in the original referral questions. In addition, the categories provided in the surveys to date have been necessarily broad (e.g., "assistance with diagnosis") to avoid damping response with a lengthy and onerous questionnaire. The current study allows for more specificity in examining not only how often diagnostic help is sought for example, but what kind (initial diagnosis, differential diagnosis, etc.) and with what types of presenting problems.

Two hundred referral questions were selected from each odd year over the 25 year period from 1983 to 2007, yielding a total of 2600 referral questions. The patients referred were 49.93% male and 49.61% female with a mean age of 55.32 years, ranging from 18 to 99 years of age. Three years emerged as the most common ages for referrals:

79 years (n=61) followed closely by 48 years (n=60), and 70 years (n=59). Thus the age range for referrals is widely and evenly dispersed across middle and late life. In the analyses described below that address the specific content of the referral questions, automated referrals for reevaluation will be excluded. While the referral source did request the reevaluation, she or he did not generate the content of the question and this content cannot be attributed to the referral. This exclusion will be noted in each instance.

Information in the referral question is almost always used in shaping the test battery and composition of the report for the patient record (Rabin, Barr, & Burton, 2006). A high majority (98.4%) of the referrals in the current study contained substantive questions, providing strong evidence that referral sources find it important to provide some basic information to guide the requested assessment. However, a small and steady minority of questions containing only some form of “please evaluate” persisted across the sampling period. A larger number of referral questions provided one symptom or complaint or one specific request and these were identified as having minimal content. When this somewhat more stringent threshold for inclusion of data in the question was applied and automated referral questions were removed, 20.9% of all referral questions were identified as having minimal content. While there is some variability, these questions are evenly distributed across the sampling period. In responding to these requests for consultation that include minimal content, the neuropsychologist is only given very broad parameters, must make many inferences about what the referral source may need, and must base their assessment decision making on the patient’s stated history and any available medical records. An alternative interpretation is that this minority of cases represents a consistent number of cases over time which are relatively straightforward

from the perspective of the referral source. These cases may be uncomplicated in diagnostic terms or in treatment indicators, but the physician would like a more complete view of the patient's neuropsychological functioning to use in current or future decision-making. While a fuller description is helpful in complex cases, even cases initially deemed straightforward can be elucidated by a brief, but comprehensive referral question.

In their responses to surveys, physicians have consistently identified assistance with diagnosis as the commonest reason for seeking a neuropsychological consultation (Bishop, Temple, Tremont, Westerveldt, & Stern, 2003; Temple, Carvalho, & Tremont, 2006; Tremont, Westerveldt, Javorsky, Podolanczuk, & Stern, 2002). Neuropsychologists have responded in kind to several surveys, also identifying diagnosis as the most common reason for referral (Rabin, Barr, & Burton, 2006); Sweet, Peck, Abramowitz, & Etzweiler, 2002; Sweet, Nelson, and Moberg, 2006). In the current study, 67.47% of all questions were identified as requesting assistance with diagnosis. This is .08% shy of the mean of the two groups' estimates of the percentage of cases with diagnostic considerations: 70.6% identified in a recent broad survey of neuropsychologists (Rabin et al, 2006) and 64.5% in a recent broad survey of physician's (Temple, et al, 2006). Thus the data from the surveys are borne out by this finding with a caveat: neuropsychologists may slightly overestimate and physicians may slightly underestimate the percentage of referral questions with diagnostic considerations.

In order to investigate the complexity of the cases referred for neuropsychological consultation the questions were analyzed for the number and type of symptoms reported, the diversity of symptoms reported across health care specialties, and the type of procedures, evaluation, and recommendations requested. Given that at least minimal

content was present in 79.1% of questions and that nearly 65% of all questions request assistance with diagnosis, the symptomatology provided by the referral source to aid in this process will be considered next. With regard to the diagnostic information provided, 40% provided one diagnostic consideration, while 27% provided differential diagnostic considerations, i.e., two or more suspected diagnoses. When automated referral questions were excluded, an average of 2.94 symptoms ($SD=.28$) were included per referral question, with only slight variability over time. In order to sample the breadth of questions addressed in the question, the number of diagnostic categories (i.e., neurological, cognitive/behavioral/mood, psychiatric, and general medical conditions) and specific requests (i.e., diagnosis, type of exam, specific procedures, specific recommendations) were tallied for each question. The average question (excluding automated referrals) included information in 4.87 of these categories. Thus, when the referral source generates the content of the question she or he generally provides three symptoms and data in nearly five of the eight categories used for content description. This represents a substantial investment of limited record-keeping time for a busy referrer. When substantive content is present, referral sources found it pertinent to include data from a broad range of sources in order to provide a context for the requested assessment. It is also likely that cases with more symptomatology and a more complex presentation will require a more complex description. The relatively high number of coding categories and symptoms represented in the average question suggests that the cases in which referral sources elected to include at least minimal content were more complex. Thus physicians may view some cases as relatively straightforward and may not include much content in

writing the referral question, while more time is invested in more fully explicating cases viewed as complex.

Four symptom and diagnostic category types were used for data coding and analysis: neurological, cognitive/behavioral/mood symptoms, psychiatric, and general medical condition. All symptoms and diagnostic considerations were placed into one of these categories. Neurological symptoms were the most commonly identified (60.88%) with cognitive/behavioral/mood symptoms close behind (57.54), and followed at a distance by psychiatric (22.38%) and general medical conditions (17.38%). Therefore, neurological problems were the most common, followed by problems described with cognitive, behavioral or mood descriptors. The high frequency of neurological problems is not surprising given that the BNL is situated in a neurology department. Cognitive symptoms can be employed to describe problems in any of the other three categories and so the relatively high frequency of this category is not unexpected. Cognitive, behavioral, and mood symptoms are not individually suggestive of a particular condition or even a diagnostic category, but in clusters they are useful for diagnosis, an important consideration given that nearly two thirds of all questions included diagnostic considerations. In 37% of cases, data in only one diagnostic category was presented. However, it was possible, and indeed was common, for symptoms in multiple domains to be presented. Thirty-five percent of questions presented symptoms in 2 diagnostic categories and 17% presented data in three or all four categories. Thus in over half of all cases, information in two or more diagnostic categories was noted, indicating that a majority of cases were sufficiently complex to span multiple areas of diagnostic consideration. In fact, the modal pattern of providing diagnostic information was two

categories: neurological and cognitive/behavioral/mood descriptors manifested in 22.08% of all cases. The second most common pattern was questions that only provided neurological consideration (20.77% of all cases).

As noted above, input on differential diagnosis was requested in 27% of all cases. While a significant number of these differential diagnosis requests were within the same diagnostic category (e.g., 21.96% of all questions were for a neurological differential diagnosis), a majority of cases were across medical specialties. Out of all requests for differential diagnosis, nearly two-thirds (66.45%) requested assistance requested assistance in making a differential diagnosis between a psychiatric disorder and another type of medical condition, either neurological or general medical. There is evidence of a trend over time with this type of question peaking in the early to mid 1990s (psychiatric versus other medical accounted for 35.1% of all cases between 1987 and 1995) and declining steadily over the next 15 years (psychiatric versus other medical accounted for 16.8% of all cases between 1999 and 2007). This finding of declining numbers in referrals for differential diagnosis involving psychiatric disorders is likely to be attributable to several factors. A second neuropsychology service was begun at the UIHC in 1987 in the Department of Psychiatry, and because of its locus, it was an additional, and perhaps more salient, service to address this type of question. Additionally, advances in technology likely play a prominent role in the decline of psychiatric versus other medical questions. Increasing neuroscience knowledge and the diminishment of the “functional versus organic” dichotomy may have removed the benefit of classifying a patient as “functional” with a neuropsychological evaluation. Additionally, the increasing popularity of well-tolerated antidepressant medications (e.g., SSRIs, SNRIs) may have

been a first line of treatment that was helpful for patients and made a neuropsychological evaluation unnecessary. It is also possible that these consultations have declined because the referral sources did not find an added benefit to their decision making process. In any event, these referrals continued and there is evidence that in many cases referral sources need consultation in discerning if the presenting problems are psychiatric in nature or related to another medical condition. While the language used in these questions has changed from “functional” and “organic”, the distinction between psychiatric and other medical problems continues to be a major theme in the usage of neuropsychological services.

As recently as 1990, Guilmette, Faust, Hart, and Arkes found in their survey of members of NAN, INS, and Division 40 that the most common referral question was “rule out organic brain function”. The error in this type of question relates to two fundamental flaws. First, it assumes that the pathological processes of many or even some psychiatric disorders are not represented in the “organic” plane of existence, namely the anatomy or physiology of the individual. This position is essentially dualistic because it indirectly posits that if the pathology is not present in the physical world (through disrupted neurotransmitter receptors, impaired neurogenesis, or neuronal damage, for example), it is present in some other plane, namely the functional plane. The conclusion must then be that the mind exists on a different plane of existence that is not determined by neuroanatomy or neurophysiology. However, there is ample evidence that the mind is inseparable from and fully represented in the brain, although our understanding of this will be exposed as rudimentary by generations of neuroscientists to come. The second fundamental flaw represented in the consultation request to “rule out organic dysfunction”

relates to the unitary theory of brain damage. This theory held that the major determiner of brain damage severity was not where the damage occurred, but how much damage occurred. If no particular deficit could be inferred from the location of a lesion, it was unnecessary to test all cognitive domains. A single test could be employed to screen for the presence of brain damage. The unitary theory of brain damage was in favor for much of the twentieth century due to several converging streams: faulty generalization of animal research models to humans, putative malpractice on the part of proponents of frontal leucotomy, and the persistence of a dualistic theory of mind and body. In the current study, the question of psychiatric versus other etiology was addressed in several ways in order to track the frequency of making this referral type and the terminology used: 1) the differential diagnosis between a psychiatric disorder and a neurological or general medical condition (19.2% of all cases), 2) the frequency of using the terminology “organic versus functional” (2% of all cases), 3) the frequency of using “somatic complaints”, a term often accompanying these questions (1.58% of all cases), and 4) the frequency of somatization occurring as a diagnostic consideration (2.42% of all cases). A trend was seen in the gradual decline of the use of organic and functional terminology as well as psychiatric versus other medical across the sampling period. Nonetheless, taken together, these related diagnostic categories account for 24.77% of all cases sampled. The language of organic versus functional appears to be waning, and has been replaced by using more precise psychiatric diagnostic terminology. Similarly, the relationship between depression and dementia was tracked using two codes: dementia versus depression, and term pseudodementia, which is often criticized for its imprecise title. Both categories followed the same general trend of slowly declining frequency across the sampling period,

indicating that referrers are asking less often for assistance in making this differential diagnosis. This finding may also have been attenuated by the advent of the second neuropsychology service in the late 1990s. It is clear, however that cases which have psychiatric and other medical components continue to pose a significant challenge to referral sources.

Referral sources requested specific tests in 12.65% of cases and over 75% of these were requests for the MMPI (either the MMPI or MMPI-2). There was a steady increase in requests for the MMPI from 1983 (2.5% of cases), peaking in 1993 (22% of cases), and declining to 7% of cases in the 2000s. The next most commonly requested test was the Beck Depression Inventory (BDI or BDI-2), which was present in just over one percent of all referrals. Requests for specific tests were thus relatively uncommon toward the end of the sampling period after reaching high levels in the early 1990s. The MMPI is often used for diagnosis in cases emphasizing differential diagnosis between a psychiatric and another medical condition. A similar decline in referrals for this differential diagnosis was also seen, as discussed above, which likely accounts for a portion of the decline in requests for the MMPI. This finding may also have been attenuated by the advent of the second neuropsychology service in the late 1990s.

In order to examine the most common presenting problems that catalyze a referral for a neuropsychological evaluation, symptoms and diagnostic considerations were tallied across the sampling period and automated referrals were excluded from these tallies. Difficulty with memory was the most commonly reported complaint, accounting for over 40% of all referral questions, followed by depression at nearly 20%. Dementia was the most commonly presented diagnostic consideration, occurring in over one quarter of

questions. Cerebrovascular disease and depression were slightly less common diagnostic considerations, each occurring in just over 10% of cases. While there is noteworthy overlap in two of these variables (memory and dementia) these common presenting problems make up a very large proportion of cases referred for neuropsychological consultation. It is often important to determine with more precision what is meant by memory problems. Problems with antero- and retrograde memory, short term memory, encoding, retrieval, consolidation, and attention are all lumped under this category. Addressing these in clear and concise terms in the neuropsychological report can build awareness of the differences between these constructs to referrers.

Although referral sources often have requests for specific procedures or types of evaluations based on their knowledge of neuropsychological assessment and the needs of their patients, this has not been systematically examined. Several surveys have addressed the frequency of specific test use, but not from the perspective of requests from the referral source. Sixty-five percent of all cases requested a specific type of evaluation or a specific test. Requests for a dementia or memory evaluation comprised just over 32% of the sample and requests for a follow up evaluation comprised 19 percent of cases. Requests for dementia/memory evaluations peaked between 1985 and 1991 when it made up over 40% of all cases. There is evidence of a slight decline in dementia evaluations from 1993 to 2007 (29.2% of all cases). However, it is likely that much of this decline in the 2000s is due to automated referrals being used to track cognitive changes in patients with dementia. There remains a decline in dementia evaluations from 1993 through 1999 that can only be partly accounted for by the beginning of the second neuropsychology service in the late 1990s. An additional explanation is physicians' increasing comfort with diagnosing more

advanced dementia in straightforward cases using tests not far afield from the neurological exam, e.g., the MMSE, while referrals for individuals in the prodromal phase with more subtle (memory only) complaints became more common.

The use of neuropsychological testing to follow patients with serial evaluations slowly increased across the 1980s (from 6.5% of questions in 1983 to 19% of questions in 1989) and began to steadily increase in 1997 until it reached a peak and plateau in the 2000s at nearly 30% of all cases. A large majority of this increase is directly attributable to the program of referrer approved automated reevaluation that began in late 1999. However the presence of this trend before this practice began, and continued engagement in automatic reevaluations, is evidence that physicians have found it useful to establish a cognitive baseline and refer back to this with periodic testing to assess current functioning.

Many presenting problems confronted in neuropsychological evaluations have progressive symptoms. Systematic use of neuropsychological assessment over time can provide a cognitive baseline against which to compare test data from periodic reevaluations allowing measurement of interval cognitive changes and the magnitude of disease progression. Epoch based questions were defined as requests to perform the evaluation relative to a future or prior evaluation, i.e., some variation on establishment of a cognitive baseline or estimation of interval change, and were requested in 28.64% of all referral questions across the sampling period. There was a general trend toward an increase in epoch based questions in the second half of the 25 years sampled, increasing from 19% of all questions from 1983-1993 to 36.5% of all questions from 1995-2007. Interval change was the most common epoch based question, arising in 17.5% of all questions, and accounting for much of the noted increase in epoch based questions over

the latter half of the period measured. Requests for estimates of interval change accounted for 7.3 % of all a questions from 1983-1987 and doubled in the 1990s to comprise 14% of questions from 1989 to 1999. After the advent of referrer approved automated requests for reevaluation, requests for interval change increased to 28.8% of all referral questions. This increase was a result of a policy change rather than sui generis increase in requests from the referral sources. However, the referral source must approve each automated referral and the continued high frequency of these reevaluations provided support for the value of this practice for clinical care. Another epoch referenced request, establish a cognitive baseline, was present in 4.6% of all questions without substantial variability across the years measured. Establishing a pre-intervention baseline, a type of cognitive baseline tallied separately, was present in a similar number of questions (4.1%) but showed a pattern of increasing frequency across the latter half of the period of interest. From 1983-1993 pre-intervention baseline requests were present in 1% of all requests, increasing to 6.7% from 1995-2007. It can be argued that as physicians became familiar with neuropsychological services, they found it increasingly valuable to have a neuropsychological evaluation to establish a cognitive baseline before a procedure in order to provide a data point for later comparison and estimation of effectiveness of the procedure.

Survey data of physicians referring patients for neuropsychological evaluations shows that satisfaction and comfort level with report recommendations is strong (96% comfortable or very comfortable; Temple, Carvalho, & Tremont, 2006). The responding physicians in a 2003 study by the same group (Bishop, Temple, Tremont, Westerveldt, & Stern, 2003) estimated that the third most frequent reason for referring was to obtain a

specific recommendation (36.4% of referrals). The current study found requests for specific recommendations in 30.2% of all cases across the period of interest. While this is somewhat lower than found by Bishop, et al, there is evidence of variability across the sampling period. From 1983-1993 requests for specific recommendations were present in 11.92% of questions while 36% of questions in the period from 1995 to 2007 contained a request for a recommendation (excluding content of automated referrals). Over this latter period the referral sources in the current study requested specific recommendations in the same proportion as did the sample in the survey Bishop and colleagues. It is likely that as physicians became more familiar with the type of procedures available in the neuropsychological evaluation and the utility of specific recommendation in constructing and providing rationale for treatment plans they became more likely to request specific recommendations that had pragmatic value.

Only two surveys were found to address the frequency of specific recommendations. Guilmette, Faust, Hart, and Arkes (1990), noted that recommendations regarding capacity for work and educational planning were the second and third most frequent reasons for referral in their survey of a broad sample of those offering neuropsychological services. In 2002, Sweet, Peck, Abramowitz, and Etzweiler published a survey of the memberships of NAN and Division 40, which identified treatment planning as the second most common reason for referral. Although these categories were not uncommon in the current study, they do not appear to account for as many of the referrals as would be anticipated based on the survey data of neuropsychologists. Recommendations regarding fitness for a surgical procedure were the most commonly requested (3.23% of cases), followed by recommendations regarding: capacity for

independent living/supervision/placement (3.19% of cases), driving (2.5% of cases), rehabilitation (2.23% of cases), and capacity for employment (2.08% of cases). Although when taken together requests for recommendations were common in this sample, these requests were relatively evenly distributed across fourteen of the sixteen specific requests identified for categorization. When treatment planning was construed more broadly in the current sample to include questions regarding treatment in the areas of surgery, rehabilitation, neurology, general medicine, and psychotherapy, 10.96% of cases contained requests for treatment planning recommendations. The pattern over time of this inclusive definition treatment planning recommendation was similar to that found in overall requests for recommendations. That is, from 1983-1993 requests for treatment planning recommendations were found in 3.42% of questions, but increased to 20.33% of questions in the period from 1995 to 2007 (again excluding content of automated referrals). This increase in the frequency of requests for specific recommendations undergirds the findings of physician survey data (Temple, Carvalho, & Tremont, 2006) that physicians value and are comfortable with the recommendations found in neuropsychological reports.

Study Limitations

In order to objectively view the import of the findings reported herein, the limitations of the study must be considered. These have been also discussed in the appropriate sections throughout. The primary weakness is the use of the ratings of the principal investigator for all analyses conducted. Several steps were taken to mitigate this unavoidable weakness to the greatest possible extent. First, all referral questions were selected using a random number generator from the BNL database and only replaced due

to compromised legibility. Second, before the rating took place, all questions were redacted with a hole punch to remove all references to the year in order to obviate any potential bias in rating based on this important variable. Third, 20% of all questions were selected at random and rated by an individual experienced with neuropsychological assessment and blind to the study hypotheses. Rater reliability checks were distributed in three phases across the rating process to examine for drift. Kendall's Kappas were computed for 126 categories in each of these three phases with a threshold identified a priori at $\kappa = .70$. In the first phase, seven of the 126 categories were below the threshold, 4 out of 126 were below threshold in the second phase, and all were above threshold in the final phase. Each variable below the threshold was revisited by the raters for identification of any problem and review of the definition.

Secondly there are two notable institutional vicissitudes that affected the sample, both occurring in the late 1990s. In 1997 a second neuropsychology service was established in the UIHC, which was housed in the Department of Psychiatry. This service became an additional location for neuropsychological consultation, perhaps particularly those involving psychiatric diagnostic considerations. A personal communication from a neuropsychologist at the BNL during this time (Dan Tranel) indicated that there was a perceptible decline in referrals for psychiatric considerations, but these referrals did continue and it is unknown how this development affected the current sample. Records from the neuropsychology service in the UIHC Department of Psychiatry were not collected or preserved in a fashion that would allow them to be compatible with the current study. The second institutional change affecting the study sampling and analyses was the policy of automatically generating referrals for reevaluation when this procedure

was indicated in the initial or most recent exam. This policy was implemented based on feedback from referral sources; feedback has been continuously monitored throughout the policy implementation and it continues to be used frequently. While it has greatly facilitated the process of follow-up testing and inclusion of these questions provided insight into how referrers used neuropsychological services, the wording of the question is standard and cannot be attributed to the physician. Thus these questions did not provide insight into the reasons for referral beyond the fact that a reevaluation was indicated and were therefore excluded from several analyses, as noted in the relevant sections. It should be noted that none of the 137 automated referral questions sampled in this study included any additional information written in by the referral source.

Finally, the data analyzed in this study were taken from an academic tertiary care medical center with a large geographical catchment area in a rural state in the US. This type of patient base will differ to a varying degree from the practices of many neuropsychologists and these findings may thereby be limited in generalizability. The presenting problems of patients seen may be different. For example, surveys from the 1990s suggest that legal referrals were more frequent in private practice and this component of clinical practice is not addressed in this study. The racial, cultural, and rural/urban composition of the patient base may also vary. However, there is evidence from surveys of the current practitioners who belong to Division 40, NAN, and INS that the number of neuropsychologists who conduct at least part of their practice in a hospital is on the rise and comprises approximately 60-70% of survey respondents in the 2000s.

Implications for Training and Practice,
and Directions for Future Research

Several findings in the current study provide additional support for and refine some descriptions of the referral process in the extant survey literature; these conclusions can inform clinical practice. First, a consistent minority of questions (21%) in the current study were found to contain minimal information, and given the fact that referral information was considered to be important or very important by 91.1% of respondents in a survey of neuropsychologists (Rabin, Barr, and Burton, 2006), it may be useful to implement strategies to elicit this valuable data when it is not forthcoming by generating a referral form that includes a menu of options. A sample referral form is provided in Figure 22 which incorporates the findings of the current study by including the most frequently requested types of evaluations, types of recommendations, and types of symptoms while allowing space for open-ended response and elaboration. Such a form will also demonstrate to the referral base what types of services are available and improve the use of neuropsychological findings in clinical care decision-making. Implementing a form that can be entered quickly and efficiently into a spreadsheet will allow clinicians to systematically describe their practice, analyze referral question patterns within and across referrers, and isolate areas of strength and weaknesses that can be addressed with their referral base. Potential research benefits from such a form include reducing rater error and bias and expediting data collection and entry. It is possible that providing response options may limit the amount of data in a referral or diminish the amount of freely composed referral questions. Future research may compare the differential information

yield between the two types of forms (structured and open-ended response) and solicit feedback from referral sources.

Second, a trend was found for an increase in requests for specific recommendations over the latter half of the sampling period. This suggests that as referral sources become aware of the data generated in a neuropsychological evaluation and the potential for practical suggestions for the clinical care of their patient or client, they become more likely to request these recommendations. In order to maximize the utility of the report for the referrer, neuropsychologists should avoid including only perfunctory recommendations. Review of a list of common requests for recommendations, such as that provided in Figure 23, while composing report recommendations will teach referral sources about the services available and maximize the benefit of the evaluation for the patient and the referrer.

Third, the most common type of referral request in the current study is for assistance in establishing a diagnosis, which has been also reported in surveys of both neuropsychologists and physician referrers. Differential diagnosis is a subtype of establishing a diagnosis that was found to be common in this study, and of these requests, assistance with psychiatric diagnoses was most common. There is convergent evidence that physicians tend to refer complicated cases for which they need diagnostic or differential diagnostic assistance. In these cases, it is not uncommon for unanticipated data or a complex social or medical history to take conclusions somewhat afield of what would have been anticipated at the outset of the evaluation. When composing the conclusion section of a report, neuropsychologists should refresh their memory about the content of the referral question to ensure that all of the concerns and requests of the

referral source are addressed. When diagnostic assistance is sought response to this request should be explicitly stated in clear language using diagnostic terminology that will allow the written report to directly address the referrer's and patient's needs. Conclusions and recommendations of the written neuropsychological report should be directly linked to what the referral question conveys about the needs of the patient and the referrer.

Fourth, there is evidence that there has been a decline in the usage of language tied to dualistic theories on mind-body and the unitary theory of brain damage. However, questions with psychiatric and other medical considerations continue compose a majority of differential diagnosis questions. Several explanations serve to account for the magnitude and long lasting nature of this challenge facing health care providers. Firstly, all patients with problems treated by multiple subspecialties present a problem of communication and cooperation in treatment planning to the medical team, and this is certainly true for those with psychiatric and other medical problems. Secondly, in the case of treating problems that are ancillary or apparently unrelated to a physician's subspecialty, a feeling of lack of experience may make a physician uncomfortable, which in extreme cases can lead to countertransference of this discomfort onto the patient and/or transferring care. Thirdly, a patient with psychiatric and other medical problems may differ with their health care provider about the interrelationship between their health and mental health problems. Fourthly, this differing view may reduce the adherence of patients to the treatment regimens proposed by their health care providers (particularly treatments directed at mental health problems not acknowledged as relevant by the patient), resulting in frustration on the part of all involved and "doctor shopping" for a different opinion. Lastly, as noted above in the discussion of mind-body dualism, there is

evidence of persistent attitudes that are irreconcilable with the current state of neuroscientific knowledge. In addition, our knowledge about the physiological basis of psychiatric disorders is arguably the weakest aspect of contemporary medicine. We are only beginning to fathom the relationship between mood problems and the experience of chronic pain, or the neural representation (and therefore largely crystallized nature) of personality and character, for example, and yet treatment of patients with poorly understood problems cannot be deferred. For all of these reasons, patients that fall in the awkward area of having problems of the mind and of the body are often referred for neuropsychological evaluation. It is important for each neuropsychologist and neuropsychological service to be fully and explicitly aware of all biases and preconceptions about the relationship between the mind and the body and how this manifests in the conceptualization of brain disease. Each service and health care provider should examine whether or not this idea is concordant with what is known about brain function while taking into account what is not yet known. It is recommended that such a discussion be facilitated in group meetings by discussion of the history of clinical neuropsychology and theories of mind and mind-body. Discussion questions for such a meeting are presented in Appendix 3.

Finally, in the current sample, referrals for reevaluations increased dramatically in the 2000s due to a new policy generating referral forms when a follow-up exam was recommended. However, an increase in reevaluation requests was noted before this policy went into effect. Comparison to prior data allows for greater precision in data analysis rather than using estimates of premorbid functioning based on hold tests. Following individuals over time improves increases the amount of data for making diagnostic

decisions as well as judgments about the efficacy of treatment. Tracking the proportion of recommendations for reevaluation that are completed and educating referral sources about the benefits of serial neuropsychological evaluation should increase the benefit to the patient and improve communication between consultant and referrer.

Implications for Training and Practice in Counseling Psychology

The inclusion of multicultural training across the curriculum in counseling psychology training programs has brought issues of linguistic and cultural diversity to the attention of trainees and instructors alike (Manly, 2008). The multicultural movement holds at its core that unexplored beliefs, conscious or unconscious, affect our interactions with everyone in our environment, including clients and patients. Multiculturally competent practice in psychological assessment is not achieved merely by acquiring the knowledge of what types of tests magnify stereotype threat, or the skill of conducting an assessment in a second language, to name just two examples. It is also important that personal awareness be pursued, not only of ideas about race, cultural, sexual orientation, and religion, but awareness of how we perceive individuals with particular diagnoses and labels, and how current scientific knowledge can be reconciled with popular views of the mind, the brain, and the body. Courses in psychological assessment can address this type of awareness by specifically assessing students' existing knowledge and beliefs about the relationship between the mind, the brain, and the body at the outset. Those beliefs can be compared to beliefs in the mainstream culture and examined in the light of scientific knowledge as the course progresses. For example, Damasio (1994) has masterfully discussed the persistent view in European-American culture that the mind and body are

separate to a great extent, and it is possible, if not likely, that trainees will hold some form of this perception as they enter their graduate training. The inseparability of the body, mind, and brain has implications for many aspects of counseling psychology from diagnosis to treatment. Attitudes, beliefs, biases, and symptoms alike must all be understood to exist in the mind, in the brain, and in the body or it is not possible to fully integrate the scientific knowledge gained in training with our own preexisting attitudes and beliefs from our own culture.

An important aspect of training in counseling psychology is addressing the needs of the client or patient as whole. In order to do this it is important that assessment culminates in concise conclusions and recommendations that communicate clearly to the referral source. Because the individual performing the assessment often a consultant, they are not in the position of following-up about any recommendations made in the report. The referral source will likely be the arbiter of which, if any, recommendations are followed. In order to maximize the possibility that recommendations are pursued, the recommendations should be specific, should follow logically from the results and conclusions presented in the report, and should be linked back to the original referral question. If a recommendation is viewed as vague, non sequitur, or is insufficiently operationalizable, it is likely to be dismissed or ignored. The recommendations should present the individual's needs in a holistic manner that will complement and be palatable to the perspective of the referral source. For example, physicians may need more information about the potential benefits of psychotherapy and social activities, while other psychologists may be helped by referrals for medical evaluation. Providing general references to research that supports a particular recommendation may provide added

weight (e.g., “research has supported the benefit of conjoint antidepressant medication and psychotherapy in treatment of refractory depression”). Writing relevant and useful recommendations can a difficult skill to master and should be addressed from the beginning stages of training in report writing and is a vital aspect of report review even for veteran practitioners.

APPENDIX A
SAMPLE REFERRAL FORM

Primary presenting problem: _____

Please provide a brief description of the reason for referral and any specific requests:

Reason for referral: (check all that apply)

_____ Assistance with diagnosis

_____ Assistance with differential diagnosis

Differential list: 1. _____ 2. _____ 3. _____

_____ Assessment of current functioning: evaluation of strengths, weaknesses, & any residual deficits.

Primary diagnoses: _____

_____ Assess the relative contributions of psychiatric and neurological or other medical factors

_____ Establish a cognitive baseline

_____ Compare to prior evaluation and assess interval change

_____ Dementia or memory evaluation

Provide recommendations regarding: (check all that apply)

_____ Suitability for an intervention

_____ Rehabilitation treatment planning

_____ Planned intervention: _____

_____ Capacity for work

_____ Capacity for independent living

_____ Psychotherapy treatment planning

_____ Driving

_____ Academic considerations

Cognitive	Mood/personality	Motor	Medical considerations	
Memory	Depressed mood	Falls	History of head injury	History of seizures
Attention	Anxious	Gait change	Cardiovascular disease	Family history of dementia
Executive	Personality change	Tremor		

functioning Language Processing speed Visuospatial	Substance abuse		Diabetes Sleep problems	History of stroke Chronic pain
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Other: _____

Brief symptom description (circle all that apply)

Additional Sx: _____

APPENDIX B

MOST COMMON REQUESTS FOR SPECIFIC RECOMMENDATIONS

1. Suitability for a surgical intervention (e.g., brain resection, DBS placement, transplant)
2. Capacity for independent living, need for supervision, and placement
3. Driving
4. Rehabilitation planning
5. Return to work
6. Disability/capacity for obtaining and maintaining gainful employment
7. Neurological and general medical treatments (
8. Academic planning and interventions
9. Psychotherapy – positive and negative treatment indicators and considerations for best match of presenting problem and personal style with type of treatment
10. Prognosis for recovery

APPENDIX C

SAMPLE QUESTIONS FOR DISCUSSIONS TO EXAMINE ASSUMPTIONS

ABOUT THE MIND-BODY RELATIONSHIP

1. How are the mind and body related?
 - a. Monistic
 - b. Dualistic
2. How is your personality represented in your brain?
3. Is every aspect of your behavior and personality determined by your neuroanatomy and neurophysiology? Or is this neo-post-modern determinism?
4. How does behavior modification take place? Synaptogenesis? Pruning? Neurogenesis? Neurotransmitter modulation?
5. How do you reconcile free will with crystallization of neural development and limited neurogenesis?

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