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# Neuropsychological Evaluation in Epilepsy Surgery – A Cross-Cultural Perspective

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## 1. Introduction

Epilepsy is a chronic neurological disorder that affects around 50 million people globally (Boer, et al., 2008; Meyer, et al., 2010). It is probably the most universal of all medical disorders, occurring in both men and women, and affecting all ages, races, social classes, and nations (Reynolds, 2000). In its report on epilepsy, the Eastern Mediterranean Regional Office (2010) of the World Health Organization (WHO) estimates that 85% of the 50 million cases of epilepsy worldwide are living in the 'developing countries', of which an estimated 4.7 million cases live in the WHO Eastern Mediterranean region that comprises 22 'developing countries', which extend from Morocco in the west to Iran in the east, and include Saudi Arabia the focus of this chapter.

The term 'developing country', however, warrants some verification in order to correct a misleading connotation associated with the countries that the term indiscriminately labels, leading to a false implication of homogeneity between these countries. The term is generally used loosely to describe a nation with a low level of material well-being. Since, at least in reality, no single definition of the term *developing country* is recognized internationally, the level of development may vary widely within the so-called developing countries. In fact, according to the United Nation Statistics Division, "There is no established convention for the designation of 'developed' and 'developing' countries or areas in the United Nations system". These terms are "intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process" (United Nation Statistics Division, 2008).

On the other hand, the developing countries have been strongly associated in the literature (Scott, et al., 2001; Meinardi, et al., 2001; Coleman, et al., 2002; Sridharan, 2002) with a high proportion of 'seizure treatment gap', a term defined as "the difference between the number of people with active epilepsy and the number of those whose seizures are being appropriately treated in a given population at a given point of time, presented as a percentage. The definition includes diagnostic and therapeutic deficits" (Meinardi, et al., 2001). The definition is said to propose a useful parameter to compare access to and quality of care for epilepsy patients across populations (Kale, 2002). The frequent link in the literature between high proportions of seizure treatment gap and the 'developing countries'

has formed a strong general impression that the estimated high proportions of epilepsy treatment gap in 'developing countries' is largely a function of the low-income and resource-poor economies of these countries (Meyer, et al., 2010; Mbuba, 2008). No doubt the adverse effects of a poor economy in some of such countries can affect the availability and quality of health care systems. Nevertheless, the case to be discussed in this chapter is that, other than an economic factor, there are diverse sociocultural realities and beliefs, as well as some indigenous customs and traditions, which prevail in some of such 'developing countries' with the consequent effects of significantly contributing towards the creation of a 'seizure treatment gap'.

Saudi Arabia is a vast country occupying most of the Arabian Peninsula, with a population of nearly 27 million who are entirely Muslims. All Saudi citizens speak Arabic. Nearly all the Saudi citizens are Arab, although there has been considerable ethnic mixture, especially in Al-Hejaz region, because of centuries of immigration connected with performing the rituals of Hajj, the fifth pillar of Islam. This rich oil-producing country is listed in the World Bank classification of world economies as a 'high income country', with a gross national income (GNI) of US\$ 24,020 per capita (World Bank, 2009). The country generally provides high standards in health care, and the medical technologies are continually upgraded. In addition, the governmental hospitals provide free medical treatment to all citizens. The country has a rate of 9.4 physicians and 21.0 nurses/midwives per 10,000 individuals (WHO, 2009). Accordingly, although it is often cited among the developing countries, Saudi Arabia can hardly be considered as a low-income or a resource-poor economy.

There is a scarcity in the published studies related to epidemiological and sociocultural dimensions of epilepsy in Saudi Arabia. A similar condition applies to studies on the role of neuropsychology in epilepsy surgery. Apart from Escandall's (2001) narrative account about neuropsychological evaluation in Saudi Arabia, no study so far has addressed the unique sociocultural features of the Saudi society in relation to the practice of neuropsychology in general, and the neuropsychological evaluation in epilepsy surgery in particular. However, epilepsy is a common neurological disorder in Saudi Arabia, as is the case with regard to other neurological disorders, due to the high rate of consanguinity (Jan, 2005; Abduljabbar, 1998). The published rate of prevalence of epilepsy in Saudi Arabia is 6.54 per 1000 population (Al Rajeh et al., 2001), which may help in approximating an estimate for seizure treatment gap in the country. It is argued that the country, based on its solid economic stand, is capable in principle of providing its epilepsy patients with adequate treatment including epilepsy surgery. The challenge is whether the cultural and social aspects related to epilepsy will facilitate or hinder optimal delivery of such care. One of the aims in this chapter, however, is to discuss the social and cultural variables that interact with the role of neuropsychological evaluation in epilepsy surgery being a viable management strategy for intractable focal epilepsies.

It is estimated that up to a third of all individuals with epilepsy are refractory to drug therapy, and surgery is widely accepted as an effective therapy for selected individuals with drug resistant epilepsy (Spencer and Huh, 2008; Helmstaedter, 2004). Despite major challenges, including a limited number of epilepsy surgery centers that are placed in one or two cities hence requiring patients to travel long distances to seek the service, the surgical treatment of epilepsy in Saudi Arabia has witnessed some notable advances in the last 10 years. Epilepsy surgery has scored considerable successes in the ultimate control of seizures

in focal epilepsies resistant to drug interventions. This chapter is built around a retrospective research work concluded this year in the comprehensive epilepsy surgery center of a tertiary medical institution that receives referrals of epilepsy patients from regional medical institutions in the country. Surgical resection procedures performed in the center for temporal lobe epilepsies represented two thirds of all epilepsy surgical operations, with the frontal lobe epilepsies ranking second in order of frequency. These figures are not different from those reported in other centers worldwide (e.g., Helmstaedter, 2004). The compiled data for this chapter came from the Adult Neurology section in the medical institution, and the discussion, therefore, is pertinent to patients of 16 years of age or older.

This chapter also deals with the role of neuropsychological evaluation as one of the primary presurgical evaluation modalities in epilepsy surgery programs. In doing so, the social and cultural aspects of epilepsy that may influence the practice of neuropsychological evaluation of this category of patients are reviewed. The ultimate cause of this work is to elucidate the need for developing an indigenous set of neuropsychological philosophy, material, and practice that are both evidence-based and reflective of social and cultural characteristics of the Saudi people. There is recognition that some important concepts and assumptions embedded in the neuropsychological testing material are derived from studies and experiences in the 'developed countries' and extrapolated to developing world practice. Such 'imports' are often proving to be inappropriate. One important factor behind this situation is that indigenous neuropsychological products of the developing countries are sparse, and what do exist may be sometimes of doubtful authenticity or originality. The account reported here in this respect is derived in most parts from hospital-based observations and clinical encounters, which are inevitably incomplete, and occasionally impressionistic. This and similar accounts may eventually pave the way to comprehensive data based on systematic reviews of sociocultural variables influencing epilepsy sufferers in the country.

## **2. The social and cultural aspects of epilepsy in Saudi Arabia**

There is generally limited data related to the developing countries on the social, psychological, and cultural aspects of epilepsy (Shorvon and Farmer, 1988; Boer, et al., 2008). In addition, data comes primarily from general surveys, which are less reliable than censuses or large-scale demographic and health surveys. There is a more obvious lack in the literature for data on the epidemiological and sociocultural aspects of epilepsy in Saudi Arabia. For example, obtaining systematic data on such aspects of epilepsy is particularly problematic due to the hard-core conservatism of most of the population of the country.

Saudi Arabia is governed according to the Islamic Sharia law whereby the Islamic orthodoxy and conservatism generally dominate the social and cultural mechanisms of the Saudi society. Traditional tribal principles and customs, however, remain significant in influencing a wide range of behavioral and attitudinal manifestations in the society. Accordingly, religious beliefs, social customs and traditions have both positive and negative impacts on epilepsy in this country. On the positive side, it is rare in Saudi Arabia that sufferers of chronic diseases or disorders find themselves abandoned by their families, regardless of the severity or burden of the ailments on either the patients or the families. Families, regardless of their financial capabilities, usually support their affected members. It is quite frequent to discover, while interviewing an adult patient with intractable epilepsy

since childhood (who, because of early onset epilepsy, has no education or a job) that he is being supported by family members into marriage and in raising his children over the years. This deeply rooted familial solidarity and generosity are frequently attributed to Islamic teachings and are reinforced by the traditional norms. This trend, however, is aided by the fact that necessities such as medical treatment and antiepileptic drugs are provided in governmental hospitals free of charge to all Saudi patients. Colleagues and superiors at a workplace also usually have understanding towards the needs of their co-workers who have epilepsy. In a clinic, many people with epilepsy on full-time jobs reported that their colleagues usually helped them by willingly covering their duties whenever they had their seizures at work. The bosses are also usually lenient with individuals with chronic diseases such as epilepsy, permitting them to keep flexible or shorter working hours. These accounts were the norm with the majority of epilepsy patients encountered in the clinical practice. It is not clear, however, if this widely reported positive support enjoyed by epilepsy patients at the workplace in Saudi Arabia is a function of a feeling of pity towards patients with epilepsy, or it is a psychosocial practice supported by a religious teaching. It is probably both.

Ironically, epilepsy in Saudi Arabia, on the other hand, is socially and culturally a devalued condition, similarly in other societies (Boer, 2008). The social disadvantage associated with epilepsy has its roots in the belief system of the society. Outside the family, a Saudi epilepsy patient and the members of his family may fear what people might think of the patient if a seizure occurs in the public. Such fear leads to noticeable efforts by the patient and his family to hide the disorder from the outsiders. Many of the epilepsy patients encountered in the clinic gave one of two reasons for why they quit school: either due to repeated school failures caused by cognitive impairment, or because of recurring seizures at school, leading to either dismissal by the school or withdrawal from school by his family to hide the fact of epilepsy in the family. After all, epilepsy is a socially sensitive and negative matter in this traditional society that over-values conformity to public norms, beliefs, and values. Related to stigmatization is the fact that epilepsy is often blamed solely on heredity. Attribution to hereditary processes is a common belief among many individuals in the Saudi society. Such an attribution often creates a social disadvantage for the patient with epilepsy, and probably for his or her healthy siblings as well, with regard to marriage prospects. In other words, the stigma occasionally extends beyond the individual to family members. It is interesting that some Saudi researchers (Jan, 2005; Abduljabbar, M. 1998) attributed the prevalence of epilepsy in Saudi Arabia to the high rate of consanguinity among Saudi people.

According to Islamic teachings, every disease of body or mind, including epilepsy, is attributed to the will of Allah (God) and to His wisdom. Probably very few Saudi individuals will dispute this belief. However, there is another widely prevailing belief that, for example in the case of epilepsy, the will of God dictates that a particular person be inflicted with a particular ailment, and the wisdom behind that only Allah knows. It is common, therefore, that some patients with epilepsy seek faith healing as the first line of intervention. Faith healers usually recite verses of the Holy Quran upon the patient who may be subjected to many sessions of faith healing over several days, weeks, or months. This trend is found among individuals from different socioeconomic strata in Saudi Arabia. Seeking faith healing to treat epilepsy in many developing countries is caused by the non-availability or non-affordability of medical treatments (e. g., Baskind and Birbeck, 2005). Seeking faith healing for treatment of epilepsy in Saudi Arabia, where medical treatment is available free of charge, is based on an indigenous belief system, rather than on economic or

availability factors. However, the precise impact of preference for faith healing on the seizure treatment gap in Saudi Arabia is unknown. Nevertheless, giving faith healing priority over medical treatment of epilepsy is believed to considerably delay the initiation of medical treatment for those patients. In the study reported in this chapter, nearly half of the patients in our sample reached the center for an advanced treatment of epilepsy after 15.4 years, in average, since the onset of their seizure disorder. Although the time of referral to the center may not be an accurate indicator in this respect, it gives an estimate about the possible role of sociocultural factors in influencing aspects of epilepsy treatment.

### **3. Neuropsychological evaluation in epilepsy surgery**

Neuropsychology and epilepsy has enjoyed a special relationship with mutual benefit to both (Loring, 1997). Neuropsychology has been involved with preoperative and postoperative evaluations of patients undergoing focal resection of a variety of brain regions to control their epilepsy (Novelly, 1992). Such an evaluation remains the best method of identifying and quantifying the nature and degree of cognitive malfunctioning that arises from epilepsy (Helmstaedter, 2004; Jones-Gotman, et al., 2000), and it provides information that other assessment modalities, such as electroencephalography and magnetic resonance imaging, do not provide (Jones-Gotman, et al., 2000). Evaluating cognitive abilities is an important part of the comprehensive presurgical clinical workup in epilepsy surgery programs. The primary function of neuropsychology in epilepsy surgery, then, is the evaluation of epilepsy-related, or lesion-related, impairments before surgery in the direction of functionally defining possible focus or foci of the epileptogenic zones in the brain. The second, and equally important, function is to employ neuropsychology as a tool for assessing a surgical treatment outcome.

Epilepsy causes a set of cognitive impairments in people with epilepsy. Memory impairment of various severities is an important cognitive problem in patients with epilepsy, especially in temporal lobe epilepsy. Epilepsy affects learning, for example, by reducing alertness and by interfering with short-term information storage and abstraction. Frequent and uncontrolled seizures impair learning of new information, disrupt consolidation of memory, and affect language functions. Cognitive impairments can also be a side effect of the various antiepileptic drugs used to control seizures. Such drugs are associated with learning difficulties, behavior changes, and memory deficits (Meador, 2006; Motamedi and Meador, 2004; Ortinski and Meador, 2004; Brunbech and Sabers, 2002; Aldenkamp, 2001; Kwan and Brodie, 2001; Devinsky, 1995). People with intractable seizures endure the additional burdens of social discrimination, stigmatization, social embarrassment when seizing or falling in public. As with any chronic condition, epilepsy can be linked to demoralization and a negative perspective on life and to disturbances of affect and mood (Baker, 2002).

The above combination of potential symptoms is what a clinical neuropsychological assessment may encounter during a presurgical evaluation of patients with intractable epilepsy considered for surgical intervention. As such, a neuropsychological testing for a pre-operative evaluation in epilepsy surgery consists, by necessity, of a battery of tests, not just one test. A typical neuropsychological assessment, thus, consists of a comprehensive evaluation of cognitive functioning that includes intelligence, executive skills, memory, attention, visuospatial abilities, language, and motor skills. Different epilepsy centers use

different tests. Apart from a neuropsychological battery for epilepsy proposed by Dodrill more than 30 years ago (Dodrill, 1978), there is not an established battery of tests that is designed and calibrated for the sole purpose of presurgical neuropsychological evaluation of patients with epilepsy. However, the question of which tests are used in epilepsy presurgical evaluation, and according to what protocol these tests are administered, is discussed below while reviewing three major neuropsychological assessment approaches. These approaches, which developed over the long history of the discipline, have informed the practice of clinical neuropsychology.

The *behavioral neurological approach* is European in origin, and it is best reflected in the Luria-Nebraska neuropsychological battery (Luria, 1973). It relates distinct functional abnormalities (signs) to neuropsychological entities (conditions; syndromes). A sign is a dichotomous state, being either present or absent, and there is no continuum of performance between the 'normal' and the 'pathological'. The patient either passes or fails the test. This approach requires a skilled clinician, depending heavily on identification of valid and easily assessable signs as indicators of abnormal function.

The *psychometric approach* is North American in origin. A psychometric example for this approach is the Halstead-Reitan neuropsychological test battery (HRB; Reitan and Wolfson, 1986). The HRB involved Reitan's observations that the relationship between tests differed in patients with different kinds of pathology. Therefore, in a pattern analysis method, the neuropsychologist is concerned with the interpretation of test performances as an index of neuropsychological functioning. This approach, accordingly, uses a number of batteries that survey a broad range of psychological functions. Then, it draws conclusions from the detailed pattern of results, employing psychometric methods. It is a thorough and systematic approach. However, this approach takes significant clinical time, and it is inflexible in its application to individual patients (Horton, 2008). One obvious limitation of such a method is exposed in unique cases for which there are no significant patterns of performance established. This limitation imposes serious problems when the battery of tests is employed in multicultural settings to assess individuals who are not represented in the normative sample on which characteristics the tests have been developed.

Approaches that employ a fixed set of tests have been criticized on the ground that neuropsychology is not a "one size fits all". That is, the use of a standardized fixed battery approach has the potential disadvantage that a particular set of tests may be inappropriate for particular patients (Horton, 2008) for a variety of reasons. On the other hand, several researchers in the field of cross-cultural neuropsychology (e.g., Artiola, et al., 1997) have been outspoken critics of those who would simply take existing measures and attempt to transform them into a foreign language measure without adequate understanding of the second language or the prevailing culture in which the test will be used. Artiola, et al. (1997) emphasized that the relevant literature afford numerous examples of how well intended practitioners have erroneously assumed that tests that work for a typical North American cohort should be adequate for use with samples or individuals that differ in important ways.

As the practice of neuropsychology became more entrenched in the clinical settings, another major division in neuropsychology occurred as a function of the kind of battery or method employed by clinical neuropsychologists. Russell (1997) described the fundamental

distinction between current schools of thought as adhering either to 'pattern analysis' or 'hypothesis testing' methods. Hypothesis testing assessments are driven by a series of individual hypotheses to be tested with regard to neuropsychological functioning in an individual patient. The *individual-centered normative approach* is originated in the United Kingdom, and it adheres to the 'hypothesis testing' school. This approach employs specific tests, combined flexibly in the investigation of a hypothesis about the patient's difficulties. It is a scientific detective work rather than medical examination (as in the behavioral neurological approach) or formal assessment (as in the psychometric approach). This approach utilizes a general initial screening procedure (e.g., the Wechsler Adult Intelligence Scale), in addition to the current clinical information about the patient, to construct hypotheses about present deficits, which are consequently tested using individual test procedures or single-case empirical investigations. This approach requires unusually high knowledge and expertise on the part of the clinician. On the other hand, the hypotheses generated are largely a function of the individual neuropsychologist's knowledge base. This, unfortunately, can lead to a considerable lack of uniformity in the assessment product. That is, if the individual administering the tests does not ask a question, it probably goes unanswered. Obviously, this approach requires from the neuropsychologist an adequate understanding of the language and the culture of the individuals being examined.

From a technical perspective, neuropsychology has undergone evolutionary changes since the initial involvement in epilepsy surgery at the Montreal Neurological Institute. Neuropsychological findings were used to help in identifying suitable candidates for surgery, deciding whether Wada testing was necessary, and to determine surgery outcome in terms of postoperative cognitive changes. Despite of the development of better technologies, such as structural imaging capability, sophisticated electroencephalography including video monitoring, and refinement of Wada test, neuropsychology has continued to provide quantitative measurements of cognitive abilities and, thus, to contribute to the evaluation, management, and surgery outcome issues of epilepsy surgery patients (Spencer and Huh, 2008; Tellez-Zenteno, et al., 2007; Loring, 1997).

#### **4. Cross-cultural issues in neuropsychological evaluations**

The ability to localize impairment on the basis of neuropsychological performance is dependent upon the sensitivity and specificity of the tests employed for that purpose (Jones-Gotman, et al., 2000). In addition to appropriate psychometric properties, such tests need to be void of cultural biases in order to allow an accurate categorization of a patient's deficits. The WMS-III and the WAIS-III were adapted and validated in Saudi Arabia using primarily clinical samples (Escandall, 2002). Apart from the shortcoming of lacking validation with normal subjects (Escandall, 2002), the use of these scales in a cultural setting such as Saudi Arabia, whose population is significantly different from the normative population upon which these scales were originally developed, imposes important problems. These tests have been developed and validated with primarily non-Muslim white Western normative cohorts and, therefore, there always is the fear that some differences in test performance may not be directly attributable to differences in brain functioning but rather a reflection of test biases (Gasquoin, 1999). In fact, within the standardization samples of the WAIS-III and the WMS-III, African American and Hispanic subjects scored lower than Caucasian subjects, and that the African American subjects were more likely than other groups to be misclassified as

impaired using a cut-off score of 1 SD below the mean (Heaton, et al., 2003). Cultural differences on the Wechsler scales have also been demonstrated in patient groups (e.g., Boone, et al., 2007). Most of these studies have been conducted with cultural groups such as African American and Hispanic subjects, which are prominent in North America and have been educated in the West with proficient English language skills, yet the cultural differences have impact on their neuropsychological test performance. Obviously, cultural differences entail much more factors than just a different language. Several definitions have been given to the term 'culture'. Handwerker (2002) states that 'culture is an arrangement of cognition, emotion, and behavior', while Padilla (1999) defines culture as similar thoughts, feelings, behaviors including, but not limited to, traditions, customs, and ways of life. Defined as the way of living of a human group, culture includes also values, attitudes, and beliefs (Harris, 1983). In addition, the physical elements characteristic of a particular culture (such as, in Saudi Arabia, traditional weapons such as swords, houses including desert tents, animals such as camels, characteristic male and female dress, traditional hobbies and games played by children or adults) are cultural elements and are also included in the definition of culture. Some researchers (e.g., Ardila, et al., 2000) include education, literacy, and schooling as element of culture, since both culture and formal education have significant effects on cognition (Cole, 1997).

There have been numerous attempts over the years to construct psychological testing measures that would be "culture free" (see, e.g., Anastasi, 1988). There has been evidence that culture-bias cannot be controlled only by eliminating verbal items from a test (Anastasi, 1988; Irvine and Berry, 1988). In fact, also the nonverbal tests may be culturally biased (Rosselli and Ardila, 2003). It has been observed in our neuropsychological practice in Saudi Arabia that a task involving drawing or copying figures of various level of complexity on paper using a pencil (as in the Visual Reproduction subtest of the WMS-III; the Complex Figure Test) can represent an enormous task for, for example, a rural illiterate healthy lady in her forties or fifties who has never touched a pencil in her life. Such a task for normal individuals in the Western societies is effortless. Such a task surely requires more than just some motor coordination. Non-verbal tests often require specific strategies and cognitive styles characteristic of middle-class Western cultures (Cohen, 1969). The notion that the performance of some nonverbal tasks, such as drawing a map or copying figures, in neuropsychological assessment are universal skills of most normal adults (Lezak, 1995), is contrasted with the argument that drawing a map or copying figures represent abilities that are absent in many cultures (Ardila and Moreno, 2001; Berry et al., 1992; Irvine and Berry, 1988). In addition, such abilities are argued to be highly school-dependent skills (Ardila, et al., 1989).

Given the fact that language is an ultimate cultural element, the translation process of a neuropsychological test from one language to another may raise a host of issues, including copyright, literal versus cognitive and emotional equivalence, and norms. Often the items are translated literally without their culturally correct equivalents, thus limiting their validity (Salazar, et al., 2007). Even when a test is properly translated, it means a little without an appropriate normative data. Related to this point is a situation whereby the neuropsychological evaluation is administered through a translator due to a language barrier between the neuropsychologist, or the examiner, and the individual evaluated. It poses ethical issues as well as testing validity concerns. There are, unfortunately a few neuropsychological tests in Saudi Arabia that were originated in the West, then literally

translated into Arabic language in other countries, apparently without author permissions, and eventually found their way to be used in the clinic with Saudi patients. Such practices have caused, among many other problems, an obstacle in the face of consolidating the efforts towards constructing indigenous Saudi neuropsychological tests.

There are important differences between the Saudi culture and the North American culture within which these tests have been developed and validated. For example, the rate of literacy (defined in terms of ability to read and write among ages from 15 and over) in Saudi Arabia for the total adult population is 85.5% (WHO, 2008), compared to 99% in the United States (2004). However, the concept of 'functional' illiteracy determines that any person with less than five years of schooling is considered functionally illiterate, or unable to engage in social activities in which literacy is assumed (UNESCO General Conference, 1978). By either definition of literacy, illiteracy rate is expected to be much higher among patients with intractable seizure disorder in Saudi Arabia, due to various reasons preventing them from seeking or continuing education, such as cognitive difficulties, stigma, and other psychosocial factors. Individuals with minimal or no formal schooling are believed to be disadvantaged with regard to neuropsychological test performance, especially when such tests are validated for a culturally different normative population. Several studies (e.g., Ardila, et al., 1989; Ardila, et al., 1992) have shown strong association between educational level and performance on various neuropsychological measures. The effect of schooling on neuropsychological test performance has been reported for various types of abilities including memory, language, problem solving, constructional abilities, motor skills, and calculation abilities (Ardila, et al., 1989; Rosselli, et al., 1990; Lecours, et al., 1988). Ostrosky and his colleagues (1998), in a study to analyze the effects of education on neuropsychological test performance across different age ranges, they compared 64 totally illiterate normal subjects with two barely schooled control groups (1-2 and 3-4 years of schooling). They found a robust education effect on most of the tests, including constructional abilities (figure copying), language (comprehension), phonological verbal fluency, and conceptual functions (similarities, calculation abilities, and sequences). They concluded by calling for caution with the education variables in neuropsychological assessment in order to avoid the risk of finding brain pathology where there are only educational differences.

The Family Picture subtest of the WMS-III has deservedly received frequent criticism in the literature for failing to assess its intended non-verbal memory construct, since the test content to be memorized can be verbally mediated (Djordjevic and Jones-Gotman, 2004). This subtest is comprised of pictorial representations of four different scenes containing members of a family including their dog. The four pictorial representations themselves contain items and acts that can be shown here that they are culturally biased. For example, the first scene (the Picnic) contains Frisbee play, which is a flying disc play that about 90% of Americans have played it at one time or another in their life (Malafronte, 1998). This recreational play, which is essentially an outdoor play, is by no means familiar among the bulk of Saudi population, whether as a physical item or as a game. It is not seen played in this country by Saudi nationals, probably due to environmental reasons since the weather is extremely hot during most of the year. Therefore, most of the patients who completed the Family Picture subtest gave different, occasionally funny, responses when prompted at the recall phase. One of the frequent responses given by some patients was that the grandfather was throwing a piece of meat to the dog! The few patients who did recognize a Frisbee were

in fact those who had seen or even played the game during their frequent travels abroad. A Frisbee game is probably a familiar practice in the Western countries and, being featured as a stimulus item in a memory test, may represent in such countries a culturally familiar scene that may aid both memory consolidation and subsequent recall. Further, the third scene (the Yard) in the same subtest involves a family member giving the dog a bath. Dogs in Saudi Arabia, at least among most of the mainstream social strata, do not enjoy the same preference or intimacy that these creatures receive in Western societies. For example, it is very unlikely that an average Saudi individual considers a dog as a member of the family. The Islamic teachings prevent harming animals, dogs included; in the same time, these teachings discourage the Muslims from keeping dogs in the houses where they live, because they can violate the purity of the living quarters, where the household live and pray, by their urine, saliva, etc. Accordingly, dogs are rarely found in the houses of Saudi individuals, let alone to give a dog a bath in public. It was noticed, during testing for this subtest, that the common practice among the vast majority of patients examined was to ignore mentioning the dog altogether, leaving the door open for guessing whether it was a recall failure or just disregarding the dog as a culturally dictated response. In general, the unsuitability of the use of pictorial representations, such as in Family Picture and Faces, has been reported in the literature (Miller, 1973). For example, the problem confronted by a neuropsychologist in Saudi Arabia when administering the Faces subtest has a religious background. Since the faces used in this subtest are real life pictures, several patients refused or were very reluctant to look at the faces that were for adult females, emphasizing that their religion prohibited looking at foreign women (a foreign woman is a woman who does not belong to one of the categories of women a muslim is prohibited by the Islamic Sharia law from mating, including sisters, aunts, mothers-in-law, etc.), unless it was an accidental glance and only once. It would have been probably acceptable for such patients if all the faces used in this subtest were for men and/or children.

## 5. Neuropsychological evaluation: A Saudi experience

The practice of neuropsychology within the context of the Comprehensive Epilepsy Surgery Program (CESP) has been informed by the individual-centered approach. This approach is deemed flexible enough to allow the introduction of new individual tests that are locally developed and standardized for clinical use. It is considered also efficient in focusing on targeted areas of dysfunction. It can be finely tuned to investigate the exact parameters of abnormal performance. As stated earlier, temporal lobe epilepsies formed a majority of epilepsy conditions that the center received and treated. Therefore, a version of the Wechsler Memory Scale (Wechsler, 1945), which is the most common test battery used to evaluate learning and memory in individuals with epilepsy (e.g., Walker, et al., 2010; Loring and Bauer, 2010), had been used extensively in the presurgical neuropsychological evaluations. The main components of the evaluation protocol adopted in this use are outlined below.

The *clinical interview* plays a central role in the individual-centered approach towards obtaining demographic data, accounting for a possible impact of behavioral and emotional malfunctioning on a patient's cognitive performance, and capturing a longitudinal personal history that, along with the *general cognitive screening procedure*, facilitate the categorization

of patients' specific and/or hypothesized cognitive deficits and impairments. The clinical interview took the shape of roughly two portions:

- a. An initial part, which was dedicated mainly for understanding a patient's status, collecting demographic data, and explaining the purposes of current and subsequent clinical encounters. The demographic data collected include age, education, geographic origin, handedness, age of seizure onset, family history of epilepsy, frequency of seizures, etc. A patient's relative was usually present, and was occasionally allowed to attend this initial part of the interview depending on the state of the patient.
- b. A subsequent part, which was aimed at obtaining and verifying the cognitive complaints of the patient, and any psychological problems related to mood, interpersonal difficulties, etc. This second part of the interview, and the subsequent testing sessions, involved the patient alone.

The general screening adopted in this study involved administering both the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III; Wechsler, 1997a) and the Wechsler Memory Scale – Third Edition (WMS-III; Wechsler, 1997b) on all patients referred for presurgical neuropsychological evaluation. The exception was the group of patients who failed to complete the evaluation due to significant cognitive impairment.

Memory, being a temporal lobe function, is routinely evaluated in patients with epilepsy undergoing presurgical evaluations. An international survey of 82 epilepsy surgery centers found that 84% of centers routinely administered all or part of the WMS or the WMS-R in their pre-operative evaluations of epilepsy (Jones-Gotman, et al., 1993). On the other hand, some degree of intellectual decline is expected in patients with recurrent seizures for relatively long durations of their life. Therefore, an assessment of intellectual capacity in such patients usually forms an essential part of their neuropsychological profiling and hypothesis testing.

In this study, various neuropsychological tests were used to verify the findings that were obtained using the WAIS-III and the WMS-III. They include Wisconsin Card Sorting Test-64, Rey-Osterrieth Complex Figure Test, Verbal Fluency Test, Beck Depression Inventory, and Epstein-Fenz Anxiety Scale. However, the data presented here were limited to the subtests from the WMS-III and the full-scale IQ (FSIQ) derived from the WAIS-III, being the tests common to all patients in the sample.

The pre-surgical investigations involved the administration of intracarotid amobarbital procedure (ICAP), or Wada test, to determine language dominance in patients suspected of having atypical representation of language. Most of the patients, however, underwent an ICAP to assess memory in conditions with bilateral temporal lobe structural anomalies and/or neuropsychological test performance showing depressed verbal and nonverbal memory test scores. The standard Wada test protocol in the center entailed bilateral testing, whereby the suspected hemisphere was injected first. The protocol required the patient to be admitted the day before the date of the procedure. The one-night inpatient stay allowed adequate time for educating the patient on the proposed invasive procedure, and for obtaining an informed consent from him or her. Quite frequently, the informed consent had to be processed with the relative accompanying the patient or with both. The process of consenting for an invasive procedure such as the Wada Test is usually a family, not an

individual, decision. Almost all patients admitted to the Epilepsy Monitoring Unit (EMU) are accompanied by a close relative who stays with the patient throughout the duration of admission. The practice of admitting patients for one night for Wada testing was informed by past experience that reinforced the importance of adequate preparation of patients and key relatives ahead of the procedure.

The patients included in this study were individuals with the diagnosis of a seizure disorder resistant to a drug therapy. Patients were referred from general hospitals in the country to the CESP for advanced management of their seizure disorder, where they were considered for epilepsy surgery intervention based on their clinical semiology and results of their presurgical investigations. These investigations were performed by different services in the hospital (i.e., Neurophysiology Section, Radiology Department, and neuropsychology service in Psychiatry Section). The inclusion criteria for this study were: (a) epilepsy was resistant to drug treatment; (b) the patient was an adult (16 years old or older); and (c) the patient had valid results in the four presurgery evaluation studies, namely: magnetic resonance imaging (MRI), positron emission tomography (PET), neuropsychological evaluation (NP), and ictal electroencephalography (iEEG).

From over 600 entries in the database, there were 330 adult patients with completed neuropsychological evaluations. Some of the excluded entries involved cases with the final diagnosis of pseudoseizure or uncompleted presurgical evaluations. Few patients failed to show up at their follow-up appointments for completing their neuropsychological evaluation. However, the final number of patients with valid sets of NP data and MRI, PET, and iEEG findings at the time of analyzing the data was 133 patients.

Patients were admitted to the EMU of the CESP from a waiting list. A CESP coordinator handled the referral of patients in the list to relevant services, and arranged hospital admissions of patients for EEG video monitoring. The patients received neuroimaging and neuropsychological evaluations, and other necessary investigative procedures, after their video monitoring was concluded. Neuropsychological evaluations were blinded from other presurgical evaluation results. A neuropsychologist administered and interpreted the neuropsychological evaluations of all patients in the sample. A research assistant then entered the neuropsychological data in a purpose-built computer database program, named “The Neuropsychology Database”, which contained the data for all patients referred for neuropsychological evaluation from the CESP. The patients included in this report were those encountered in the period from July 2006 to July 2009 (during which one neuropsychologist performed all the evaluations) and satisfied the inclusion criteria stated above.

In summary, the outlined social, cultural, and ethnic characteristics of the Saudi population were expected to produce important implications on the neuropsychological test performance of the Saudi patient sample. This prediction was based on the fact that the test material involved were originally designed and standardized for use in a potentially different cultural context and with individuals having different cultural characteristics. Despite of the previous standardization work on these tests, there were still some salient aspects of cultural bias, as described above, that were expected to influence the ability of these tests in efficiently characterizing patient performances. The general purpose of the study, then, was to elucidate these implications by using the tests with a group of Saudi epilepsy patients in a presurgical neuropsychological evaluation, and then to examine their scores on these tests against the findings obtained for the same

group of patients using other presurgical evaluation studies (i.e., MRI, PET, and iEEG). The specific objectives for this study were:

1. To examine the amount of agreement between the neuropsychological evaluation and PET, MRI, and iEEG findings iEEG in identifying the epileptogenic brain areas in presurgical evaluation of patients with intractable epilepsies.
2. To examine whether the scores obtained using the WMS-III were capable of differentiating the three patient groups with three categories of epilepsy: Temporal lobe epilepsy, frontal lobe epilepsy, and other epilepsies.
3. To examine whether the scores obtained using the WMS-III were capable of differentiating a subgroup of TLE patients with right and left temporal lobe foci.

The sample of 133 patients included 97 (72.93%) males and 36 (27.07%) females. The mean age of the sample was 27.5 (SD = 7.6) years and the mean educational level was 9.9 (SD = 4.4) years. The mean age at the onset of seizures was 10.7 (SD = 8.4) years, while the mean duration between seizure onset and time of evaluation was 15.4 (SD = 8.3) years. The mean WAIS-III FSIQ was 71.9 (SD = 12.6). A demand to interview and test a patient alone sometimes met with objections from patients’ relatives, especially those of female patients, who frequently demanded to be present during both the interview and testing sessions. Other patients began the interview with feverish objection to being referred to a ‘psychic’ clinic. Almost always, an on-the-spot counseling and explanation were successful in defusing the dismay of such patients’ relatives.

The 133 patients were classified, according to the brain lobe of their seizure origin, into three groups: temporal lobe epilepsy (TLE), frontal lobe epilepsy (FLE), and epilepsy originating in a brain area other than the temporal or frontal lobes (Other). The characteristics of the patients in each of the three groups are presented in Table 1. A comparison of groups according to demographic variables revealed no significant differences in group-composition for age, years of education, age at seizure onset, duration since seizure onset, FSIQ, gender, or hand dominance.

Group	N	Age (years) M (SD)	Education (years) M (SD)	FSIQ (WAIS) M (SD)	OnsetAge (years) M (SD)	Epilepsy Duration M (SD)	Gender		Handed.	
							M	F	R	L
TLE	90	28.21(7.81)	9.76(4.38)	72.49(12.75)	10.50(8.42)	16.22(8.17)	62	28	75	14*
FLE	12	27.08(8.54)	10.58(4.71)	67.82(11.79)	12.18(10.05)	17.75(8.28)	08	04	10	02
OTHER	31	25.58(6.36)	9.94(4.44)	71.81(12.78)	10.72(7.76)	12.29(8.18)	27	04	24	02
TOTAL	133	27.50(4.39)	9.87(4.39)	71.90(12.65)	10.71(8.36)	15.44(8.32)	97	36	109	23

TLE = Temporal Lobe Epilepsy - FLE = Frontal Lobe Epilepsy - Other: Epilepsies originating in brain lobes other than temporal or frontal (include: occipital & parietal lobe epilepsies, generalized epilepsies, and unclassified epilepsies with secondary generalized semiologies) - FSIQ = Full-scale Intelligence Quotient - WAIS = Wechsler Adult Intelligence Scale - Third Edition.  
\* = One male patient in this cell was not included because he was ambidextrous.

Table 1. Characteristics of Patient Groups

A caution is necessary when handling information given by patients about their age, education, and occupation in Saudi Arabia (see Escandall, 2002). An approximation of the patient’s age is frequently given, which is often inconsistent with other chronological items

of personal history, such as years of education or age of seizure onset, given by the same patients. Knowing this cultural factor, a clinician needs to skillfully and politely probe the best age approximation, especially with patients in their 40s or elder and/or of minimal formal education. With respect to educational level, it was noticed that an educational level given by a patient might be misleading. Sometimes, the figure given as the years of schooling might represent the number of years spent in grade one after which the patient was dismissed from the school or he quit. Such incidents were particularly often with patients from rural communities. One striking example was that of a patient who, during an interview, was found to have a primary school education, only to discover during testing that he was illiterate. In brief, education and occupation often did not correlate with the actual intellectual abilities assessed in the clinic. Such realities emphasize the importance of a thorough and careful clinical interviewing of such patients by a practitioner who is both familiar with the unique sociocultural variables of the population and proficient in the language of the people. The patients were classified, following the definition of the UNESCO (1978) for a functional illiterate (= any one with less than 5 years of formal schooling), into literates and illiterates. There were 114 (85.71%) literate patients and 19 (14.29%) illiterate patients. The chi-square test results (chi-square = 0.5141; DF = 2; p = 0.7733) indicated that there was no significant group difference in literacy. The group distribution on the literacy variable is presented in Table 2. The overall percentage of literate patients in the sample (85.71%) is similar to that for the adult population in Saudi Arabia (85.5%).

Education	TLE	FLE	Other	Total
Illiterates	14 (10.53%)	01 (0.75%)	04 (03.01%)	019 (14.29%)
Literates	76 (57.14%)	11 (8.27%)	27 (20.30%)	114 (85.71%)
Total	90 (67.67%)	12 (0.02%)	31 (23.31%)	133 (100.00%)

Table 2. Illiteracy Level in Epilepsy Groups

Regarding handedness, 109 (81.95%) patients claimed to be right-handed, whereby 23 (17.29%) declared themselves left-handed, and just one patient (0.75%) regarded himself as ambidextrous. Based on subsequent Wada test procedures, 124 (93.23%) patients were left hemisphere dominant for language functions, and 8 (6.01%) patients were right-hemisphere dominant. A single patient (0.75%) was proven by a Wada test procedure to have language functions in both hemispheres of the brain. These findings show that the number of patients in the sample who claimed to be left handed (N = 23), an attribute that was believed to be culturally and religiously unfavorable, was in fact higher than the number of patients with Wada-proven right hemisphere language dominance. The self-reported handedness compared with Wada-proven hemispheric language dominance of the sample is presented in Table 3.

Handedness	Hemisphere Dominance			Total
	Right	Left	Both	
Right-handed	2	106	1	109
Left-handed	6	17	0	23
Ambidextrous	0	1	0	1
Total	8	124	1	133

Table 3. Self-reported Handedness versus Wada Proven Hemispheric Language Dominance of the Sample

The types of seizure encountered in each of the three patient groups are presented in Table 4. The chi-square test performed (chi-square = 75.8544; DF = 26;  $p < 0.0001$ ) showed significant difference between the three groups in terms of seizure types. In fact, 77.78% of the seizures in the TLE group were complex partial, which represents 52.63% of all complex partial seizures accounted for in this patient sample.

The temporal lobe epilepsies represented two thirds (67.67%) of epilepsy syndromes of the patients encountered in this Saudi sample, followed by frontal lobe epilepsies that mounted to 9.02% of the total number of patients. Other epilepsies represented 23.31% of all cases. The classification figures of epilepsies encountered in this center are not claimed to be a representation of the prevalence rates of epilepsy types in Saudi Arabia. In fact, there has been a bias in favor of temporal lobe epilepsies among the total number of referrals to this center. This bias is probably related in someway to the fact that temporal lobe epilepsy is globally the most common epilepsy syndrome (Weibe, et al., 2001), and that its resection procedures make up about two thirds of all operations (Helmstaedter, 2004).

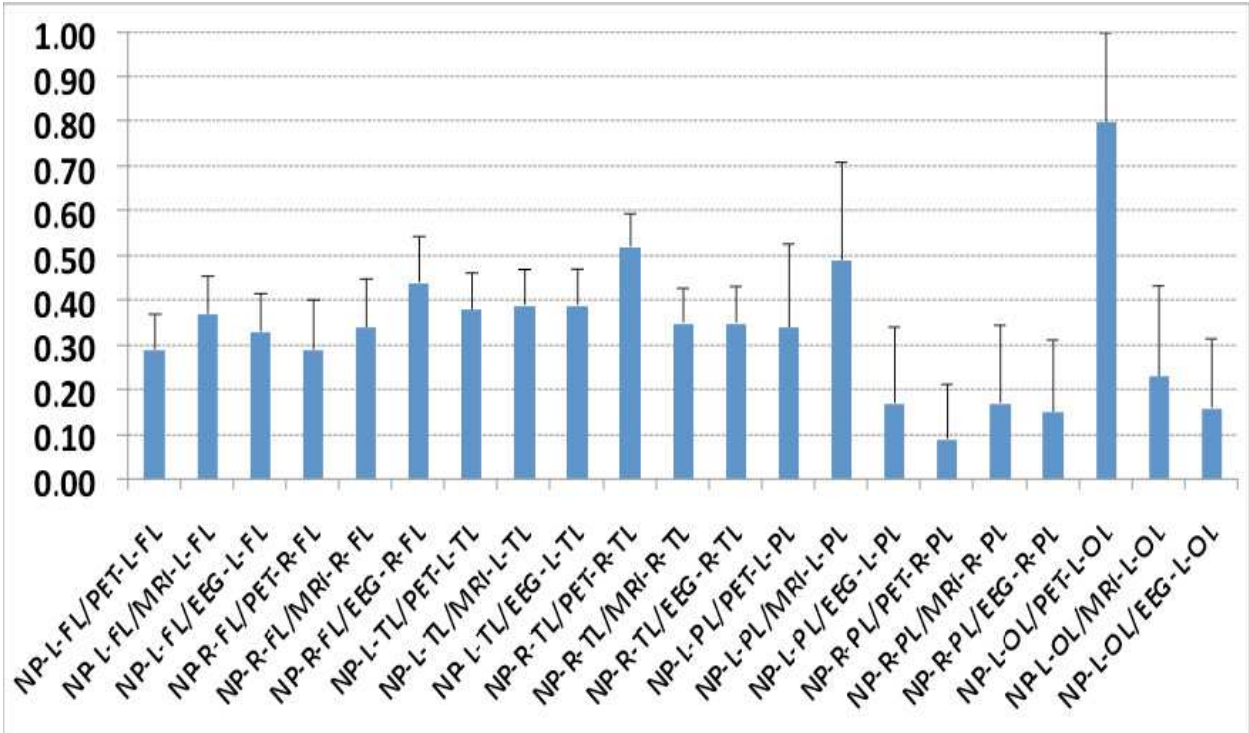
Seizure Type	TLE N (%)	FLE N (%)	Other N (%)	Total
Complex Partial	70 (52.63%)	05 (3.76%)	14 (10.53%)	89 (66.92)
Simple Partial	05 (3.76%)	02 (1.50%)	05 (3.76%)	12 (09.02)
Tonic-Clonic	13 (9.77%)	05 (3.76%)	10 (7.52%)	28 (21.05)
Other	02 (1.50)	0	02 (1.50%)	04 (03.01)
Total	90 (67.67%)	12 (9.02%)	31 (23.31%)	133 (100.00)

Table 4. Classification of Seizure Types in the Patient Groups

Hereditary was reviewed as a possible risk factor among this sample of epilepsy patients. There were 45 (33.83%) patients who had at least one first-degree or second-degree relative with epilepsy, while 88 (66.17%) patients had no family history of the disorder. Among the patients with positive family history of epilepsy (N=45), 31 (68.89%) of them were temporal lobe epilepsy patients, compared to 14 (31.11%) patients with frontal lobe or other extra-temporal epilepsies.

5.1 Relative agreement between presurgical evaluation modalities

The amount of agreement between the four evaluation modalities (i.e., NP, PET, MRI, and iEEG) in identifying the lobe impaired by epilepsy in the patient sample was examined by computing kappa statistics. The results presented in Figure 1 show the relative amount of agreement between each two methods of evaluation on each brain lobe in the left and the right hemispheres. The figure indicates a moderate amount of agreement achieved between NP and both PET and MRI modalities (kappa values are around the 0.5) in identifying left temporal lobe involvement. The agreement amount between NP and iEEG in identifying frontal lobe involvement is even smaller (kappa = 0.43). However, other amounts of agreement between the evaluation modalities are of low magnitude (kappa < .40). The high amount of agreement pertinent to the left occipital lobe area is probably misleading since a very small number of patients had an occipital lobe seizure focus.



Legend: NP = Neuropsychology - PET = Positron Emission Tomography - MRI = Magnetic Resonance Imaging - iEEG = ictal Electroencephalography.  
L-FL = Left Frontal Lobe - R-FL = Right Frontal Lobe - L-TL = Left Temporal Lobe -  
R-TL = Right Temporal Lobe - L-PL = Left Parietal Lobe - R-PL = Right Parietal Lobe -  
L-OL = Left Occipital Lobe - R-OL = Right Occipital Lobe.

Fig. 1. Amount of Agreement between the Four Raters (NP, PET, MRI, and iEEG) across the Four Lobes of the Brain Bilaterally.

The accurate neuropsychological localization of dysfunction is a function of several factors. Sensitivity and specificity of tests used (Jones-Gotman et al., 2000) is one of such factors. The already outlined cultural biases in the tests used in this study can partially explain the relative accuracy of results presented here. However, other factors not accounted for in the study, such as the differential impact of prolonged use of antiepileptic medications, or practically difficult to control, such as the factual level of literacy, may contribute to the varying neuropsychological performance of the patients in the sample and, hence, influence the localization accuracy.

5.2 Group differences across WMS-III indexes, subtests, and discrepancy scores

ANOVA procedures were computed to analyze group differences in the WMS-III Primary Indexes and Subtest raw scores (refer to Table 5 for the labels of these indexes and subtests). There were no significant differences between the three groups on any indexes or subtest scores. These results are not quite surprising for two reasons. First, the ability of the WMS-III to distinguish Saudi patients with temporal and non-temporal lobe epilepsies based on their memory scores has been disputed on cross-cultural considerations. Second, each of the three study groups contained patients with left and right hemisphere epileptic foci and, therefore, group differences on the primary indexes and subtest scores may be affected by ‘within group’ differences. This latter assumption was examined in the next

section below after the TLE group was divided into right (RTL) and left (LTL) temporal lobe subgroups. Discrepancy scores were calculated by subtracting the Visual Memory Index from the Auditory Memory Index, and compared between the groups for both immediate and delayed indexes. An ANOVA procedure was then computed to analyze group difference in these Indexes. The result indicated no significant group difference on these discrepancy scores. Again, these results are attributed to reasons similar to those stated above.

WMS-III score	LTL			RTL		
	N	M	SD	n	M	SD
<b>Indexes</b>						
Auditory Immediate Index	44	66.20	(10.843)	34	93.00	(13.423)
Visual Immediate Index	44	71.73	(10.210)	34	78.12	(11.969)
Immediate Memory Index	44	62.05	(10.716)	34	82.97	(14.540)
Auditory Delayed Index	44	62.86	(13.861)	34	92.56	(15.673)
Visual Delayed Index	44	72.68	(12.799)	34	78.35	(12.982)
General Memory Index	44	63.82	(12.848)	34	85.47	(15.839)
Auditory Recognition Delayed Index	44	75.23	(12.802)	34	95.44	(16.939)
Working Memory Index	44	72.55	(14.534)	34	81.38	(13.253)
Auditory Immediate – Visual Immediate	44	-5.5227	11.5929	34	14.8824	8.72740
Auditory Delayed – Visual Delayed	44	-9.8182	13.7457	34	14.2059	12.3160
<b>Subtests</b>						
Logical Memory I	44	17.95	(8.482)	34	33.59	(11.206)
Logical Memory II	44	06.66	(6.961)	34	18.71	(10.406)
Faces I	44	32.34	(4.554)	34	33.56	(04.800)
Faces II	44	33.73	(5.173)	34	34.38	(03.742)
Verbal Paired Associates I	44	07.48	(5.263)	34	18.18	(06.264)
Verbal Paired Associates II	44	01.73	(1.796)	34	05.65	(02.073)
Family Pictures I	44	23.41	(8.809)	34	29.88	(11.635)
Family Pictures II	44	23.18	(9.473)	34	29.65	(12.185)
Letter-Number Sequencing	44	05.18	(2.863)	34	07.53	(02.915)
Spatial Span	44	11.02	(4.185)	34	12.50	(03.703)

WMS-III = Wechsler Memory Scale – Third Edition – LTL = left temporal lobe – RTL = right temporal lobe.

Table 5. WMS-III Mean Scores for the LTL and RTL Subgroup

5.3 LTL and RTL subgroup differences across WMS-III indexes, subtest, and discrepancy scores

The temporal lobe epilepsy (TLE) group was analyzed in terms of left and right lateralization of memory deficits. That is, the WMS-III indexes and subtest scores of the patients in the TLE group were analyzed after they were subdivided into left temporal lobe (LTL) and right temporal lobe (RTL) subgroups. The means and standard deviations for the WMS-III Primary Indexes and Subtest scores are provided in Table 5 (For auditory-visual discrepancy scores shown in Table 5, the net difference scores were in the positive direction for the RTL group indicating that Visual Index scores were lower than Auditory Index

scores, whereas the opposite was the case for the LTL group). The independent t-tests of the Primary Index scores indicated that the LTL and RTL subgroups differed significantly from one another on all index scores except the Visual Delayed Index. The independent t-test results for the LTL and RTL comparisons on the WMS-III Subtest scores indicated that the LTL and RTL subgroups differed significantly from one another in 8 of the 10 Subtest scores. Faces subtest, a visually encoded test, failed to differentiate the two groups at both the immediate and delayed stages of assessment. Table 6 shows these independent t-test results, which reflect some sensitivity to lateralization in patients with right and left temporal lobe epilepsies. Discrepancy scores, calculated by subtracting the visual memory index from the auditory memory index, were compared between the LTL and RTL subgroups for both immediate and delayed indexes. Analyses of these discrepancies using independent t-tests revealed significant differences between the TLT and RTL subgroups on both the Immediate [ $t(75.962) = -8.868, p < .0001$ ] and the Delayed scores [ $t(74.284) = -8.119, p < .0001$ ]. Similar results were obtained in earlier studies (e.g., Wilde, et al., 2001).

WMS-III Primary Indexes	t	df	Sig. (2-tailed)
Auditory Immediate Index	- 9.491	62.476	0.000
Visual Immediate Index	- 2.491	64.818	0.015
Immediate Memory Index	- 7.043	58.593	0.000
Auditory Delayed Index	- 8.722	66.344	0.000
Visual Delayed Index	- 1.925	70.614	0.058
General Memory Index	- 6.490	62.660	0.000
Auditory Recognition Index	- 6.005	76	0.000
Working Memory Index	- 2.799	73.873	0.007
WMS-III Subtest Scores	t	df	Sig. (2-tailed)
Logical Memory I	- 6.772	59.707	0.000
Logical Memory II	- 6.115	76	0.000
Faces I	- 1.136	69.185	0.260
Faces II	- 0.649	75.713	0.519
Verbal Paired Associates I	- 8.011	64.165	0.000
Verbal Paired Associates II	- 8.772	65.489	0.000
Family Pictures I	- 2.701	59.715	0.009
Family Pictures II	- 2.554	60.837	0.013
Letter-Number Sequencing	- 3.554	70.480	0.001
Spatial Span	- 2.799	73.873	0.007

Table 6. LTL and RTL differences on WMS-III Primary Indexes and Subtest Scores

Finally, to examine the predictive power of the auditory-visual delayed index discrepancy, a univariate logistic regression was used to study the effects of the discrepancy on the probability of having temporal lobe epilepsy on the diagnostic groups, and consequently to plot the Receiver Operating Characteristics (ROC). The level of significance was set at  $p < 0.05$ . The resulting area for the auditory-visual delayed index difference score is 0.53, which is close to chance level. The area under the curve (AUC) that describes the ROC is presented in Figure 2. This result emphasizes the suspected issue of sensitivity and specificity of the neuropsychological evaluation tools used.

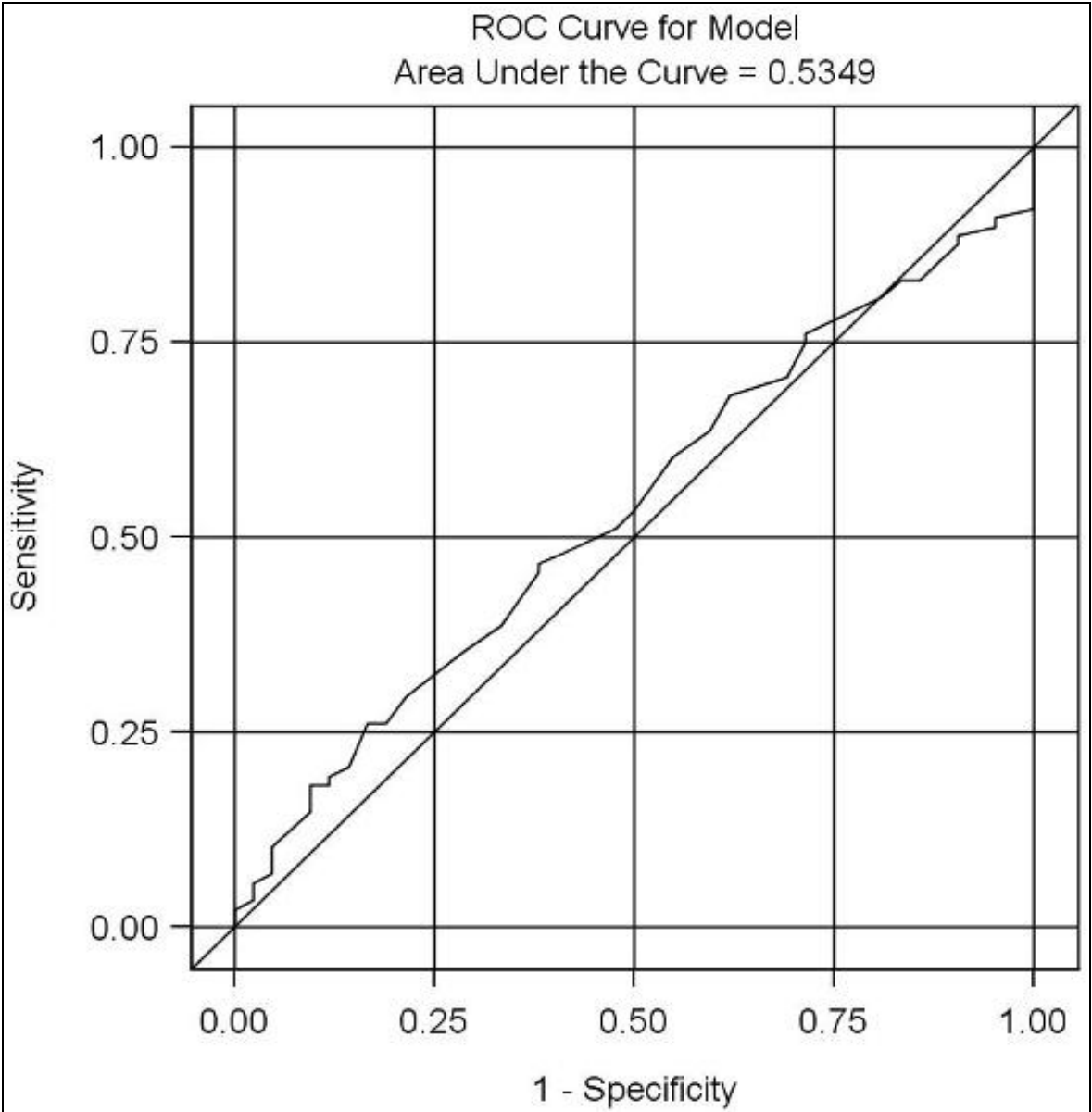


Fig. 2. The AUC for the Auditory-Visual Delayed Index Difference Score

6. Discussion

There are enormous similarities shared by the various groups in the human kingdom, yet cultural diversity is a dynamic reality. In a field like clinical neuropsychology, a practitioner cannot afford not to attend to cultural diversities. The practice of neuropsychology is affected by cultural differences. For a neuropsychologist in a ‘developing country’ where most of the substances used on daily practice are extrapolated from a different culture, the professional challenges are limitless. The purpose of this chapter was not to provide an in-depth analysis of the psychometric properties of neuropsychological testing material. It was rather to review some of the social and cultural characteristics in Saudi Arabia that are believed to dictate the relative relevance of much of the neuropsychological material that have been imported and used to evaluate Saudi patients. The review focused on the practice of neuropsychology and its role of evaluating epilepsy patients in an epilepsy surgery

program. As the majority of epilepsy syndromes encountered in the presurgical workup were temporal lobe epilepsy, the discussion was devoted in part to neuropsychological issues relevant to temporal lobe epilepsies. The data presented above were aimed at elucidating the need for developing indigenous neuropsychological traditions and material not only for patient evaluation, but also for rehabilitation, teaching and training.

The results presented above may speak for themselves. They generally indicate the relatively limited ability of the WMS-III in identifying the brain areas that were implicated with dysfunction. The performance of TLE, FLE, and other seizures' groups on the WMS-III indexes and subtest scores was insensitive to localization of dysfunction. Nor was the auditory-visual discrepancy for both delayed and immediate scores. On the other hand, the WMS-III auditory-visual discrepancy scores were efficiently sensitive to laterality among patients with either left or right temporal lobe dysfunction. Hence, despite the several aspects of cultural bias identified in the WMS-III subtests, these discrepancy scores demonstrated ability to distinguish patients with left and right temporal lobe dysfunction associated with a unilateral seizure onset. In fact, apart from the failure to document "between group" differences, the WMS-III primary indexes and subtest scores were able to detect material-specific memory impairment as demonstrated by auditory-visual difference scores of temporal lobe patients. It is not clear, however, if the failure to demonstrate differences in the performance of patients with different epileptic foci is associated with the psychometric characteristics of the WMS-III subtests. There were studies that reported similar insensitivity of the WMS-III index and subtest scores to laterality (Wilde, et al., 2001). Comparing the results reported here with results published in similar previous studies is hampered by the fact that the sample of this study differed in a number of important aspects from the WMS-III normative population.

These results reinforced the importance of using the WMS-III scores in combination with other neuropsychological measures to improve the validity of evaluations. One of the inadequacies of the WMS-III is that, some of the subtests included in the scale may not allow accurate lateralization of dysfunction because they can be coded both verbally and visually (Jones-Gotman et al., 2000). In addition, the WMS-III protocol for verbal passages task, for example, requires recall after a single presentation of the material to be remembered. Jones-Gotman and colleagues (2000) argued that when material was presented to patients with lesions in either the left or the right temporal lobe only once, deficient recall might result for a variety of reasons including lapses of attention and misunderstanding. However, the demonstrated ability of the scale to relatively accurately differentiate between the LTL and RTL subgroups as reported above, may suggest that factors other than the psychometric properties of the scale are at work in influencing the performance of patients in this sample. On the other hand, the amount of agreement between the neuropsychological data and other evaluation modalities was at best 'fair' (Haut, et al., 2002) and limited to temporal lobe areas. Studies that compare and contrast the efficacy of different evaluation modalities in documenting dysfunction in epilepsy patients at the presurgical workup are quite rare (e.g., Akanuma, et al., 2003; Haut, et al., 2002). Such comparison studies can provide a gold standard against which neuropsychological evaluation tools can be calibrated.

To conclude, this chapter has emphasized the importance of developing indigenous neuropsychological tests and norms relevant to the cultural characteristics of individuals to whom the tests are administered. The reported study was meant to provide an empirical

platform on which the concepts argued above were demonstrated. The WMS-III remains a useful tool for assessing memory, even if its ability to classify patients is limited.

## 7. Acknowledgement

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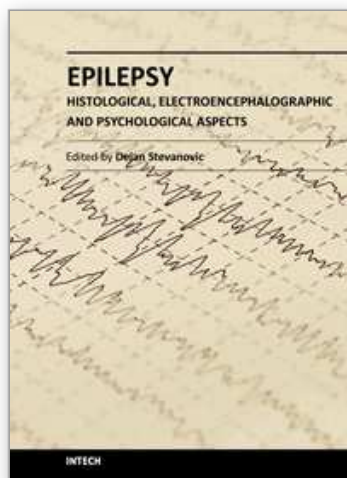
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