# The Neuropsychological Functioning of Men Residing in a Homeless Shelter

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# THE NEUROPSYCHOLOGICAL FUNCTIONING OF MEN RESIDING IN A HOMELESS SHELTER

by

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ABSTRACT
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The number of homeless individuals in the U.S. has continued to increase, with men comprising the majority of this population. These men are at substantial risk for neuropsychological impairment due to several factors, such as substance misuse, severe mental illness, untreated medical conditions (e.g., diabetes, liver disease, HIV/AIDS), poor nutrition, and the increased likelihood of suffering a traumatic brain injury. Impairments in attention, memory, executive functioning, and other neuropsychological domains can result in poor daily functioning and difficulty engaging in psychological, medical, or educational services. Thus, knowledge of the neuropsychological functioning of homeless men is critical for those who work with this population. Yet data in this area are limited. This study aimed to describe the functioning of men residing in an urban homeless shelter across the domains of attention/concentration, memory, executive functions, language, sensory-motor abilities, general intelligence, and reading ability. Particular areas of impairment included attention, visual memory, cognitive flexibility, balance/coordination, and fine motor control. Correlational analyses found that educational background and ethnicity were linked to test performance, and the results of cluster analysis found two distinct subgroups based on neuropsychological functioning: an "average" group and a "low average/impaired" group. Caveats in interpreting test scores, particularly in the domain of language, are discussed, along with possible explanations for differences between African American and non-African American participants. Based on the findings of this study, it is recommended that clinicians and other service providers working with men residing in homeless shelters consider the possibility of neuropsychological impairment when developing treatment plans. Specific recommendations for each subgroup are discussed. Future research in this area might also explore the utility of offering skill-enhancing interventions within homeless shelters, such as workshops to improve organizational and planning skills. Further, the development of adequate norms for neuropsychological tests that are to be used with homeless individuals is recommended, given the possibility of low educational attainments and below average reading skills in this population.

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# CHAPTER I
# INTRODUCTION

Homelessness is not a new issue in the United States. For the past several decades, researchers and clinicians have been working to find answers to some very basic questions: What causes homelessness? Who is more likely to become homeless? Why do some people become "chronically" homeless? and What can we do to solve this problem? Research suggests that economic factors are often involved in the onset and continuation of homelessness, such as low wages, high unemployment rates, and a decline in low-cost housing (Milwaukee Continuum of Care, 2007; Koegel, Burnam, & Baumohl, 1996; The United States Conference of Mayors – Sodexho, Inc., 2006). Yet not all people who experience these conditions become homeless. Substance abuse/dependence, psychiatric disorders, and physical illness are all highly prevalent in the homeless population, compared to the general public (e.g., Koegel et al., 1996; Koegel, Sullivan, Burnam, Morton, & Wenzel, 1999; Reardon, Burns, Preist, Sachs-Ericsson, & Lang, 2003; Silver & Felix, 1999; Toro et al., 1995); however, whether these factors are causes or consequences of homelessness is unclear. The presence of a substance use or mental health disorder alone does not necessarily cause one to become homeless. It seems likely that the pathway to homelessness is built through person-environment interactions.

One component of these person-environment interactions is neuropsychological functioning. Individuals who are homeless are often malnourished, which can produce short-term neuropsychological impairment (Silver & Felix, 1999). Compounding the situation is the longer-term neuropsychological impairment that can result from poorly managed chronic illnesses such as diabetes or HIV/AIDS, which are prevalent in the

homeless population (Falk, 2006; Silver & Felix, 1999). Also prevalent in this population are substance misuse and mental health disorders (e.g., Falk, 2006; Silver & Felix, 1999), and the neuropsychological sequelae of these conditions can be widespread and, in some cases, permanent (e.g., Knight & Longmore, 1994). The situation can be dire for those individuals with both psychiatric and substance use disorders, as they are often in very poor physical health, perhaps due to the multiple negative effects of alcohol and drugs on the body (e.g., Brust, 2004; Struening & Padgett, 1990). In addition to these factors, life on the streets or in shelters can be dangerous, as evidenced by the high rates of physical assault and traumatic brain injury in this population (Silver & Felix, 1999). Thus, individuals who are homeless are vulnerable to neuropsychological impairment on several fronts.

While it seems logical – and intuitive – that some people who are homeless would evidence signs of cognitive or neuropsychological impairment, there has been very little empirical research to support this idea. For those who work with or develop programs for people who are homeless, this information is important. For example, research suggests that deficits in attention, concentration, and executive functioning are linked to health risk behavior (Hall, Elias, & Crossley, 2006). Further, psychotherapy and other types of psychosocial interventions are said to be learning situations that require attention, memory, problem solving, and abstract thinking (Fals-Stewart, Schafer, Lucente, Rustine, & Brown, 1994). At a very basic level, organized, planful thinking and goal-setting are necessary skills for managing money, running a household, and maintaining employment.

Professionals who work with this population need to know which areas of neuropsychological functioning are likely to be impaired or are vulnerable to impairment.

Such information can be used to identify needed services and develop interventions tailored to the capacities of the individual. Further, a more accurate understanding of the lives of homeless persons can help improve the quality of interaction between provider and client by reducing inaccurate assumptions and stereotypes about the homeless (Backer & Howard, 2007). Thus, obtaining information about the neuropsychological functioning of homeless individuals is an important area of research with several useful applications.

## Statement of the Problem

Currently, our knowledge of the neuropsychological functioning of homeless individuals is limited to a handful of studies based on the performance of less than 600 individuals who have experienced homelessness (Cotman & Sandman, 1997; Douyon et al., 1998; Duerksen, 1995; Foulks, McCown, Duckworth, & Sutker, 1990; Gonzalez, Dieter, Natale, & Tanner, 2001; Lo, 2001; Seidman et al., 1997; Solliday-McRoy, Campbell, Melchert, Young, & Cisler, 2004; Zlotnick, Fischer & Agnew, 1995). These studies have varied in terms of sample characteristics, instruments used, and coverage of the various domains of neuropsychological functioning. Even the definition of "homeless" is of concern when synthesizing the findings across several studies; some researchers have chosen to take a categorical approach (homeless vs. not homeless; sheltered vs. roofless) while others have utilized a continuous approach (e.g., length of homelessness). There may be important differences between individuals who have had one short episode of homelessness in his or her lifetime, and those who have been continuously homeless for several years. However, the extant research does not answer the question of how these groups may differ in terms of neuropsychological functioning.

Despite these drawbacks, research into the neuropsychological functioning of homeless individuals has produced some important initial findings. Although not found across the entire homeless population, there are at least some subgroups of homeless individuals who have anywhere from mild to severe deficits in various domains of neuropsychological functioning. A tentative conclusion from these data is that individuals who are or have been homeless may be more likely than non-homeless individuals to evidence impairments in attention span, processing speed, sustained and selective attention, verbal memory, prose recall, visuospatial memory, expressive language, motor-sensory functioning, and domains of executive functioning. However, some of these domains have been more extensively researched than have others. The domain of attention has been the most extensively examined in this population (Cotman & Sandman, 1997; Duerksen, 1995; Foulks et al., 1990; Gonzalez et al., 2001; Lo, 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004), followed by memory and executive functions (Duerksen, 1995; Foulks et al., 1990; Gonzalez et al., 2001; Lo, 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004). On the other hand, the areas of language and motor-sensory functions have received little attention. Further, some homeless individuals have performed in the average range on neuropsychological tests (e.g., Cotman & Sandman, 1997; Foulks et al., 1990; Zlotnick et al., 1995). These mixed results point to a need for further research.

## Purpose of the Study

The purpose of the current study is to describe the neuropsychological functioning of a sample of men who are currently homeless and receiving services through the Guest

House of Milwaukee (GHOM), a comprehensive social services agency that also provides emergency shelter services. Three research questions will guide this study:

1. What do the results of a neuropsychological assessment battery reveal about the neuropsychological functioning of men who are homeless, specifically in the domains of attention, memory, language, motor-sensory abilities, and executive abilities?
2. How does neuropsychological functioning relate to the background/ demographic variables, psychosocial variables, and psychiatric diagnosis issues for these men?
3. Can men who are homeless be divided into subgroups on the basis of their neuropsychological functioning, and if so, what characterizes these subgroups?

## Definition of Terms

### *Homeless*

In this study, **"homeless"** and **"homelessness"** are defined according to the Stewart B. McKinney Act (1987):

> (1) An individual who lacks a fixed, regular, and adequate nighttime residence; and (2) an individual who has a primary nighttime residence that is—(a) a supervised publicly or privately operated shelter designed to provide temporary living accommodations (including welfare hotels, congregate shelters, and transitional housing for the mentally ill); (b) an institution that provides a temporary residence for individuals intended to be institutionalized; or (c) a public or private place not designed for, or ordinarily used as, a regular sleeping accommodation for human beings.

Specific examples of living or sleeping arrangements that fit this definition include (1) staying in emergency shelters; (2) sleeping in places such as cars, parks, sidewalks, or abandoned buildings; or (3) transitional or supportive housing, when the individual came

from the streets or a shelter. Further, individuals who spend less than thirty days in an institution but typically sleep in shelters or other arrangements listed above are also considered homeless.

**"Episodes"** of homelessness are defined in accordance with other research with this population (e.g., Kuhn & Culhane, 1998). An instance of homelessness must be separated by at least thirty days from another instance of homelessness in order to be classified as a unique episode.

*Neuropsychological Functioning*

**Neuropsychology** is defined as the study of brain-behavior relationships. In this study, **neuropsychological functioning** is based on the following:

1. **Attention and concentration**, as measured by the Conners' Continuous Performance Test II (CPT-II; Conners & MHS Staff, 2000) and the Digit Span and Digit Symbol subtests of the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III; The Psychological Corporation, 1997).
2. **Working memory**, as measured by the Digit Span and Letter-Number Sequencing subtests of the WAIS-III.
3. **Construction ability**, based on scores from the Copy trial of the Rey Complex Figure Test (RCFT; Meyers & Meyers, 1995).
4. **Visual and verbal memory**, as measured by the Visual and Verbal indices of the Wide Range Assessment of Memory and Learning – Second Edition (WRAML2; Sheslow & Adams, 2003) and the Immediate and Delayed Recall trials of the RCFT.

5. **Language functioning**, as measured by the Boston Naming Test (BNT; Goodglass, Kaplan, & Barresi, 2000).
6. **Executive functioning**, based on Trail Making, Verbal Fluency, and Tower tests from the Delis-Kaplan Executive Function System (D-KEFS; The Psychological Corporation, 2001), and the self-report version of the Frontal Systems Behavior Scale (FrSBe; Grace & Malloy, 2001).
7. **Motor-sensory functioning**, as measured by the Grooved Pegboard test (Lafayette Instrument Company, 2002) and selected subtests of the Dean-Woodcock Sensory Motor Battery (D-WSMB; Dean & Woodcock, 2003).

## Importance of the Study

The importance of this study is twofold. First, the results will add to the normative databases for the tests used in the study. This is important given the limited normative data available for psychologists working with individuals who are homeless. Second, the information regarding the neuropsychological functioning of homeless men in shelter can be used to develop clinical and programmatic recommendations. It is believed that these recommendations could lead to improved services for homeless men in shelter.

## Note Regarding Person-First Language

Person-first language has been used wherever possible in this document (i.e. “individuals who are homeless” versus “homeless individuals”). However, in some cases the nature of writing is such that a “shortened” phrase is preferred. In those cases where phrases such as “homeless individuals,” “homeless persons,” or “homeless men” are used, it should be noted that this has been done for writing style purposes and not to diminish the personhood of individuals who experience homelessness.

# CHAPTER II
# REVIEW OF THE LITERATURE

Individuals who are homeless tend to be a heterogeneous group, with some experiencing short episodes of homelessness and others spending extended periods of time on the streets or in shelters. Research and programmatic efforts over the past several decades have aimed to understand the causes and consequences of homelessness in order to better serve this population. A primary focus of these efforts has been on the substance use and mental health concerns of homeless individuals. At the same time, it has been suggested that therapy – and perhaps psychosocial services in general – is a type of learning situation, one that requires cognitive and neuropsychological skills such as attention, memory, problem solving, and abstract thinking (Fals-Stewart et al., 1994, p. 756). Such skills can be impaired by the use of drugs/alcohol and the presence of mental and/or medical illnesses, all of which are concerns frequently found among homeless individuals. This review will discuss the current research on homelessness in the United States and factors that increase the likelihood of neurobehavioral impairment among homeless individuals, as well as critically review the empirical research regarding the cognitive and neuropsychological functioning of homeless individuals.

## Homeless Individuals in the United States

### *Demographics*

Homelessness in the United States is a widespread problem and a national concern, as evidenced by the Bush Administration's goal to end chronic homelessness by the year 2012 (McCarty, 2005). Estimating the number of people in the U.S. who are considered homeless is a difficult task. In 2005, 744,313 people were estimated to be

homeless at one point in time (National Coalition for the Homeless, 2007). Period prevalence counts, which estimate the number of homeless over a given period of time, suggest that approximately 3.5 million individuals in the U.S. will be homeless in a given year (National Coalition for the Homeless, 2007). These data were gathered from surveys of service providers in 1996; more recent statistics indicate that the homeless population in the U.S. is anywhere between 600,000 to 2.5 million persons (McCarty, 2005). Due to the reliance on shelters and service providers to count homeless persons, it is likely that these numbers underestimate the actual number of homeless people (National Coalition for the Homeless, 2007). Although an accurate period prevalence count is difficult to obtain, researchers have concluded that there has been a dramatic increase in the number of homeless persons in the U.S. over the past twenty years (National Coalition for the Homeless, 2007).

The composition of the homeless population has been changing over the past several years (The United States Conference of Mayors – Sodexho, Inc., 2006; National Coalition for the Homeless, 2007), with more children and families experiencing homelessness. However, adult men continue to make up the majority of the homeless population. In the 2006 U.S. Conference of Mayors Hunger and Homelessness Survey, men comprised 51% of the homeless population across twenty-three major U.S. cities, and single women were estimated to make up 17% of the homeless population. Survey results also indicated that the U.S. homeless population is predominantly African American (42%) and Caucasian (39%), and that individuals remain homeless for eight months on average.

The homeless population in Milwaukee, Wisconsin, closely mirrors these national figures. A point-in-time count in 2007 estimated that there are 1,470 homeless adults and children on a given day in the city of Milwaukee (Milwaukee Continuum of Care, 2007). Survey data from a portion of this group indicated that nearly one third are between the ages of 41-50 (30.8%), and one in four is under the age of 30 years old. However, those considered to be "chronically" homeless tended to be older. The majority of Milwaukee's homeless are men (55%), and nearly three-fourths of the chronically homeless are men. African Americans are over-represented among the homeless in Milwaukee (61.8% compared to 40.2% of the general population in Milwaukee). In terms of episodes of homelessness, the majority of Milwaukee's homeless have at least one or two previous episodes of homelessness, and 80% of the chronically homeless have been homeless for longer than one year. While most individuals surveyed had spent the last night in a shelter or transitional housing, one-third were identified as unsheltered.

### *Causes of Homelessness*

Research into the causes of homelessness has suggested myriad reasons. Two broad trends over the past two decades have received a great deal of attention: the decline in low-cost housing and increasing numbers of individuals living at or below the poverty line (Koegel, et al., 1996). Other economic factors that are cited as causes of homelessness are low wages and unemployment (e.g., The United States Conference of Mayors – Sodexho, Inc., 2006; Milwaukee Continuum of Care, 2007). In addition, certain risk factors have also been suggested, namely severe and disabling mental illness and substance abuse (Koegel et al., 1996). Certain early life conditions, such as physical or sexual abuse, parental mental illness or substance abuse, and time spent in out-of-home

placements, have also been tentatively linked to homelessness in adulthood (Koegel et al., 1996).

Recent research tends to fall in line with these ideas. The majority of community-based providers surveyed for the 2006 U.S. Conference of Mayors study reported that mental illness coupled with a lack of needed services was the main cause of homelessness, followed by lack of affordable housing and substance abuse problems. A survey of homeless adults in the city of Milwaukee found that the most common responses to the cause of homelessness question were unemployment and low wages, eviction or loss of place to stay (i.e. with friends/family), drug/alcohol problems, and family breakup (Milwaukee Continuum of Care, 2007). Adults in Milwaukee classified as "chronically" homeless were more likely to cite drug/alcohol problems and mental illness as reasons for becoming homeless.

While the statistics suggest that economic factors, drugs/alcohol, and mental illness are among the more common causes of homelessness, it is unclear as to how these factors interact. For example, it has been suggested that mental illness and substance abuse might precede homelessness – and thus be considered a causal factor – or be consequences of homelessness (Koegel et al., 1996). While research on the causes of homelessness is ongoing, there is a wealth of information on the problems faced by homeless adults in the U.S.

## *Epidemiology*

### *Mental Illness*

As previously mentioned, mental illness has long been considered a concern and possible cause of homelessness in the United States (Koegel, et al., 1996). Older

estimates suggested that 20-25% of homeless persons had at one point suffered from a severe or disabling mental illness, such as schizophrenia or bipolar disorder (Koegel et al., 1996). More recent estimates suggest that 16% of homeless individuals have mental health problems (The United States Conference of Mayors – Sodexho, Inc., 2006). In the city of Milwaukee, 33% of homeless individuals interviewed self-reported a history of mental illness (Milwaukee Continuum of Care, 2007), while Solliday-McRoy et al. (2004) found that 50% of their sample of adults from a men's homeless shelter in Milwaukee had received some form of mental health treatment in the past.

A large-scale study in Colorado comparing formerly homeless and never homeless adults found that 47.3% of the formerly homeless had a DSM-III diagnosis in the past year, compared to 23% of the never homeless group (Reardon et al., 2003). Toro and colleagues (1995) also found that currently homeless individuals scored higher than did formerly homeless and never-homeless poor individuals in the areas of depression, anxiety, and paranoid ideation. Commonly found DSM-III diagnoses have been schizophrenia, mood disorders, dementia, and antisocial personality (Fischer & Breakey, 1991). More recently, Solliday-McRoy et al. found that nearly 30% of adult homeless men had received treatment for a mood disorder in the past. High rates of posttraumatic stress disorder have also been found among the homeless (North & Smith, 1992).

*Substance Misuse*

The prevalence of substance abuse among the homeless has long been studied, and is believed to be even more common than mental illness (Koegel et al., 1996). The most recent U.S. Conference of Mayors survey (2006) estimated that 26% of homeless individuals abuse drugs or alcohol. In one major U.S. city, approximately 59% of

homeless adults had received a diagnosis of alcohol dependence sometime in their life, with men comprising 64% of this group, and more men than women had currently met diagnostic criteria for alcohol or drug dependence (Koegel, et al., 1999). However, formerly homeless women have been found to have higher rates of alcohol disorders than never-homeless women (Reardon et al., 2003). A lifetime diagnosis of substance abuse has also been found to be more common among currently and formerly homeless individuals, compared to the never-homeless poor (Toro et al., 1995). Sixty percent of homeless individuals surveyed in the city of Milwaukee reported having problems with drugs or alcohol (Milwaukee Continuum of Care, 2007), and Solliday-McRoy et al. (2004) found that 93% of their Milwaukee-based participants had a history of substance abuse or dependence.

Research also indicates that co-occurring mental health and substance use disorders are prevalent among the homeless (e.g., Drake, Osher, & Wallach, 1991; Reardon et al., 2003). While little information exists regarding the specific "drugs of choice" of homeless individuals, Solliday-McRoy et al. (2004) found that the majority of homeless men had a history of polysubstance abuse/dependence (74%), followed by cocaine (11%) and alcohol (7%).

*Health Problems*

Physical health problems are considered to be both a cause and consequence of homelessness (Wright, 1990). Conditions found in higher rates among the homeless include upper respiratory infections, malnutrition, hypertension, peripheral vascular disease, seizures, anemia, and liver disease (Silver & Felix, 1999; Wright, 1990). Other common conditions in this population include AIDS/HIV, tuberculosis, and diabetes

(Silver & Felix, 1999). An additional concern is the relatively high rate of traumatic brain injury among the homeless; for example, Solliday-McRoy et al. (2004) found that nearly half (48%) of their sample had a history of traumatic brain injury with accompanying loss of consciousness. Many of these conditions have serious consequences if left untreated. Homeless individuals with histories of heavy substance use and symptoms of mental illness tend to have the highest rates of poor physical health among all homeless persons (Struening & Padgett, 1990).

### *Shelter Use*

Little empirical evidence exists on the differences or similarities between "sheltered" and "unsheltered" homeless individuals. The former includes individuals who frequent homeless shelters, while the latter are individuals who rarely use shelters and may be found sleeping in parks, under bridges, or in vehicles. Roth and Bean (1986) attempted to delineate types of homeless individuals and explore differences among them. The three identified types were "street people" (infrequent contact with shelters or service agencies), "shelter people" (frequently use shelters and other services), and "resource people" (individuals with more resources who do not stay in shelters but typically use hotels or stay with friends/family). In examining differences among the groups, Roth and Bean reported that the street sample was more likely to evidence signs of behavioral disturbance, including speech disorganization and inappropriate affect. No other differences were found, although participants were not compared on the basis of DSM-based diagnoses and there was no exploration of cognitive or neuropsychological functioning among the three groups.

In a second study examining shelter and street samples, where the “street” sample spent less than half of the time in shelters, few differences were found (Hannappel, Calsyn, and Morse, 1989). Compared to shelter users (both moderate and high frequency users), the low-frequency shelter users (“street sample”) had been out of permanent housing longer and expressed a greater need for social support. No differences in psychiatric distress, mental health service utilization, or willingness to use services for the homeless were found between the two groups. Although the authors concluded that these samples were essentially similar, they failed to examine differences in substance use, psychiatric diagnoses, medical health problems, history of head injuries, cognitive impairment, or length of time spent in treatment.

Interest in a “homelessness typology” continued into the 1990s, with studies such as that by Kuhn and Culhane (1998). These authors compared homeless populations in Philadelphia and New York, and used cluster analysis to identify three basic types of homelessness: episodic, transitional, and chronic. The transitional group, which was the largest of the three, consists of those individuals who stay in shelters for brief periods in order to recover from an emergency. The episodic group is those individuals who are in and out of shelters frequently, while the chronic group consists of individuals who stay in shelter for extended periods of time. Kuhn and Culhane found that the chronic group tended to be older and had higher rates of medical problems than the other two groups. Both the chronic and episodic group also had higher rates of substance abuse and mental health problems than the transitional group. These results point out the variation within the broader homeless population.

In summary, there is limited information on whether these proposed subgroups of homeless individuals differ in terms of substance use history, psychiatric diagnoses, and involvement in social services. Virtually no information exists regarding differences among these groups in terms of traumatic brain injuries or other neurological disorders, medical illnesses, or cognitive or neuropsychological functioning.

### *Service Use*

It has been suggested that homeless individuals who seek services at a community health center are representative of the larger homeless community in terms of substance use, health, mental illness, service utilization, and life satisfaction (Stein & Gelberg, 1997). Thus, research with homeless individuals is often based on samples drawn from health clinics, shelters, or other agencies serving the homeless.

However, there is evidence to suggest that differences between service-seeking and non service-seeking homeless individuals may exist. For example, homeless individuals who lost contact with service agencies were five times more likely to have serious substance dependence problems, compared to homeless individuals who maintained contact with service providers (Marshall, Nehring, Taylor, & Gath, 1994). Further, homeless individuals with mental health problems who do not voluntarily seek psychiatric services may be more difficult to engage in treatment compared to those who voluntarily seek treatment (Sachs-Ericsson, Ciarlo, Tweed, Dilts, & Casper, 1994). Some of the factors rendering this group difficult to treat include being judged as unmotivated, uncooperative, or in denial by service providers (Sachs-Ericsson et al., 1994). Piliavin, Westerfelt, and Elliott (1989) reached a different conclusion, finding that homeless individuals who used a health clinic were more likely to have been psychiatrically

hospitalized in the past, compared to homeless individuals who did not seek services at the health clinic.

It is difficult to draw conclusions regarding the similarities and differences between service-using versus non service-using homeless individuals. In addition to the discrepancies discussed above, there is virtually no information regarding differences with respect to cognitive or neuropsychological functioning.

### *Summary*

The homeless population in the United States is clearly not homogenous with respect to gender, age, race/ethnicity, mental health status, substance use status, or shelter/service use. Further, our understanding of the homeless population in this country may be limited to contacts with those individuals who are more able, willing, or likely to present at shelters, soup kitchens, or treatment programs. It seems likely that certain subgroups of the homeless population would be more likely to evidence signs of poor functioning across several domains, such as those individuals who have longstanding problems with substance use, mental illness, or medical diseases. The reason for impaired functioning in this group may be related to the neurological and neuropsychological sequelae of these problems.

## Factors Affecting the Neurobehavioral Status of Homeless Individuals

### *Substance Misuse*

#### *Alcohol*

There are numerous physical effects from the chronic abuse of alcohol. The areas of the body sustaining damage from chronic abuse include the liver, heart, digestive system, and nervous system (Brust, 2004; Knight & Longmore, 1994). Common illnesses

include fatty liver, hepatitis, cirrhosis, coronary heart disease, high blood pressure, nutritional deficiencies, and pancreatitis. These illnesses can have secondary effects on neuropsychological functioning. In the case of liver damage, a common consequence of a poorly functioning liver is hepatic encephalopathy. Symptoms include delirium and decreased alertness, although these are temporary effects and typically resolve with medical treatment or liver transplantation. Another area of indirect effects on neuropsychological functioning is nutritional deficiencies. Thiamine deficiency, a hallmark of Wernicke-Korsakoff syndrome, leads to diminished utilization of cerebral glucose, a consequence of which is neuron death (Brust, 2004). In addition, individuals lacking in thiamine experience slowed neural recovery following injury and may experience encephalopathy (Hartman, 1995). In addition, individuals with a long history of chronic alcohol abuse have a greater risk of stroke, which can cause permanent impairment in neuropsychological functioning (Knight & Longmore, 1994).

Effects of alcohol on the nervous system are also found. Acute effects are typically reversible and leave no apparent structural damage (Knight & Longmore, 1994). Symptoms include an initial excitatory effect on the cortex due to depression of activity in the reticular activating system (Knight & Longmore, 1994). Later effects include blackouts and acute memory loss. For individuals who have developed a physiological dependence, neuropsychological impairment is often seen during the withdrawal phase; these deficits will typically clear up following completion of withdrawal. However, residual neurological disorders are found among long-term abusers of alcohol. These include cerebellar degeneration (with accompanying ataxia), peripheral neuropathy (with

sensory/motor disturbances in the hands, feet, and legs), and Wernicke-Korsakoff syndrome.

Over the years, there has also been increased interest in the direct neurotoxic effects of alcohol. Long-term alcohol abuse has been linked to widespread cerebral damage, with neuron loss especially prominent in the superior frontal association cortex, hypothalamus, and cerebellum (Brust, 2004; Knight & Longmore, 1994). Both neurons and neurotransmitters are negatively affected by alcohol, and cortical atrophy is the most common consequence of excessive, ongoing alcohol abuse (Hartman, 1995; Fals-Stewart, et al., 1994). Individuals with signs of Wernicke's encephalopathy or Korsakoff's syndrome typically have gray matter lesions in the cortical tissue surrounding the third and fourth ventricles, which produces the appearance of enlarged ventricles (Knight & Longmore, 1994; Lezak, Howieson, & Loring, 2004). Even in the case of individuals who do not reach the extremes of Wernicke-Korsakoff syndrome there are multiple neuropathological effects. For example, one hypothesis is that chronic alcohol abuse causes a frontal-limbic-diencephalic injury; this is supported by PET scans that evidence frontal abnormalities (Hartman, 1995). In addition, chronic alcohol abuse can cause a reduction in blood flow to the frontal and parietal areas of the brain (Lezak et al., 2004).

Given the complex effects of alcohol on the brain, it is not surprising that the neuropsychological effects are equally, if not more, complex. The negative effects of chronic alcohol abuse have been found in abstract reasoning, memory, visuospatial abilities, general intelligence, cognitive flexibility, psychomotor speed, problem solving, and sustained attention (Hartman, 1995; Knight & Longmore, 1994; Lezak et al., 2004; Parsons, 1987). For example, memory problems, while not universal, are commonly

found among chronic alcoholics. Lezak et al. (2004) note that the main problem seems to be with encoding, as opposed to retrieval, which suggests that executive functions may also be implicated. Knight and Longmore (1994) echo this idea, stating that poor motivation and lack of persistence may contribute to poor performance on memory tests. Lezak and colleagues (2004) further state that performance may be particularly pronounced on visuospatial learning and memory tests, as opposed to verbal learning and memory tests.

Although memory is often quite impaired in the first few weeks of abstinence, it typically improves thereafter (Lezak et al., 2004). Other areas of neuropsychological functioning may improve with sustained abstinence over several years. However, some deficits can be permanent. This appears to be true for older individuals, as younger individuals (i.e., age 40 and younger) typically show greater recovery of neuropsychological functioning (Knight & Longmore, 1994; Lezak et al., 2004). However, it is unknown as to whether subtle deficits in executive functioning might be permanent.

There are several problems in understanding the relationship between chronic alcohol abuse and neuropsychological deficits. Studies examining neuropsychological functioning of alcoholics often use tests that are not sensitive to the subtle effects of alcohol, such as those that measure abilities heavily dependent on verbal functions and established skills (Hartman, 1995; Lezak et al., 2004). Knight and Longmore (1994) also report that deficits are typically found in performance or non-verbal tests. In support of this idea, research using the Halstead-Reitan Battery (HRB) has been more successful than the Luria-Nebraska Neuropsychological Battery (LNNB) in identifying alcoholics;

the HRB includes tests of sustained attention, abstract reasoning, and complex perceptual processes, while the LNNB includes tests that are more verbal-dependent (Hartman, 1995, p. 252).

A second problem in understanding alcohol's effects on neuropsychological functioning is the lack of information on premorbid functioning. Parsons (1987) pointed out that it is difficult to assess the effect of alcohol on neuropsychological functioning without having an estimate of functioning prior to the onset of heavy alcohol use. This leads to the question of whether neuropsychological deficits might be a cause as opposed to a consequence of heavy drinking. While information about the direct toxic effects of alcohol is relatively established (Lezak et al., 2004), it remains to be seen whether certain neuropsychological vulnerabilities might contribute to the onset of problem drinking (Fals-Stewart et al., 1994).

In addition to these methodological issues, the relationship between alcohol abuse and neuropsychological impairment is also complicated by the influence of co-existing variables. For example, factors such as age, genetics, nutritional deficits, comorbid psychopathology, and head trauma can also influence neuropsychological functioning. It is common for homeless individuals to have both substance use and mental health disorders (e.g., Drake et al., 1991; Reardon et al., 2003), and persons who abuse alcohol are at an increased risk of suffered head trauma (Hartman, 1995). These factors may explain neuropsychological impairment in alcoholics, as opposed to alcohol per se. However, in the case of age, research points to independent as well as synergistic effects of alcohol intake and age (Hartman, 1995). Further, Knight and Longmore (1994) discuss research pointing to age, consumption (measured as maximum quantity per session plus

frequency of sessions), and education (e.g., premorbid IQ or premorbid educational achievement) as predictors of neuropsychological impairment among chronic alcohol abusers. Mixed evidence exists in the case of drinking history; tentatively, it is suggested that earlier onset of drinking leads to a greater likelihood of impairment (Hartman, 1995). However, the question remains as to whether factors that predispose one to early drinking might also make one vulnerable to neuropsychological impairment.

In conclusion, the effects of alcohol on the brain are complex, as are the neuropsychological sequelae. Lesions found via MRI or PET scans often do not correspond exactly to neuropsychological test performance, and impaired neuropsychological functioning can be found in individuals with "clean" MRIs (Knight & Longmore, 1994). Further complicating matters is the finding that some neuropsychological tests are not sensitive to the subtle effects of alcohol on various domains of cognition. Despite these challenges, decades of research points to the deleterious effects of chronic alcohol abuse on neuropsychological functioning, at least among individuals who continue drinking. Some improvement is possible following sustained abstinence, although in some individuals there is no improvement (Lezak et al., 2004). With the high incidence of alcohol abuse among the homeless, it is important to consider this factor when examining the neuropsychological functioning of this population.

*Cocaine*

The neurobehavioral effects of substances other than alcohol have not been as thoroughly researched. Cocaine, a central nervous system stimulant, can permeate the blood-brain barrier, yet much less information is available about its effects on the brain

than is available for alcohol. Chronic cocaine use has been linked to cerebral atrophy and white matter abnormalities (Brust, 2004; Hartman, 1995), as well as abnormal cerebral metabolism (Lezak et al., 2004) and cerebral hypoperfusion in the frontal, temporal, and parietal areas of the brain (Rosselli, Ardila, Lubomski, Murray, & King, 2001). Information on the lasting mental effects of cocaine also lags behind the research on alcohol's effects. Brust (2004) concludes that evidence does exist for lasting impairment and suggests that reduced blood flow in the brain as a likely cause.

Areas in which impairment has been found include memory, attention, mental processing, and mental flexibility (Hartman, 1995; Lezak et al., 2004). Mittenberg and Motta (1993) compared the memory functioning of weekly cocaine users with ten days of abstinence with that of non-cocaine-using controls. Using the California Verbal Learning Test, the results indicated that the cocaine-using subjects learned and recalled fewer words than non-users, even in the cueing and recognition trials. Further, these results were not due to differences in attentional capacity, susceptibility to interference, or intellectual capacity. Due to the strict exclusionary criteria used in this study (e.g., no other substance use disorders, no Axis I diagnoses, no head injuries, etc.), it was concluded that verbal memory impairments among individuals who chronically abuse cocaine may be primarily the results of storage deficits.

In a similar study, Rosselli and colleagues (2001) examined the neuropsychological functioning of 42 crack- or cocaine-dependent individuals compared to a control group of non-users. Participants had at least two months of abstinence, and had no history of brain injuries, epilepsy, or cerebrovascular disease. Participants were also negative for current alcohol abuse or dependence, although most endorsed a history

of both alcohol and marijuana use. On a series of neuropsychological tests, including the CVLT, Trails-B, WCST, and Stroop Color-Word, controls outperformed the former cocaine addicts, suggesting that cocaine had a negative effect on neuropsychological functioning. However, these results must be interpreted cautiously, as no measure of premorbid functioning was obtained. Together, these studies suggest that chronic cocaine abuse is linked to neuropsychological impairment.

As with alcohol abuse, it is important to consider the role of cocaine abuse in understanding neuropsychological functioning of homeless individuals. In a small study of homeless men in Milwaukee, cocaine was more commonly cited as the drug of choice than alcohol (Solliday-McRoy et al., 2004). While limited information exists regarding the long-term impact of cocaine abuse on the brain, the extant literature suggests that impairments are likely.

*Marijuana*

A fair amount of controversy has surrounded the issue of lasting mental effects from marijuana abuse, with some researchers finding multiple negative effects on neuropsychological functioning and others finding no long-term deficits (Brust, 2004). Early opinions were that marijuana use produced acute neuropsychological effects, but no lasting negative impact (Hartman, 1995). However, several sources acknowledged that the lack of chronic effects may be linked to the inadequacy of standard neuropsychological tests for detecting the often subtle effects of marijuana (e.g., Carlin, 1986; Hartman, 1995; Lezak et al., 2004). Further, participants in research studies on the effects of marijuana abuse may not have been heavy users, and thus measurable effects

would have been difficult to obtain with the use of insensitive tests (Carlin, 1986; Hartman, 1995).

What is known regarding the neuropsychological impact of marijuana abuse is minimal at this time. Hartman (1995) reviewed the research in this area and stated that deficits have been identified in sustained attention, effortful processing, and word retrieval. In a more recent review, Brust (2004) cited deficits in memory, executive functioning, psychomotor speed, and manual dexterity; however, Brust notes that these findings must be interpreted cautiously, as estimates of premorbid functioning are often lacking among studies in this area. An additional, yet tentative, finding is that marijuana abuse has been linked to a higher incidence of strokes among young adult users. Thus, neuropsychological effects secondary to stroke may be of concern among chronic users.

Although empirical findings on the neuropsychological effects of chronic marijuana use are limited and sometimes contradictory, a consideration of the effects of marijuana is warranted.

*Opiates*

There has been relatively little research on the neuropsychological sequelae of opiate abuse, compared to that of alcohol, stimulants, and marijuana (Rogers & Robbins, 2001). Neurological consequences of heroin abuse can include stroke, seizures, and myopathy (Brust, 2004). In addition, neurological effects secondary to infections acquired through intravenous drug use (e.g., HIV) can occur. Recent research suggests that heroin abusers, regardless of length of abstinence, show impairments in attentional set-shifting, planning, memory/learning tasks, and reasoning, relative to non-drug users (e.g., Ersche, Clark, London, Robbins, & Sahakian, 2006; Ornstein et al., 2000; Verdejo-

Garcia & Perez-Garcia, 2007). Although stimulant abusers typically evidence poorer neuropsychological test performance than opiate abusers, Ornstein et al. (2000) found that heroin users were more impaired than amphetamine users in abstraction, spatial working memory, visuospatial abilities, and general learning ability. These results were not replicated by Ersche et al., possibly due to the different tests used. An additional difficulty in measuring the independent impact of heroin abuse on neuropsychological functioning is that many former heroin abusers use methadone, making it difficult to tease apart the effects of these two substances (Rogers & Robbins, 2001). For now, it appears that earlier ideas about the lack of chronic effects of opiates on cognition (e.g., Hartman, 1995) may be incorrect, although the effects may be less pronounced than that found with chronic alcohol or stimulant abuse.

*Summary*

While researchers typically aim to study individuals who meet criteria for one substance use disorder, it is perhaps more common in clinical practice to work with individuals with polysubstance abuse issues. The most consistent findings regarding neuropsychological effects of substance use are found among individuals with polysubstance abuse, and the results suggest the effects are similar to those among chronic alcohol abusers (Fals-Stewart & Lucente, 1994). This is particularly relevant in understanding the neuropsychological functioning of homeless individuals, who may abuse several substances as opposed to just one. While evidence supports the idea of independent neuropsychological effects for at least some substances (e.g., alcohol, cocaine), the combined effects can have both direct toxic effects on the brain as well as indirect neuropsychological effects via neurological impairment. Further, research

suggests that these neuropsychological effects can persist even after months of abstinence, and in some cases may be permanent.

## *Psychopathology*

Across several studies, common mental health concerns identified among the homeless are schizophrenia, affective disorders, anxiety, and antisocial personality disorder (e.g., Fischer, Shapiro, Breakey, Anthony, & Kramer, 1986; Reardon et al., 2003; Struening & Padgett, 1990). Reardon et al. (2003) found that rates of mental illness among formerly homeless individuals were similar to that of currently homeless individuals. A link between mental illness and homelessness has long been identified (Koegel et al., 1996), although it remains to be seen whether mental illness contributes to or is a consequence of homelessness. In either case, several of the common psychiatric disorders in this population carry neuropsychological consequences, and thus have an additional impact on the functioning and treatment of these individuals.

### *Schizophrenia*

Research on schizophrenia indicates that various neurological and neurodevelopmental abnormalities may explain the neuropsychological impairment among schizophrenics. Structural brain abnormalities include enlarged ventricles and diffuse cortical atrophy, while post-mortem examinations have revealed abnormalities in the hippocampus and medial temporal lobe structures in general (Lezak et al., 2004; Rains, 2002). Functional imaging studies have identified abnormal cerebral blood flow in schizophrenics, particularly in the frontal cortical regions (Lezak et al., 2004; Rains, 2002). Such data has led to the hypothesis that prefrontal cortex abnormalities are a major etiological factor in schizophrenia. Evidence in favor of this hypothesis comes

from studies that have found low frontal activation among schizophrenics working on frontal-heavy tasks, compared to non-schizophrenic controls (see Rains, 2002 for review). Additional research has suggested that children at risk for developing schizophrenia are often found to be cognitively impaired; such neurodevelopmental deficits may contribute to the neurocognitive deficits seen in adults with schizophrenia (Marenco & Weinberger, 2001; Silverstein, Mavrolefteros, & Close, 2002).

Although structural abnormalities have been found in adults with schizophrenia, a direct link to neuropsychological impairment has not been fully established. Numerous studies over the past several years have identified neurocognitive impairments in individuals with schizophrenia (for reviews see Heinrichs & Zakzanis, 1998; Lezak et al., 2004; Wilk et al., 2005). In a meta-analysis of over 200 studies, Heinrichs and Zakzanis (1998) found that adults with schizophrenia were impaired across numerous neuropsychological tests, relative to controls. Prominent areas of impairment included verbal memory, motor skills, performance IQ, attentional processes, and general intelligence. Similarly, Wilk et al. (2005) found that compared to FSIQ-matched controls, adults with schizophrenia performed poorly in the areas of processing speed and memory. An additional finding of this study was that individuals with schizophrenia may obtain similar FSIQs as non-schizophrenic controls, yet this occurs in different ways for the two groups. Individuals with schizophrenia often obtain relatively higher scores in verbal-laden tasks, compared to nonverbal tasks. Wilk and colleagues point out that a consideration of premorbid functioning is important to understanding and recognizing the neuropsychological deficits among individuals with schizophrenia.

While deficits in processing speed and attention have received much attention (Rains, 2002), memory impairments are also notable among individuals with schizophrenia. Deficits in processing speed and attention can help explain the long-term memory deficits among schizophrenics, but there is also evidence suggesting that such memory problems may be primary to schizophrenia (Holthausen et al., 2003). The authors of this study conclude that diminished activity in the prefrontal cortex and hippocampus may explain such deficits.

An additional factor to consider is the effect of a comorbid substance use disorder on the neuropsychological functioning of individuals with schizophrenia. In a study comparing schizophrenics and non-schizophrenics with and without alcoholism, the dually diagnosed group evidenced subtle impairments relative to the schizophrenia-only group (Allen, Goldstein, & Aldarondo, 1999). Further, both schizophrenia groups were more impaired than were alcoholics without schizophrenia. The impairment in the dually diagnosed group was particularly prominent as individuals reached older ages. In this study, particular areas of impairment were working memory, abstraction, social comprehension, and verbal auditory perceptions.

Although the research regarding neurocognitive impairment among schizophrenics is relatively well established, questions remain as to what explains such impairment. Lezak et al. (2004) note that the poor performance of schizophrenics on neuropsychological tests may be due to poor motivation, poor strategies, or other factors, as opposed to neurological factors. While answers in this area are needed, it is perhaps of greater importance to know that neuropsychological impairments – particularly in verbal

memory and vigilance – have been linked to poorer functional outcomes, such as social problem solving and skill acquisition (Green, 1996).

*Mood Disorders*

Individuals with Major Depressive Disorder (MDD) sometimes evidence reduced blood flow in the frontal cortex, similar to that seen in schizophrenia (Rains, 2002). However, unlike schizophrenics, depressed individuals do not show the same lack of prefrontal activation on frontal-heavy tasks (Berman, Doran, Pickar, & Weinberger, 1993). The main structural abnormalities in individuals with MDD are enlarged lateral ventricles and decreased frontal lobe volume (Pennington, 2002). Due to disruptions in attention, concentration, and motivation among individuals with depression, neuropsychological test performance may be impaired (see Lezak et al., 2004 for discussion). This becomes a particularly difficult issue when attempting to differentiate between dementia and depression, as the latter can mimic symptoms of progressive dementia (Lezak et al., 2004). Caine (1986) terms this pseudodementia syndrome. Additionally, depression is commonly found among individuals with neurological disorders, such as Parkinson's disease, stroke, and AIDS dementia, and it can exacerbate the cognitive impairment consistent with these disorders, particularly in the domain of memory (Lezak et al., 2004).

Research in this area suggests that impairment in neuropsychological functioning is a particular concern for individuals with recurrent depressive episodes (Basso & Bornstein, 1999). However, severity of depression has not always been linked to poorer neuropsychological functioning. For example, in a study by Martin, Oren, and Boone (1991) individuals with Dysthymic Disorder and MDD both performed poorly on the

WCST relative to non-depressed controls. On the other hand, moderately depressed older adults have been found to be more impaired in the areas of processing speed and executive functioning, compared to mildly depressed and non-depressed older adults (Boone et al., 1995).

Bipolar Disorder (BD) has also been linked to neuropsychological impairment. Basso, Lowery, Neel, Purdie, and Bornstein (2002) found that individuals with BD who were experiencing either depressed, mixed, or manic episodes scored lower than controls in the areas of verbal memory, executive functioning, processing speed, and dexterity. The authors noted that the three groups performed similarly to each other, suggesting that the impairments may be linked to BD itself, as opposed to current mood state. Neuroimaging studies of bipolar patients show two main structural abnormalities: white matter hyperintensities (WMH) and cortical atrophy (Pennington, 2002). The presence of WMH has been linked to deficits in executive functioning and processing speed (e.g., Jokinen et al., 2005).

*Anxiety Disorders*

North and Smith (1992) found high rates of Post-traumatic Stress Disorder (PTSD) among a sample of homeless men and women, and in most cases the onset of PTSD preceded that of homelessness. One of the structural findings of neuroimaging studies is reduced hippocampal volume among individuals with PTSD (Pennington, 2002). Less information is available about structural abnormalities in individuals with other anxiety disorders. Neuroimaging research suggests individuals with anxiety disorders evidence increased right prefrontal activation, and the orbital prefrontal cortex has been implicated in obsessive-compulsive disorder (Pennington, 2002).

## *Medical Issues*

### *Malnutrition*

While malnutrition in adulthood does not typically lead to permanent cognitive impairments (Rains, 2002), the short-term effects of poor nutrition can include disturbances in mood, memory, and thinking (Silver & Felix, 1999), all of which can negatively affect performance on neuropsychological tests. Older adults with dietary deficiencies are particularly likely to evidence cognitive impairment, such as slowed processing speed due to B-vitamin deficiencies (Lezak et al., 2004). Folate deficiency, commonly found among the elderly and those with limited access to folate-rich foods, can also produce neuropsychological impairment (Lezak et al., 2004). More severe nutritional deficiencies, such as thiamine deficiency among individuals with Wernicke-Korsakoff syndrome, can produce memory and other cognitive impairments (Rains, 2002).

### *Diabetes and Hypertension*

When left untreated, diabetes and hypertension can lead to neuropsychiatric symptoms, such as disorientation, confusion, and lethargy (Silver & Felix, 1999, p. 323). Further, uncontrolled diabetes and hypertension increases the risk of stroke and vascular dementia, which may lead to impairments in neuropsychological functioning (Silver & Felix, 1999).

### *Liver Disease*

Individuals who abuse alcohol are at risk for liver disease, including alcoholic hepatitis and cirrhosis (Brust, 2004; Sarafino, 2008). Further, persons with the hepatitis C virus (HCV) who drink heavily are more likely to develop cirrhosis, and a major source

of HCV among alcoholics is injection drug use (Brust, 2004). Given the high rates of alcohol and drug use among individuals who are homeless, liver disease is of major concern.

In addition to the multiple physical health consequences of liver disease is the collection of neurological symptoms known as hepatic encephalopathy. Common signs of hepatic encephalopathy include inattentiveness, dysarthria, lethargy, and behavioral changes, all of which can progress to the point of psychosis, delirium, or even coma (Brust, 2004, p. 350). Such symptoms may go unnoticed due to the simultaneous symptoms of intoxication, withdrawal, Wernicke-Korsakoff syndrome, hypoglycemia, and other alcohol-related diseases (Brust, 2004). Further, research with alcoholic and non-alcoholic cirrhosis patients suggests that hepatic encephalopathy leads to neuropsychological impairment, not the toxic effects of alcohol (Arria, Tarter, Kabene, Laird, Moss, & Van Thiel, 1991; Arria, Tarter, Starzl, & Van Thiel, 1991; Tarter, Van Theil, Arria, Carra, & Moss, 1988). Difficulties with attention, processing speed, and visuospatial skills are often found in individuals with hepatic encephalopathy (Lezak et al., 2004).

*HIV/AIDS*

There are multiple neuropsychological consequences associated with AIDS and HIV (Marotta & Perry, 1989; Silver & Felix, 1999). This is due to both the direct effects of the virus on the nervous system, as well as indirect effects from secondary illnesses or treatment complications (Marotta & Perry, 1989; Lezak et al., 2004). In the early stages, some individuals experience mild deficiencies in mental processing, as well as confusion

and attentional problems. Patients with HIV/AIDS-related dementia typically experience mild cognitive symptoms before progressing to full-blown dementia (Lezak et al., 2004).

*Traumatic Brain Injury*

Homeless individuals are at an increased risk for traumatic brain injuries (TBIs) due to several factors, including risk-taking behavior related in part to substance abuse, victimization, and the presence of antisocial personality traits (Silver & Felix, 1999). The neuropsychological consequences of TBI are numerous and depend in part on the nature (e.g., closed head vs. penetrating head injury) and severity of the injury, lesion sites, the age of the individual, and premorbid personality characteristics (Lezak et al., 2004).

Neuropsychological effects of penetrating head injuries (PHI) are more often focal than diffuse, although seizure disorders are common among PHI patients (Lezak et al., 2004). Closed head injuries (CHI), in comparison, produce diffuse neuropsychological effects, due to the nature of these injuries. Brain damage occurs from the primary injury (i.e., sustained at the time of impact) and from the second injury, which consists of effects set in motion by the primary injury (Lezak et al., 2004). Common sequelae of diffuse damage are reduced mental speed and impaired attentional capacity, but severe damage can lead to impairments in higher-level reasoning and concept formation skills (Lezak et al., 2004). Frontal and temporal lobe injuries can also occur, with accompanying changes in personality and psychosocial functioning. In cases of mild CHI, the most common cognitive deficit is attentional problems (Lezak et al., 2004).

*Seizure Disorders*

Over the course of several decades, the most commonly found neurological problem among the homeless has been seizures (Olin, 1966; Wright, 1990). Seizure disorders occur more often among homeless individuals who abuse alcohol, and the rates are three times higher in this group compared to homeless individuals who do not abuse alcohol (Wright, 1990). However, Wright also notes that seizure disorders tend to be more common among non-drinking homeless individuals compared to non-homeless adults seeking routine medical services. Neuropsychological effects of seizure disorder depend on the etiology, age of onset, and seizure origin (e.g., focal; temporal lobe), and can include memory and learning disorders (Lezak et al., 2004). Further, neuropsychological functioning can be negatively affected by antiepileptic drugs (Lezak et al., 2004).

*Neurological Deficits*

In addition to the conditions discussed above, there is evidence to suggest that homeless individuals have more neurological deficits than non-homeless individuals. Douyon and colleagues (1998) compared cerebellar dysfunction, frontoparietal deficits, frontal soft signs, and overall neurological performance among chronically homeless, acutely homeless, and non-homeless male veterans receiving inpatient psychiatric services. All participants were free of primary psychotic disorders and had no history of seizures, head injuries, encephalitis, or meningitis. The homeless participants were statistically significantly more neurological impaired than the non-homeless participants in the areas of frontoparietal and cerebellar functioning. Interestingly, both the homeless and non-homeless groups had similar substance use histories. Further, the acutely and

chronically homeless groups did not differ in terms of neurological impairment. Although Douyon and colleagues did not conduct any neuropsychological testing, the results suggest that neurological impairment is a concern for at least a subset of homeless individuals.

### *Summary*

Most of the biological and psychological issues found in the homeless population have been linked, in varying degrees of certainty, to neuropsychological impairment. Substance abuse, mental illness, and physical health problems all have direct or indirect effects on attention, learning, memory, and perhaps even higher order cognitive functions. While these effects are not always permanent, they can still have deleterious effects on daily functioning, employability, and the ability to benefit from clinical interventions. Fals-Stewart and colleagues (1994) suggest that substance abuse treatment programs may be too structured and rely too heavily on information processing skills for individuals with cognitive impairments to fully participate and succeed. These authors also emphasize the importance of understanding the nature of neuropsychological impairment among individuals who chronically abuse substances; such information would allow treatment providers to develop tailored interventions. This recommendation can easily be extended to the case of homeless individuals.

## Cognitive Functioning of Homeless Individuals

Interest in the cognitive functioning of homeless individuals can be traced back to Olin's 1966 survey of the "skid row" population in Toronto. These individuals, chronically homeless and evidencing serious alcohol abuse problems, were found to have multiple physical health problems and signs of central nervous system disorders,

including epilepsy, memory loss, and staggering gait. Further attention to cognitive impairment among homeless individuals did not occur until the 1980s and 1990s, when efforts were made to profile the physical health, mental health, and social characteristics of homeless individuals (e.g., Fischer & Breakey, 1991; Fischer et al., 1986; Struening & Padgett, 1990.)

These early research efforts focused on identifying the prevalence of cognitive impairment among homeless individuals. The Mini Mental Status Exam (MMSE; Folstein, Folstein, & McHugh, 1975) has been used in the vast majority of studies in this area. The MMSE is a screening tool that is widely used in both clinical and research settings, and it includes items that tap attention span, concentration, working memory, language, and construction abilities (Lezak et al., 2004).

Based on research using the MMSE, the prevalence of global cognitive impairment among homeless individuals appears to be high, with prevalence rates ranging from 1.8 to 10% (Bremner, Duke, Nelson, Pantelis, & Barnes, 1996; Buhrich, Hodder, & Teesson, 2000; Fichter, Koniarczyk, Greifenhagen, & Koegel, 1996; Fischer et al., 1986; Koegel, Burnam, & Farr, 1988; Koegel et al., 1999; Munoz, Vazquez, Koegel, Sanz, & Burnam, 1998; Spence, Stevens & Parks, 2004), although Teesson and Buhrich (1993) found that 40% of participants met criteria for at least mild cognitive impairment. In comparison, approximately 7% of non-institutionalized civilian adults over age 65 show some sign of memory loss or confusion (Bernstein & Remsburg, 2007), and approximately 2-3% of the general population meets criteria for cognitive impairment based on the MMSE (Spence et al.).

The discrepant findings on the prevalence of cognitive impairment among homeless individuals can partly be explained by limitations with the MMSE. For example, Lezak and colleagues' (2004) review of the MMSE points out that performance is influenced by age, education, and ethnicity, and that the MMSE is best used to identify moderate to severe impairment as opposed to mild impairment. In a study that highlights the concerns with using the MMSE with homeless individuals, Gonzalez and colleagues (2001) found that 80% of homeless participants were cognitively impaired based on a battery of cognitive and neuropsychological tests, yet less than 45% of these individuals were considered impaired by MMSE criteria.

The prevalence of cognitive impairment among homeless individuals has also been assessed with the use of other cognitive screening tools, although infrequently. Geddes, Newton, Bailey, Freeman, and Young (1996) found that 28% of their sample evidenced impairment using the Abbreviated Mental Test, a screening tool designed to be used with a geriatric population. However, these results must be interpreted cautiously, given that the majority of participants in this study were under the age of 65. A more recent study by Solliday-McRoy et al. (2004) found that 80% of participants in a sample of homeless men met criteria for at least mild cognitive impairment on the Cognistat, with memory as an area of particular impairment. The Cognistat (Northern California Neurobehavioral Group, 2007) is a screening battery that has been found to be more sensitive than the MMSE in detecting mild cognitive deficits (Schwamm, Van Dyke, Kiernan, Merrin, & Mueller, 1987). However, recent research has found that the Cognistat may not be sufficiently sensitive to the subtle impairments found among

individuals with TBI (Doninger et al., 2006), suggesting that subtle cognitive impairments may be pervasive among the homeless.

These early studies have been useful in terms of identifying that cognitive impairment is a concern among homeless individuals. However, this research is limited in that specific domains of cognitive functioning were not assessed. Additional research over the past several years has aimed to address this limitation.

### *General Intelligence*

There have been several different approaches to assessing the general intelligence of homeless individuals. Several researchers have used the full Wechsler Adult Intelligence Scale, Revised version (WAIS-R) or Third Edition (WAIS-III) to generate full-scale, verbal, and performance intelligence quotient (IQ) scores (Foulks et al., 1990; Cotman & Sandman, 1997; Duerksen, 1995; Lo, 2001), while others have used short forms to estimate intellectual capacity (Seidman et al., 1997; Solliday-McRoy et al., 2004). Seidman and colleagues (1997) used the vocabulary and block design subtests of the WAIS-R to generate an estimate of full-scale IQ, an approach that is considered to produce reliable and valid results (Sattler, 2001). Similarly, Solliday-McRoy and colleagues (2004) used the Wechsler Abbreviated Scale of Intelligence (WASI) to estimate verbal, performance, and full-scale IQ scores. The WASI (The Psychological Corporation, 1999) includes four subtests similar to those found in the WAIS-III—vocabulary, block design, similarities, and matrix reasoning—and has good psychometric properties (Sattler, 2001). Finally, a few studies have taken a different approach by assessing whether general intelligence among homeless individuals declines over time (Adams, Pantelis, Duke, & Barnes, 1996; Bremner et al., 1996).

Across these studies, mean full-scale IQs or IQ estimates ranged from 82.8 (Seidman et al., 1997) to 97.3 (Foulks et al., 1990). On the upper end were IQ scores obtained by a group of homeless male veterans (Foulks et al., 1990); of note here is the finding that homeless veterans tend to have more years of education than non-veterans (e.g., Rosenheck & Koegel, 1993; Seidner, Burling, Fisher, & Blair, 1990), and thus they may obtain higher IQ scores than non-veteran samples. Ignoring this extreme, the majority of studies have reported mean full-scale IQs in the 80 – 89 point range, suggesting below average intellectual ability among homeless individuals compared to population norms. Few studies have reported verbal or performance IQ scores, but the results suggest that both tend to be below average. Specifically, estimated verbal IQs ranged from 83.7 (Solliday-McRoy et al., 2004) to 97.6 (Foulks et al., 1990), and estimated performance IQs ranged from 87.1 (Solliday-McRoy et al., 2004) to 98.1 (Foulks et al., 1990).

In addition to assessing current IQ, some researchers have attempted to answer the question of whether homeless individuals' intellectual abilities decline over time (Adams et al., 1996; Bremner et al., 1996). In both studies that took this approach, current intellectual abilities were estimated using Raven's Progressive Matrices (RPM) and premorbid intelligence was determined using the National Adult Reading Test (NART). The NART is a reading test that taps verbal intellectual abilities and is commonly used to estimate premorbid intellectual abilities (Strauss, Sherman, & Spreen, 2006). The assumption in using this approach is that word reading ability, highly correlated with general intelligence, is typically retained even among individuals who have suffered brain injuries or in those with dementia (Lezak et al., 2004; Strauss et al.).

The RPM has been described as a test of inductive reasoning, concept formation, and nonverbal intelligence (Lezak et al., 2004; Sattler, 2001; Spreen & Strauss, 1998). Its use in estimating general intelligence has been questioned for its reliance on the capacity for figural reasoning (Sattler, 2001; Strauss et al.).

In these studies, the difference in performance on the NART and RPM was labeled as IQ change or "drop." Bremner et al. (1996) found an average IQ drop of 10.6 points (NART mean = 95.9; RPM mean = 83.6), a difference that was found to be statistically significant. The most dramatic differences were found in two small subsamples: individuals diagnosed with schizophrenia evidenced an 18.2-point difference between NART and RPM scores, while those with an alcohol use disorder saw an 18.7-point difference. Similarly, Adams et al. (1996) examined IQ change among those with severe mental illnesses and those without. A large decline in IQ (23 points) was found in the former group, which saw a decrease from a premorbid IQ estimate of 97 to a current IQ estimate of 74. The non-severely mentally ill group saw an 8-point IQ drop, from 89 to 80. The authors did not explain the nearly 10-point premorbid IQ difference between the groups.

Adams et al. (1996**)** and Bremner et al. (1996**)** suggest that severe mental illness – particularly schizophrenia – and malnutrition might explain the decline in IQ found among their participants. However, without knowledge of the participants' previous nonverbal intellectual abilities it is difficult to know whether the low performance on the RPM reflects changes in functioning or a continuation of poor performance. These results can also be looked at as estimates of current verbal and nonverbal intellectual abilities, as opposed to changes over time. The reason for such dramatic differences in verbal- and

nonverbal-based intellectual abilities could be explained in multiple ways, including the presence of brain injury or psychopathology (Sattler, 2001).

In sum, across the extant studies examining the intellectual capacities of homeless individuals, IQ scores and estimates tend to fall in the low average range. However, there are some homeless individuals, namely those who are military veterans, who tend to exhibit average intellectual capabilities. It is also possible that distinct differences in verbal and nonverbal intellectual abilities exist among certain subgroups of homeless individuals, although this is a tentative suggestion that requires more research. At this time, it is unknown as to whether individuals who experience a cognitive decline are more likely to become homeless, or if homelessness is a contributing cause of cognitive decline.

### *Achievement*

Few studies have directly assessed the academic achievement abilities of homeless individuals. Seidman and colleagues (1997) used the Wide Range Achievement Test, Revised Edition (WRAT-R) to obtain information about the reading, mathematics, and spelling abilities of homeless individuals, while Solliday-McRoy and colleagues (2004**)** used the reading subtests of the Woodcock Johnson Revised Tests of Achievement (WJ-R ACH) to determine homeless men's reading abilities. As mentioned previously, Adams et al. (1996) and Bremner et al. (1996) used the NART, a word reading test, but scores were converted to premorbid IQ estimates. Additionally, O'Neil-Pirozzi (2003), a speech pathologist, has assessed the language functioning of homeless mothers and children living in shelter using the Test of Adolescent and Adult Language – Third Edition.

Across this limited group of studies, few generalizations can be made. One tentative conclusion is that reading deficits are common among homeless individuals. Solliday-McRoy and colleagues (2004) found that, on average, participants were reading at the 8th to 9th grade level, although nearly one-third of the sample obtained reading comprehension scores at or below a 5th grade level. Seidman and colleagues (1997) found that reading ability in their sample fell in the low average range (mean = 81.4), and O'Neill-Pirozzi (2003) found that 32% of sheltered homeless mothers had reading deficits. One study reported data on spelling (WRAT-R mean = 82.1) and arithmetic skills (WRAT-R mean = 78.7), finding that homeless individuals performed below average in these areas as well (Seidman et al., 1997).

These studies tentatively suggest that academic achievement deficits exist among homeless individuals; however, more information in this area is needed before firm conclusions can be drawn. Information regarding academic-related skills such as reading and mathematics has direct relevance when considering employability, household management, and related life skill domains; as such, achievement abilities are an important area to assess when working with homeless persons.

### *Summary*

Early efforts to determine the prevalence of cognitive impairment among homeless individuals shed light on this important issue, and the primary conclusion from this research is that cognitive impairment tends to be more common in the homeless population than in the general population. Subsequent research over the past two decades suggests that homeless individuals in general function below average in the areas of general intelligence and academic achievement, and that nonverbal intellectual abilities

may be particularly impaired for certain subgroups. However, more sophisticated assessment procedures are needed to understand the nature of cognitive impairment in this population.

## Neuropsychological Functioning of Homeless Individuals

Although an evaluation of the neuropsychological functioning of homeless individuals could deepen our understanding of this population, it is an area that has received little attention. Since 1990, only a handful of studies have gathered neuropsychological test data on homeless individuals, and these studies have ranged in terms of their comprehensiveness. The recommended domains for a comprehensive neuropsychological evaluation include attention, memory, language, motor and sensory functioning, and executive functioning (Spreen & Strauss, 1998; Strauss et al., 2006). The existing research with homeless individuals addresses most of these domains, but as will be seen, the conclusions that can be drawn from these studies are tentative at best.

### *Attention*

#### *Definitions*

Mesulam (2000) defines attention from both a psychological and neural perspective; psychologically speaking, it involves the shifting of information processing resources and behavioral response networks toward events or stimuli that have become salient or relevant. The neuronal response to salient stimuli is stronger, more selective, and longer compared to the neuronal response to irrelevant information. Similarly, Luria (1973) considers attention to be an intentional process that is both directive and selective in its workings.

Further, Mesulam (2000, p. 176) conceptualizes attention as a “matrix” that is maintained by top-down influence from the frontal lobes and bottom-up influence from the reticular activating system (RAS). The RAS helps maintain a state of arousal, while the frontal lobes, as well as parietal and limbic cortices, are involved in channeling the attention toward a particular target, filtering out insignificant stimuli, and dividing attention as needed. Collectively, these processes are independent of any particular sensory modality or domain. There are also domain-specific neurons that are involved in attentional processes; for example, visual neurons are activated when attending to visual stimuli.

The concept of attention has been further broken down into several components, most commonly processing speed / reaction time, sustained attention or vigilance, attention span / capacity or short-term storage, selective attention, and mental tracking or working memory (Lezak et al., 2004; Mesulam, 2000; Ponsford, 2000). The terms attention, concentration, and mental tracking are often used interchangeably, although there are subtle differences according to Lezak et al. (2004); for example, attention is required for concentration, which in turn is a prerequisite for mental tracking. More recently, an attentional system consisting of several networks has been proposed: The alerting network is responsible for arousal and vigilance, the orienting network is linked to selective attending, and the executive network is implicated in response inhibition, cognitive flexibility, and divided attention (Posner and Rothbart, 2007). Regardless of the particular terminology, attentional processes serve as the foundation for intelligence, goal-directed behavior, memory, and executive processes (Lezak et al., 2004; Mesulam, 2000; Rains, 2002).

*Assessment*

Weintraub (2000) lists attention as the first domain to be assessed in any evaluation of mental state and suggests that it is the most important, given the influence of attention on all other forms of cognitive activity. Included in this assessment is a determination of the level of arousal, followed by an assessment of attention span, sustained attention, selective attention, short-term memory, and other aspects of the attentional "matrix." Ponsford (2000) and Lezak et al. (2004) similarly organize the assessment of attention into processing speed, sustained attention/vigilance, selective attention, attention span, and mental tracking. In addition to evaluating attentional abilities from these different perspectives, it is important to consider the influence of mood, motivation, sensory and motor capabilities, medication use, fatigue, pain, substance use, and neurological or psychiatric problems on attentional abilities (Lezak et al., 2004; Ponsford, 2000; Weintraub, 2000). Additionally, subtle attentional deficits do not always emerge in a structured, quiet, and distraction-free test situation, which is quite different from everyday life (Ponsford, 2000).

The typical assessment of attention can include several instruments. Both Lezak et al. (2004) and Weintraub (2000) recommend starting with an evaluation of arousal or wakefulness, as clients who are not fully awake and oriented will be unable to participate in further examination. Following this, sustained attention can be assessed with the use of continuous performance tests (CPTs; Lezak et al., 2004; Weintraub, 2000), which utilize either visual or auditory stimuli. For example, Conners' CPT-II (Conners & MHS Staff, 2000) is a visual sustained attention task in which letters are continuously shown on a

screen; examinees press a button for each letter except the letter "X." These tasks also tap into the individual's ability to inhibit a response (Weintraub, 2000).

To evaluate selective attention, Weintraub (2000) and Ponsford (2000) recommend the Stroop Color Word Test (specifically the interference or "color-word" task) and the Trail Making Test (TMT). The interference task of the Stroop requires examinees to name the colors in which words are printed, rather than the words themselves. Lezak et al. (2004) classify the Stroop procedure as a measure of concentration and mental tracking, while Strauss et al. (2006) list it as a test of executive functions, specifically cognitive flexibility and selective attention.

There are similar difficulties with categorizing the TMT. In Part A of the TMT examinees connect numbered dots in order as quickly as possible, while in Part B examinees alternate between numbers and letters (e.g., 1-A-2-B-3-C). Lezak et al. (2004) describe it as a measure of mental tracking ability, visual processing, and perseveration tendencies. Strauss et al. (2006) discuss the differences between Parts A and B and suggest that Part B taps cognitive set-shifting capacities more so than Part A. Similarly, Weintraub (2000) discusses the use of Part B to assess for response inhibition ability. In sum, it is difficult to place the Stroop or the TMT in one test category, as they tap into multiple cognitive functions.

Processing speed, attention span, and working memory are perhaps more straightforward in terms of test selection. While some have suggested an informal assessment of processing speed by observing performance across various tasks (e.g., Lezak et al., 2004), other have recommended the use of formal tests such as the Digit Symbol-Coding subtest of the WAIS-III or the color-naming and word reading tasks of

the Stroop (Ponsford, 2000). However, there is a graphomotor element to Digit Symbol-Coding that must be considered when interpreting an individual's performance. Attention span can also be assessed using subtests of the WAIS-III, typically Digit Span (Lezak et al., 2004; Ponsford, 2000; Weintraub, 2000). The digits backward portion of this test can be used to assess mental tracking or working memory, as can the Letter-Number Sequencing subtest (Lezak et al., 2004; Ponsford, 2000; Weintraub, 2000).

In summary, evaluating the various aspects of attention requires the use of multiple assessment approaches, with attention to factors (e.g., mood, motivation, fatigue, etc.) that can negatively influence the attentional matrix. Yet there is no universal definition of attention and no established battery of tests for its measurement (Ponsford, 2000). The most frequently used tests include the Stroop, the Trail Making Test, Digit Span, Letter-Number Sequencing, and Continuous Performance Tests.

*Research with Individuals Who Are Homeless*

All of the available studies assessing the neuropsychological functioning of homeless individuals have included tests that tap attentional capacities. Instruments used to assess attention have included the Digit Span and Digit Symbol subtests of the WAIS-R (Cotman & Sandman, 1997; Gonzalez et al., 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004), CPTs (Cotman & Sandman, 1997; Seidman et al., 1997), the Stroop test (Duerksen, 1995; Foulks et al., 1990), the Spatial Span subtest of the WAIS-R as a Neuropsychological Instrument (WAIS-R NI; Cotman & Sandman, 1997), Part A of the TMT (Gonzalez et al., 2001; Lo, 2001), and the Color Trails Test – Part 1 (Lo, 2001). However, none of the existing studies has included tests traditionally used to assess

mental tracking or working memory, such as the Letter-Number Sequencing subtest of the WAIS-III.

Studies using the Digit Span and Spatial Span subtests of the WAIS-III suggest that homeless individuals function slightly below average (Seidman et al., 1997) or in the average range (Cotman & Sandman, 1997; Foulks et al., 1990; Solliday-McRoy et al., 2004) in attention span. However, Solliday-McRoy and colleagues (2004) found that although most participants performed in the average range on Digit Span, roughly one in four participants evidenced some degree of attention span impairment. In terms of processing speed, research with the Digit Symbol subtest suggests that homeless individuals may evidence slowed mental processing compared to the general population (Gonzalez et al., 2001; Seidman et al., 1997), although Foulks and colleagues (1990) found that homeless men outperformed housed men on Digit Symbol. This test has a graphomotor component, and it is unknown if homeless individuals who participated in these studies had any motor or sensory impairments that might have compromised performance on the test.

Research on the sustained attention abilities of homeless individuals using CPTs (Cotman & Sandman, 1997; Seidman et al., 1997) are more suggestive of impairment, although only two studies exist in this area and each assessed attention using different sensory modalities. Cotman and Sandman (1997) used the visual version of the Test of Variables of Attention (T.O.V.A.) and found that half of the participants met criteria for attentional problems (e.g., omissions: $M = 1.9$, $SD = 3.8$; commissions: $M = 8.8$, $SD = 6.6$). Thus, participants tended to perform poorly on tasks of sustained attention but evidenced average performance in processing speed as discussed above. Seidman and

colleagues (1997) also found impairments in sustained attention among homeless individuals using an auditory CPT; the average performance among participants was below average (*M* = 20.1, *SD* = 7.7).

In contrast to the mild attentional impairments in sustained attention, research with homeless individuals using the Stroop tests suggests no impairment in selective attention. Homeless participants in Foulks et al. (1990) performed in the average range on the Stroop interference ("color-word") task based on scores predicted by Mitrushina, Boone, Razani, and D'Elia (2005), and homeless men in Duerksen (1995) performed as well as non-homeless men on the Stroop, obtaining above average scores on the interference task.

Different findings regarding the selective attentional abilities of homeless individuals have been obtained with the use of tests other than the Stroop. Performance on Part A of the TMT falls in the impaired range (*M* = 55.6, *SD* = 39.5; Gonzalez et al., 2001) and the borderline to low average range (*M* = 45.5, *SD* = 28.7; Lo, 2001) based on normative data (Mitrushina et al., 2005; Spreen & Strauss, 1998). Lo also reported data for the Color Trails Test – Part 1, which is conceptually similar to the TMT; performance on this test is also suggestive of impairment in selective attention (*M* = 55.0, *SD* = 38.5).

*Summary*

The current research on the attentional abilities of homeless individuals suggests little impairment overall, with the exception of some difficulties in selective attention. However, these conclusions are based on a very small group of studies. Further, it is difficult to draw conclusions across these studies because of possible moderating variables and sample characteristics. For example, Foulks and colleagues (1990) studied

homeless male veterans and found essentially no attentional deficits. These individuals typically have had extensive military training and/or experience that may lend itself to better performance on tests that require sustained and selective attention.

There are also variations in the psychiatric and substance use histories of the samples. Individuals who participated in Cotman and Sandman's (1997) study, for example, did not have severe mental illnesses, and none were currently using drugs or alcohol. Similarly, Gonzalez and colleagues (2001) excluded individuals with suspected chronic substance abuse problems. On the other hand, Solliday-McRoy and colleagues (2004) only excluded homeless men who had fewer than eight hours of sobriety, and participants in Seidman et al. (1997) had histories of psychiatric and substance use disorders. Such variables are important to consider when assessing attention and could have contributed to the inconsistent findings across these studies. Further, the data were not grouped by age, education, or IQ level, which would provide interpretive value (Mitrushina et al., 2005).

## *Memory*

### *Definitions*

Memory has been conceptualized and organized in various ways. Categorizations of memory can be based on *what* is remembered, *how much* is remembered, and the *process* of memory (Rains, 2002). The domains of explicit and implicit memory have been proposed, although there is not complete agreement on this conceptualization (Markowitsch, 2000). Explicit memory is that which is consciously recollected and typically includes memories of personal experiences (i.e., episodic memory) and factual information (i.e., semantic memory). Implicit memory is a non-conscious process that

includes our memories of motor skills, perceptual skills, and cognitive abilities; the behavioral manifestation of the skill or knowledge is evidence of memory.

More agreement exists on the capacity/duration organization of memory, the most basic conceptualization being short- versus long-term memory. Rains (2002) expands this to include the sensory register, short-term memory, working memory, and long-term memory. Short-term memory holds information very briefly and is limited in its capacity; further, the data in short-term storage is vulnerable to distractions (Rains, 2002). Several researchers have incorporated short-term memory into the working memory concept (e.g., Baddeley, 2002; Markowitsch, 2000; Rains, 2002); this is seen as a multipart system that includes an attentional/executive "overseer" at its core, along with a "workspace" that consists of separate short-term memory processes for visuospatial and verbal information (Baddeley, 2002; Della Sala and Logie, 2002). Long-term memory has the largest capacity and longest duration of these components, with some memories held for a lifetime (Rains, 2002).

In addition to the content- and temporal-based conceptualizations of memory, researchers have also proposed a process for how memory works. This is commonly described as a three-part process of encoding, storage, and retrieval (Baddeley, 2002; Markowitsch, 2000; Rains, 2002). A prerequisite for encoding is attentiveness/arousal, as incoming information must be recognized by the nervous system in order to be represented in some shape or form. Information that is encoded will be lost unless it is stored, and that stored information is retrieved when needed (Rains, 2002). Retrieval can occur via recall, recognition, or by a behavioral demonstration that something was implicitly learned (Baddeley, 2002). Recall, which requires the independent reproduction

of the item/object, is more cognitively taxing than recognition (Baddeley, 2002). Luria (1973) has suggested that interference in the retrieval process explains the experience of forgetting, as opposed to the decay of memories over time. This three-part memory system has been used as a foundation for understanding the source of memory deficits.

*Assessment*

There are many different manifestations of memory impairment and a memory complaint is often the primary reason for a neuropsychological evaluation (Lezak et al., 2004). Further, Lezak et al. consider the evaluation of memory to be an essential component of any neuropsychological assessment.

The elements of a comprehensive memory evaluation include rote learning ability, visuospatial and verbal memory, prose recall, remote memory, and autobiographical memory (Lezak et al., 2004). Rote learning ability provides information on attention, short-term memory span, storage, and retrieval (Lezak et al., 2004); tests such as the Rey Auditory Verbal Learning Test (RAVLT) are useful in this regard. The evaluation of both verbal and visuospatial memory is recommended as each involves separate memory processes (Della Sala and Logie, 2002), and impairments in one or the other can often provide information about the type of brain lesion involved (Groth-Marnat, 2003; Lezak et al., 2004). Verbal memory can be assessed with the RAVLT, paired associate word learning tests, and tests of prose recall, among others. Prose recall, the ability to remember information heard in conversation or in story form, can be assessed with the Logical Memory subtests of the WMS-III, or similar tests.

Visuospatial memory is typically evaluated with tests such as the Rey Complex Figure Test (RCFT) and the Benton Visual Retention Test (BVRT); these tests tap the

nonverbal aspects of memory, although some include verbal aspects (Lezak et al., 2004). Finally, the integrity of long-term, or remote, memory can be assessed by testing an individual's fund of information (e.g., recall and recognition of famous events or people) and knowledge of personal life events (e.g., autobiographical interviews).

The assessment of attention should also be part of any memory evaluation (Lezak et al., 2004). As discussed earlier, attentional impairments can compromise the encoding process, which consequently impedes the storage process (Groth-Marnat, 2003; Lezak et al., 2004; Rains, 2002). This can manifest in retrieval difficulties, as it is difficult to recall information that has not been encoded or stored. However, retrieval problems can also result from interference in the process of recalling stored information. In order to differentiate between the two, Lezak et al. (2004) recommend that memory evaluations incorporate strategies such as recognition trials or memory cues to gain more information about where in the encoding-storage-retrieval process a breakdown has occurred.

In addition to attention, the impact of other variables on memory test performance should be considered (Groth-Marnat, 2003; Lezak et al., 2004). Two areas that have been highlighted are sensory impairments and motivation/spontaneity. Vision and hearing impairments are highly likely to influence performance on memory tests, a particular area of concern for older adults. Lezak et al. (2004, p. 415) also point out that individuals with frontal lobe damage or types of subcortical damage may exhibit diminished spontaneity, drive, or persistence, all of which can negatively affect performance on memory tests. While sensory impairments and brain damage account for most of the poor performance on memory tests, the impact of depression should also be considered (Groth-Marnat,

2003). Depressed individuals with psychomotor retardation or lack of drive are also found to perform poorly on memory tests (Lezak et al., 2004).

*Research with Individuals Who Are Homeless*

Most of the studies on the neuropsychological functioning of homeless individuals have included at least some assessment of memory (Cotman & Sandman, 1997; Duerksen, 1995; Lo, 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004). Each study met the recommendation (Lezak et al., 2004) of including an assessment of attention, and most included at least a few items tapping remote and autobiographical memory. Verbal memory, including rote learning, recall, and recognition, was assessed in four of the five studies. Two studies used the Verbal Paired Associates subtest of the WMS-R (Cotman and Sandman, 1997; Seidman et al., 1997) and three used the Logical Memory subtests of the WMS-R or WMS-III (Cotman and Sandman, 1997; Lo, 2001; Seidman et al., 1997). Word list-learning tests were used in three of the studies, with each using a different test format (Cotman & Sandman, 1997; Lo, 2001; Solliday-McRoy et al., 2004). These tests all include immediate and delayed recall and recognition trials.

Visual memory was also assessed in four of the five studies (Cotman & Sandman, 1997; Duerksen, 1995; Lo, 2001; Solliday-McRoy et al., 2004). Each used a type of figural memory test; Cotman and Sandman used the BVRT and the Figural Memory and Visual Reproduction subtests of the WMS-R, while Duerksen, Lo, and Solliday-McRoy and colleagues used the RCFT. In addition, Lo used the Visual Reproduction subtests of the WMS-III. In all, only two studies (Cotman & Sandman, 1997; Lo, 2001) have included all of the recommended components (i.e., rote learning, prose recall, verbal and visual recall, and verbal and visual recognition trials) of a thorough memory evaluation.

Across the small group of existing studies in this area, the data are somewhat inconclusive. In terms of verbal memory, rather dramatic differences were found between the two studies that utilized the same verbal subtests of the WMS-R (Cotman & Sandman, 1997; Seidman et al., 1997). The mean Verbal Index score for Cotman and Sandman's sample was 90.5 (*SD* = 13.2), whereas participants in Seidman and colleagues' study averaged 80.7 (*SD* = 17.5), suggesting greater impairment in the latter group. Lo (2001), using similar subtests of the WMS-III, obtained results that lie between these earlier studies; participants with a history of one or more TBI obtained an average verbal memory score of 85.3 (*SD* = 14.6), and those with no TBI history obtained an average score of 85.6 (*SD* = 13.5).

The disparate findings across these studies can be explained in terms of sample characteristics. Cotman and Sandman (1997) assessed 24 individuals who were part of a select residential program that excluded persons with severe mental illness, mental retardation, or other features rendering them unemployable. In addition, individuals in the program underwent random drug testing as a condition of remaining in the program. Only two participants in this study self-reported previous treatment for a psychiatric or substance use disorder, although two-third acknowledged a past problem with drug abuse. Lo (2001) analyzed data collected at a neuropsychology clinic; individuals who self-reported any experience with homelessness were included in the data set. No information was provided regarding the length of homelessness, the number of episodes of homelessness, or whether the individuals were homeless at the time of testing. Further, Lo (2001) did not assess for mental health or substance use disorders. What is known

about the sample used in this study is that roughly one third of the participants had education beyond high school and 40% were currently receiving disability benefits.

In contrast to these relatively "healthy" samples, Seidman and colleagues' (1997) sample of 114 participants was recruited from shelters for individuals with mental health histories, and well over half had multiple Axis I diagnoses, including schizophrenia, bipolar disorder, and substance dependence. Given the striking differences in these samples, it is perhaps unsurprising that participants in Seidman and colleagues' study performed relatively poorly on the verbal memory tests.

Additional data regarding verbal memory was obtained through the use of word list learning tests. Cotman and Sandman (1997) used the CVLT and Solliday-McRoy et al. (2004) used the RAVLT, tests that are conceptually similar and moderately correlated (Strauss et al., 2006). However, Strauss and colleagues also note that the CVLT may be more sensitive to memory impairment than the RAVLT or WMS-R. Participants in Cotman and Sandman's study performed within one standard deviation of the general population mean ($M$ = 43.7, $SD$ = 1.4). However, age, gender, and intelligence moderate CVLT performance (Strauss et al., 2006). Using normative data (Spreen & Strauss, 1998) based on individuals aged 30 to 39 years old ($M$ = 30.6) with full-scale IQ scores in the range of 90 to 99 ($M$ = 89.4), Cotman and Sandman's sample performed slightly below that expected for both men and women. These results seem to suggest that subtle verbal memory impairments may exist even among relatively "healthy" homeless individuals.

Among participants in Solliday-McRoy and colleagues' (2004) study, on the other hand, over half (60%) obtained RAVLT standard scores below 85, and 33% obtained extremely low scores for Trials 1 through 5. The vast majority of individuals participating

in this study, in contrast to Cotman and Sandman's participants, reported current or past substance abuse/dependence, and half reported receiving mental health treatment in the past. Further, participants in this study were, on average, 10 years older than were participants in Cotman and Sandman's study. While not a drastic difference, age is a factor influencing performance on both the CVLT and the RAVLT (Strauss et al., 2006).

In examining the findings regarding verbal memory across these three studies, few clear conclusions emerge. Perhaps not surprisingly, homeless individuals who are less affected by severe mental illness or substance abuse/dependence appear to have few or less severe verbal memory deficits, although subtle deficits not detected by all tests may be present. Among homeless individuals who are affected by mental illness and addiction, deficits in verbal memory appear to be mild to moderate on average. Differences in sample characteristics across this group of studies also diminish the ability to draw firm conclusions, obviating the need for further research.

Information regarding the prose recall abilities of homeless individuals is similarly scant. Three studies (Cotman & Sandman, 1997; Lo, 2001; Seidman et al., 1997) assessed this aspect of verbal memory by using the Logical Memory subtests of the WMS-R or WMS-III. These tests tap an individual's ability to listen to a story and recall specific or central elements in both the short- and long-term. In a sample of homeless individuals with histories of mental health and substance use problems, mean percentiles for immediate and delayed prose recall were 25.6 (*SD* = 25.6) and 24.4 (*SD* = 23.4), respectively (Seidman et al., 1997). This corresponds to low average performance in both the immediate and delayed domains. Similarly, participants in Lo's (2001) study performed in the low average range on immediate prose recall; however, performance on

delayed prose recall was in the average range. Cotman and Sandman reported only the verbal index score of the WMS-R, which incorporates both Logical Memory subtests and Verbal Paired Associates; the Verbal Index mean of 90.5 (*SD* = 13.2) suggests that Logical Memory performance may have been in the low average to average range. In all, these results suggest that difficulties with prose recall may exist for some homeless individuals, although very little data exists in this area. Further complicating matters is that, among the three studies that assessed prose recall, the sample characteristics were quite different, as previously discussed.

Similar limitations exist in the extant literature on the visuospatial memory abilities of homeless individuals. Four studies assessed this facet of memory (Cotman & Sandman, 1997; Duerksen, 1995; Lo, 2001; Solliday-McRoy et al., 2004). Although three of these studies used the RCFT, each one administered the test in a slightly different manner. Lo (2001) administered a 3-minute recall trial following the initial copy task, while Duerksen (1995) administered the initial copy task followed by a 30-minute delay trial. Solliday-McRoy et al. (2004) administered the copy task and both recall trials and found that, on average, participants performed slightly below average on both the immediate and delayed memory tasks (immediate: *M* = 74.89, *SD* = 20.15; delayed: *M* = 73.70, *SD* = 20.46). In addition, 46% of the sample performed in the extremely low range on the immediate recall task and 49% scored in the extremely low range on delayed recall. Duerksen (1995) and Lo (2001) obtained similar results; based on normative data provided in Spreen and Strauss (1998), participants performed slightly below average on delayed and immediate recall tasks, respectively.

The results of other visual memory tests align with findings from the RCFT. Lo (2001) found that homeless individuals with no history of TBI (*M* = 87.9, *SD* = 17.6) and those with a history of TBI (*M* = 83.2, *SD* = 14.6) both performed below average on visual memory subtests from the WMS-III. However, participants in another study using the WMS-III found that participants obtained a mean visual memory index score in the average range (*M* = 103.8, *SD* = 18.1; Cotman & Sandman, 1997). Interestingly, these same participants performed poorer than expected on the BVRT, based on the sample's mean IQ. More errors (*M* = 5.6, *SD* = 4.9) and fewer correct responses (*M* = 6.4, *SD* = 2.3) were made by participants in the sample, compared to the average performance for individuals in both the 80 to 89 and 90 to 99 full scale IQ groups of the standardization sample (Cotman & Sandman, 1997; Spreen & Strauss, 1998).

Again, sample characteristics may account for these differences. Participants in Solliday-McRoy et al. (2004) evidenced more psychological and substance use problems – in addition to a high rate of head injury with loss of consciousness – than did participants in the other studies. Collectively, the results of this group of studies suggest that visuospatial memory may be an area of concern for homeless individuals, particularly given the discrepancy in Cotman and Sandman's study between visual memory performance and IQ.

Finally, minimal information regarding remote or autobiographical memory among homeless individuals has been reported. A few studies have included brief screening measures of orientation or attention (e.g., Cotman & Sandman, 1997; Solliday-McRoy et al., 2004) that ask the participant to provide a date of birth and other

autobiographical data. However, there has been no formal reporting of data regarding remote or autobiographical memory among homeless individuals.

*Summary*

It is difficult to draw conclusions about the memory functioning of homeless individuals from a small group of studies. Across these studies, the findings suggest that a subgroup of homeless individuals exhibit mild or subtle impairments in the areas of verbal and visuospatial memory, rote learning, prose recall, immediate and delayed recall, and/or recognition memory. However, these studies also indicate that a sizable number of homeless individuals may be experiencing severe memory problems.

The extant literature reveals a lack of sufficient data to understand the memory functioning of homeless individuals. In the four studies that recruited homeless individuals for neuropsychological testing (Lo, 2001 analyzed a data set obtained from an assessment clinic), participants were drawn from treatment programs or shelters, and thus no information exists regarding the memory functioning of homeless individuals who are not actively engaged in the service system. It may be that those individuals who are able (and willing) to access social services are higher functioning in the domain of memory – for example, remembering the address and rules of the shelter, keeping track of appointments, and so forth.

Additionally, little is known about variables or factors that may increase the likelihood of memory impairment among homeless individuals. Both Solliday-McRoy et al. (2004) and Seidman et al. (1997) found no statistically significant correlations between potential moderators (e.g., substance use or mental health conditions) and memory test performance. Research has also failed to establish a strong link between

history of TBI and memory functioning among homeless individuals (Lo, 2001; Solliday-McRoy et al., 2004). However, Seidman et al. did not obtain information regarding head injuries or loss of consciousness, so it is unknown as to whether these variables were correlated with memory test performance among their participants. Furthermore, Cotman and Sandman (1997) did not explore any relationships between client variables and memory functioning. Thus, it is unknown as to whether there is something about being homeless that is linked to memory problems, or if pre-existing conditions that impair memory make some individuals more susceptible to becoming homeless.

## *Language*

### *Definitions*

Language is a communication system that allows for the sending and receiving of messages (Rains, 2002). There are several characteristics of language, including the basic sound units (phonemes) that comprise a language, the manner in which these units are combined to make words (morphology), and the rules for linking words into phrases and sentences (syntax or grammar). Further, these words and sentences must have some meaning attached to them in order to facilitate communication; this is the domain of semantics. Finally, the realm of pragmatics addresses the use of language in different social contexts. The role of language in social communication and general intellectual activity has made it an important area of study (Luria, 1973; Rains, 2002).

Neuropsychologists typically divide language into two broad domains of expression and reception (Johnstone, Holland & Larimore, 2000; Lezak et al., 2004; Luria, 1973). Receptive language includes comprehension of both visual (i.e. reading) and auditory (i.e. speech) information (Johnstone et al., 2000). Luria (1973) has outlined

several requirements for adequately receiving and comprehending speech. At the most basic level, an individual must be capable of isolating and identifying the phonemes of the language being spoken. The received sounds and words must also be retained in one's short-term memory so that the whole of the narrative can be analyzed, decoded, and ultimately understood. Additionally, the words, phrases, and sentences must be analyzed and synthesized simultaneously to fully understand what is being communicated. Luria has said that understanding complex narrative speech relies on the ability to pick out the most essential and significant elements of the narrative so that appropriate meaning can be attached; this is a goal-directed activity that calls upon the frontal lobes and executive processes. In the visual domain, reading comprehension can be impaired as the result of visual processing difficulties, as in visual word-form dyslexia, or impaired processing following an accurate visual analysis of the words (Rains, 2002). This latter category is the central dyslexias and includes impairments in comprehending words that are phonetically irregular in their sound or appearance (Rains, 2002).

Expressive language can be broken down into repetition, naming, and narrative speech (Luria, 1973). There are four important requirements or conditions for successful repetition of spoken words/sounds, the first of which is the ability to receive and process auditory information. Provided that this requirement is fulfilled, the individual must be capable of articulating the sound or word that was spoken, instead of substituting a sound that uses similar articulation processes. Further, successful repetition requires the individual to flexibly switch from one sound or phoneme to the next, as opposed to perseverating on one particular articulation. Finally, Luria discusses the involvement of

the frontal lobes in regulating the repetition process by inhibiting the production of similar or more familiar sounds and words.

A more complex type of expressive language involves the ability to correctly name objects. This is also termed word retrieval or confrontational naming (Rains, 2002). As with repetition, successful word retrieval depends on adequate sensory functioning (Luria, 1973). In order to correctly name an object one must be able to form an adequate visual image of the object. Further, the individual must be capable of articulating the correct sounds to produce the name, as discussed earlier in regard to repetition (Luria, 1973; Rains, 2002). A more complex facet of naming involves the process of selecting the most accurate name for the object out of the pool of alternatives. Finally, once a correct name is identified and produced, the individual must be able to set this name aside and not apply it to all objects.

In addition to repetition and naming, expressive language occurs in the form of spelling and writing. Spelling difficulties also fall into two categories: central disorders and assembly disorders. Central spelling disorders include difficulty with words that are irregular or unusual, or impaired knowledge of letter-phoneme pairings. Assembly-based spelling problems are those in which the order of letters is incorrect. Impaired writing ability is typically seen in association with aphasia; for example, individuals with Broca's aphasia will typically write in a manner that matches their telegraphic speech (Rains, 2002).

Perhaps the most complex expressive language function is spontaneous speech (Luria, 1973). The first phase of this process is the generation of an intention or plan that will eventually be translated into verbal form. As a spontaneous, self-generated, goal-

directed activity, this process implies the involvement of the frontal lobes. The second phase of spontaneous expressive speech involves the actual translation of the plan into words, phrases, and sentences. Luria links this to the capacity for internal speech, or the ability to mentally generate a meaningful, orderly speech structure that will accurately express one's thoughts.

Disorders of language can take several forms. The term aphasia is used to describe a language disorder resulting from cerebral damage (Rains, 2002). Also important to this definition is that the language dysfunction is not due to a motor or sensory impairment or a general cognitive/intellectual deficit. In addition to aphasia, speech/language disorders can be categorized as dysarthria or central processing deficits. Dysarthria is defined as speech that is slurred or inarticulate due to oral-motor impairments (Rains, 2002), and is perhaps more accurately classified as a speech impediment as opposed to a language disorder. Central processing deficits can produce phonemic and kinetic speech disorders (Rains, 2002). A phonemic disorder involves impairment in the ability to string together phonemes quickly and accurately in order to produce fluent speech. Individuals with Broca's aphasia evidence reduced verbal fluency, as seen in their telegraph-like speech, while the characteristic sign of Wernicke's aphasia is hyperfluent and nonsensical speech (Rains, 2002). A kinetic speech disorder, also called speech apraxia, involves the inability to produce a word or sound on command, due to a disconnection between the intention and the motor activity needed to carry out the intention (Rains, 2002).

*Assessment*

The evaluation of language functioning is an important part of a comprehensive neuropsychological assessment, particularly for individuals with a history of head injury or stroke, or in cases where dementia is suspected (Damasio & Damasio, 2000; Lezak et al., 2004). Aphasia diminishes the ability to engage in activities that utilize internal speech (Damasio & Damasio, 2000), many of which are critical for daily functioning. Such activities include decision making, formulating goals and plans, and performing mental calculations. Additionally, language impairments affect social communication, which is important from both a personal and occupational perspective (Crosson, 1996).

A comprehensive assessment of speech and language should follow a conceptual framework organized around the expressive and receptive language domains (Johnstone et al., 2000). More specifically, spontaneous speech, repetition, speech comprehension, naming, reading, and writing should be evaluated (Johnstone et al., 2000; Lezak et al., 2004; Weintraub, 2000), as deficits in these areas are pathognomonic signs of language impairment (Johnstone et al., 2000). Further, assessors should attend to articulation, grammar, fluency, and prosody of speech, while bearing in mind the characteristic signs of the various aphasic syndromes (Johnstone et al., 2000; Lezak et al., 2004).

Although a comprehensive language assessment is ideal, time constraints often do not allow for such an approach. Thus, an aphasia screening test is often utilized in the initial neuropsychological evaluation, followed by a more thorough evaluation for those who exhibit signs of a language disorder (Johnstone et al., 2000). The Aphasia Screening Test (AST) is widely used for these purposes and has been incorporated into several aphasia and neuropsychological batteries (Lezak et al., 2004). However, some have

cautioned against its use (e.g., Crosson, 1996; Lezak et al., 2004). Additional individual tests that are frequently used to screen for language impairment include the Token Test, the Boston Naming Test (BNT), and the Controlled Oral Word Association Test (COWAT). The BNT is a popular instrument used to screen for expressive language deficits and confrontational naming in particular. It is useful as an aphasia screen, in that naming difficulties are a pathognomonic sign of a language dysfunction (Johnstone et al., 2000; Spreen & Strauss, 1998). The COWAT is another test of expressive language abilities, although what it actually measures has been debated (Johnstone et al., 2000). It has traditionally been classified as a test of verbal fluency. In terms of screening for receptive language deficits, the Token Test has been used to assess the ability to comprehend and follow verbal commands. One or more of these individual tests can be added to a neuropsychological evaluation as a means of screening for pathognomonic signs of language dysfunction.

Several language batteries exist for those situations that demand a more comprehensive assessment of language. The most common are the Boston Diagnostic Aphasia Examination (BDAE), the Western Aphasia Battery (WAB), and the Multilingual Aphasia Examination (MAE). The BDAE covers conversational speech, auditory comprehension, oral expression, comprehension of written language, and writing through a series of several subtests. It is a popular battery that is used to diagnose aphasic syndromes, as opposed to following a conceptual framework of language (Strauss et al., 2006). The WAB is based on the BDAE and was designed to be used for both clinical and research purposes (Lezak et al., 2004), while the MAE is a shorter battery that covers oral expression, spelling, oral comprehension, and reading. These batteries have in

common the goal of discriminating the patient's particular aphasic syndrome, and are typically reserved for situations in which a language deficit has been identified (i.e. through screening or observation) or is likely (e.g., following a traumatic brain injury).

The issue of subtle versus obvious language deficits is an important one, in that neuropsychologists tend to be responsible for the diagnosis of the former while speech-language pathologists often diagnose the latter (Crosson, 1996). The selection of appropriate tests or batteries for the detection of subtle language deficits can be difficult, due to the preponderance of batteries (e.g., the BDAE, MAE, and WAB) designed to discriminate among the various aphasic syndromes. These batteries are often most extensively normed on aphasic populations and the level of item difficulty is such that subtle impairments can be missed (Crosson, 1996). A second problem in selecting appropriate measures for subtle language deficit assessment is the insufficient reliability of screening tests; for example, the AST includes only a few items each for naming, comprehension, and repetition (Crosson, 1996; Lezak et al., 2004). Crosson has recommended Visual Naming, Sentence Repetition, the COWAT, and the Cookie Theft Test as individual language tests that are useful for detecting subtle deficits.

*Research With Individuals Who Are Homeless*

Despite the importance of screening for language impairments as part of a comprehensive neuropsychological evaluation, this has rarely been included in studies with homeless populations. In addition to the data regarding the reading and spelling abilities of homeless individuals, discussed in a previous section, only two studies have included language tests. Lo (2001) included data from the BNT and the COWAT in his analysis of the neuropsychological functioning of individuals with a history of

homelessness and Gonzalez et al. (2001) utilized the AST. Lo did not interpret the BNT or COWAT data in light of any particular norms; using normative data in Johnstone et al. (2000) and Mitrushina et al. (2005), it appears that participants performed in the low average and average range on these tests, respectively. However, it is difficult to accurately interpret these results as performance is influenced by age, gender, and education (Mitrushina et al., 2005), and Lo did not report scores for such subgroups. Gonzalez and colleagues used Russell's (1975) system for calculating a rating score based on the number of AST errors and found that, on average, participants scored in the normal range. However, given the difficulty in identifying subtle language impairments with the AST, it is unknown as to whether language deficits existed among participants in this study.

*Summary*

Data on the language functioning of homeless individuals are scarce, and results of the two studies that incorporated language tests are difficult to interpret. There is some suggestion of impairment in verbal fluency, although this is based on the results of one test. Further, these studies have emphasized expressive language and have largely ignored receptive language. Given the incidence of traumatic brain injuries among homeless individuals, it would seem reasonable to expect at least subtle language deficits in this population. Additional research using tests that are sensitive to subtle deficits is necessary to understand fully the language functioning of homeless individuals.

## *Motor and Sensory Functions*

### *Voluntary Movement*

Voluntary movement is the manifestation of our intentions and the basis of behavior (Rains, 2002). The voluntary motor system consists of both peripheral components and concertedly working cerebral regions (Luria, 1973; Rains, 2002). Peripheral components include the connections between motor neurons and muscles, as well as muscles themselves; damage in these components can lead to such disorders as muscular dystrophy and myasthenia gravis (Rains, 2002). In addition, the spinal cord and its motor pathways are part of the periphery of the voluntary motor system. The higher-order control of movement is more complex. Although the brain as a whole is involved in motor activity, regions of particular importance are the motor cortex, premotor and supplementary motor areas, somatosensory cortex, cerebellum, basal ganglia, and prefrontal cortex (Rains, 2002). Working together, these regions are responsible for a variety of functions, including forming intentions, knowing the steps required to carry out a movement, the capacity to carry out the steps in the proper manner, and self-monitoring progress toward a movement goal.

Luria (1973) has described voluntary movement as consisting of efferent and afferent processes. The efferent organization of movement is largely the work of the motor cortex, which prepares the body for movement, executes the motor activity, and controls the force and direction of movement. This process involves close coordination with the somatosensory cortex, part of the afferent aspect of movement. Input from the somatosensory cortex provides information to motor neurons regarding body positioning and bodily sensations; such information is necessary for the appropriate execution of

movement. In addition to sensory inputs, the motor cortex receives input from the premotor and supplementary motor areas. These cortical regions, part of the efferent organization of movement, are involved in the strategic planning of complex movements, as well as ensuring that a movement goal is being met. The prefrontal cortex, implicated in the highest level of movement control, manages additional planning, regulation, and behavior modification. Two subcortical regions, the cerebellum and basal ganglia, are also involved in higher-order voluntary movement. The cerebellum compares intended movement with actual movement and sends efferent projections to the cortical motor regions when adjustments are needed (Rains, 2002). The basal ganglia have a similar indirect influence on motor activity by connecting with the prefrontal cortex and other cortical areas involved in the execution of movement (Rains, 2002).

Disturbances in voluntary movement can occur for a variety of reasons, and the nature of the disturbance has some value in localizing a brain lesion (Lezak et al., 2004). For example, motor cortex lesions manifest as contralateral muscle weakness, while premotor or supplementary motor area lesions result in an inability to perform the correct sequence of movements (Rains, 2002). Somatosensory cortex lesions can also give the appearance of a motor deficit, although these are not true motor disturbances. For example, diminished sensation in a body part impedes voluntary movement of that area even though muscle strength is intact (Luria, 1973).

Voluntary movement can also be disturbed in the absence of motor or sensory impairment (Rains, 2002). This is the case with apraxia, in which individuals are unable to carry out movements on command, due to a disconnection between the intention to move and actual movement. This can take different forms. Ideomotor apraxia, for

example, is the inability to carry out simple, familiar movements on command. Individuals with ideational apraxia are able to perform simple motor tasks but cannot carry out a sequence of commands. Thus, a movement disturbance requires close examination in order to be correctly diagnosed.

*Sensation and Perception*

As mentioned above, information about bodily sensations is received by the somatosensory cortex. This includes touch, pain, temperature, body position, and body movement (Rains, 2002). Other functional divisions of the cortex receive visual, auditory, and olfactory input (e.g., primary visual cortex), while perceptual processing of this basic sensory input takes place in association areas or secondary cortical zones (Luria, 1973; Rains, 2002). Lesions in primary sensory areas impair basic sensory functions, such as visual acuity or tactile sensation. Difficulties in associating meaning with sensory information result from lesions in perceptual processing areas, as with the agnosias (Rains, 2002).

*Assessment*

An assessment of motor and sensory functions is useful for the neuropsychologist because of the information it provides about the functional integrity of the cerebral hemispheres (Strauss et al., 2006). In addition, the findings of a motor-sensory exam can assist in the localization of a brain lesion (Lezak et al., 2004). Although neurologists typically examine motor and sensory functions, neuropsychologists can also administer tests of these functions (Selby, 2000; Stringer & Nadolne, 2000). For example, the Halstead-Reitan Neuropsychological Test Battery includes several tests of motor and sensory perceptual functioning.

Motor-sensory exams can include tests of manual dexterity, strength, speed, right-left awareness, gross sensory awareness, gait, balance, and coordination (Lezak et al., 2004; Strauss et al., 2006). Some of the commonly used measures include the Finger Tapping Test, the Purdue Pegboard Test, the Grooved Pegboard, and the Grip Strength Test. Luria also designed several tasks to assess motor functioning, such as hand positioning and following simple movement commands (Christensen, 1975; Luria, 1980). In addition, there are various tests for sensation and perception. For example, tests of tactile sensation include palm writing, finger identification, and localization of a touch (Lezak et al., 2004). These tests are useful for identifying the presence of a somatosensory deficit or agnosia (Strauss et al., 2006).

*Research With Individuals Who Are Homeless*

The prevalence of head trauma, neurological disorders, and substance abuse among homeless individuals would suggest that motor-sensory deficits are likely to be seen in this population. Two studies of the neuropsychological functioning of homeless individuals have included motor-sensory tests (Lo, 2001; Seidman et al., 1997), and two additional studies focused solely on neurological or neurobehavioral functioning (Douyon et al., 1998; Zlotnick et al., 1995). Motor speed and dexterity were the most commonly assessed domains, using the Finger Tapping Test (Seidman et al., 1997; Zlotnick et al., 1995) and pegboard tests (Grooved and Purdue versions; Lo, 2001; Zlotnick et al., 1995). Reaction time was assessed in one study using a visual reaction time test; scores were based on the length of time to react to a red light, averaged over several trials (Zlotnick et al., 1995). In addition, Seidman et al. assessed motor regulation using a version of Luria's "fist-edge-palm" test. Finally, Douyon et al. screened for

neurological impairment using the Quantified Neurological Scale (Convit, Volavka, Czobor, de Asis & Evangelista, 1994). This scale is used to identify cerebellar dysfunction, graphesthesia, astereognosis, and other signs of neurological impairment.

In terms of visual reaction time, participants in Zlotnick et al. (1995) scored in the average range, based on norms for healthy individuals in the 25-45 year old age bracket (Spreen and Strauss, 1998). The homeless individuals recruited by Zlotnick et al. consisted of men (majority were 25 to 44; mean age was not provided) taking part in an alcohol rehabilitation program operated by a homeless shelter; individuals were classified as homeless based on their sleeping arrangements over the past year, with no further information provided about what this meant. No specific information about substance use was provided, only that all participants had been identified as having an alcohol abuse problem. None of the participants were diagnosed with serious medical or mental illnesses, although nearly 40% reported head trauma. Over half had more than twelve years of education. Thus, the reaction time findings from this study would not necessarily generalize to homeless individuals without a primary alcohol abuse disorder, those with serious medical problems or psychological disorders, those who have less than a high school education, and those who are older than age 45.

Concerning motor speed and manual dexterity, the data suggest that homeless individuals perform in the impaired to low average range. Based on the Finger Tapping Test data provided in Seidman et al. (1997), participants performed in the low average range for both dominant and non-dominant hands, using normative data for healthy individuals as a comparison (Mitrushina et al., 2005; Spreen & Strauss, 1998). Participants in this study were mostly male (72%), with an average age of 37.6 years and

an average of 10.8 years of education, and were recruited from homeless shelters for individuals with mental health treatment needs. Results for the Finger Tapping Test in Zlotnick et al. cannot be interpreted due to the lack of norms for their non-standard manner of administration (two 30-second tapping intervals, with scores equaling the sum of taps for the two trials). Further, the data are reported in terms of right and left hand, as opposed to dominant and non-dominant hand; this further hinders the interpretation of the data (Mitrushina et al., 2005).

Additional information regarding motor speed and dexterity comes from the Grooved Pegboard test (Lo, 2001). Data were reported separately based on TBI status (no TBI; one TBI; more than one TBI) and were not grouped by age, gender, or education level. Participants across all three groups obtained scores in the impaired range for both dominant and non-dominant hands (Mitrushina et al., 2005). As with the Finger Tapping Test, data from Zlotnick et al. cannot be interpreted due to inconsistencies in the data (i.e. data are inconsistent with administration of the test and do not fit with procedures and norms provided in Mitrushina et al., 2005; Spreen & Strauss, 1998; and Strauss et al., 2006).

The performance of homeless individuals on motor regulation tasks is more difficult to interpret. Luria tended to favor a qualitative interpretation of performance on this and other motor tests (Lezak et al., 2004), and therefore normative data are virtually nonexistent. Seidman et al. (1997) calculated the number of correct sequences (fist-palm-edge) for each hand, and performance was considered impaired if verbalization from the assessor was required. However, the authors did not provide any information on how many participants qualified for the “impaired” classification.

From a neurological perspective, homeless individuals have evidenced more neurological deficits than non-homeless individuals, particularly in the domains of frontoparietal (e.g., graphesthesia and astereognosis) and cerebellar functioning (Douyon et al., 1998). Participants in this study were veterans seeking psychiatric services at a Veterans Affairs medical center who self-reported a lack of stable housing for some period of time in the previous six months. Excluded from this study were individuals with psychotic disorders and neurological conditions, although the majority of participants endorsed a family history of mental illness. Further, an overwhelming majority of participants reported alcohol and/or cocaine abuse. The authors did not report whether any of these factors moderated performance on the Quantified Neurological Scale.

*Summary*

The motor and sensory functioning of homeless individuals is largely unknown. At this time, it appears that at least some motor-sensory deficits exist in this population, particularly in motor speed and dexterity. This is a tentative conclusion based on very little empirical data from studies using dissimilar samples. Thus, the generalizability of the existing research in this area may be limited. For example, Lo (2001) analyzed data collected from individuals who had experienced homelessness at some point in time, without any indication of how recently this had occurred, the duration or frequency of homelessness, or current living situation. Other studies recruited participants from homeless shelters (Seidman et al., 1997; Zlotnick et al., 1995) or inpatient psychiatric hospitals (Douyon et al., 1998), with little explanation of what constituted the classification of “homeless.” The inclusion of individuals with psychological disorders, substance use disorders, and head injury has also varied, with some researchers excluding

individuals with these characteristics. In addition to these concerns, there is simply a lack of information regarding other aspects of motor-sensory functioning, such as gross sensory awareness, gait, balance, and perceptual ability. Further research is necessary before stronger conclusions can be drawn regarding the functioning of homeless individuals in this domain.

## *Executive Functions*

### *Definitions*

Lezak et al. (2004) define executive functions as "the ability to respond in an adaptive manner to novel situations" (p. 611). Similarly, Sbordone (2000) points out that the executive functions are the process by which individuals see problems through from start to finish. Key components of this process are self-awareness, self-direction, self-regulation, planning, cognitive flexibility, decision making, judgment, self-correction, and self-perception (Cripe, 1996; Groth-Marnat, 2003; Strauss et al., 2006). Luria (1973, p. 89) conceptualized the executive functions in a similar way when he described the tertiary zones of the frontal lobes as a "superstructure," responsible for the "programming, regulation, and verification of human activity" (p. 187).

These higher cognitive functions tend to be poorly understood (Sbordone, 2000), and have been difficult to operationalize (Cripe, 1996). Disturbances in executive functioning have been labeled "frontal lobe syndrome" because of the involvement of the frontal lobes in metacognitive processes. However, damage to other cortical and subcortical regions of the brain can produce impairments in executive functioning, due to the rich network of connections between the frontal lobes and other brain regions (Lezak et al., 2004; Luria, 1973). Further, certain psychiatric disorders (e.g., depression, mania,

attention deficit disorder) and subcortical diseases (e.g., Parkinson's disease; Korsakoff's syndrome) can impair executive functions (Lezak et al., 2004; Sbordone, 2000). Cripe (1996) highlights the difficulty in defining the executive functions by noting that they are both process- and outcome-oriented, involving both *what* occurs and *how* this is accomplished. Lezak et al. (2004) divided this complex, integrated system of cognitive activity into several domains: volition, planning, purposive action, self-regulation, and effective performance. This organization of the executive functions has been used by others (e.g., Cripe, 1996; Groth-Marnat, 2003; Sbordone, 2000) and dovetails Luria's conceptualization (1973).

*Domains of Executive Functions*

*Volition.* Volition, or intentionality, is the capacity to formulate an intention or goal (Lezak et al., 2004). Individuals with volitional deficits may evidence apathy, poor hygiene, a lack of curiosity, a need for external structure, poor awareness of wants and needs, and a loss of motivation (Sbordone, 2000). For example, individuals with poor intentionality often require instructions to impel them to act, as they will not typically initiate new activities independently. Lezak et al. (2004, p. 612) note that this is particularly true of activities that involve long-term or abstract goals. Thus, there are important connections between volition and activities such as finding and maintaining employment, managing a household, attending school/training programs, obtaining needed medical or psychological treatment, and planning one's future. Currently, no formal tests of volitional capacity exist (Lezak et al., 2004), and many neuropsychological tests are not sensitive to mild volitional deficits (Sbordone, 2000). Methods of assessing volitional capacity include observing individuals in daily activities,

interviewing caregivers and family members, and observing examinees in their interactions with the examiner during the testing situation.

*Planning.* Beyond volition is the capacity to develop a set of plans to achieve a goal. This involves organizing the necessary steps, gathering important materials, looking ahead to assess potential outcomes, weighing various alternatives, and developing an overall framework for enacting the plan (Lezak et al., 2004). Important to this process are memory, impulse control, sustained attention, and intentionality. Individuals with planning deficits typically display concrete, disorganized, and inflexible thinking, as well as few plans for the future (Sbordone, 2000).

As with volition, there are few formal tests of planning ability, and examiners often assess skills in this domain through a qualitative analysis of the performance on standardized tests (Sbordone, 2000). This is the preferred approach according to some (e.g., Cripe, 1996; Sbordone, 2000), as standardized test scores only provide information on how well the examinee performed, as opposed to describing the planning that took place during testing. Further, many examiners provide what Sbordone (2000, p. 446) calls "compensatory interventions" during standardized testing, such as simplifying instructions or providing cues and prompts; this can assist the examinee in completing the tasks, but can mask any deficits in planning. Thus, an integration of quantitative and qualitative approaches is preferred.

Maze tracing and tower building tests have typically been used to assess planning skills. The Porteus Maze Test (Porteus, 1959), for example, requires individuals to plan an efficient path through a maze and calls upon the ability to think ahead, weigh alternatives, and choose the most appropriate path. Tower tests, such as the Tower of

London, also place demands on aspects of planning, such as forethought, working memory, impulse control, and visuospatial memory. In addition to these standardized tests, examiners can assess planning skills in daily life. For example, examinees might be asked to plan a response to an everyday problem, such as resolving a conflict with a noisy neighbor or developing a script for going grocery shopping (Channon & Crawford, 1998; Lezak et al., 2004). Such approaches to assessing planning skills are critical for understanding how well individuals function in daily life, and add to the ecological validity of neuropsychological assessment.

*Purposive action.* Once a plan has been developed, it must be carried out. The capacity for purposive action involves the ability to independently translate plans into action, particularly in the case of non-routine tasks. According to Lezak et al. (2004), impairments in carrying out non-routine or novel tasks are more likely to occur following brain damage, as opposed to familiar, routine, and overlearned tasks. Individuals with deficits in purposive action are often unable to filter out needs and wants that are irrelevant to the situation, and thus tend to be highly distractible (Sbordone, 2000). Other symptoms include impatience, low frustration tolerance, and poor work habits.

As with planning skills, the assessment of purposive action is often hampered by the nature of the testing situation. Examiners routinely provide a quiet, distraction-free testing area, and use cues, prompts, encouragement, and external rewards to facilitate purposive action (Sbordone, 2000). Consequently, symptoms associated with deficits in purposive action may not emerge. To overcome these problems, the use of tests that present a relatively unstructured situation, requiring the examinee to develop a plan and carry it out independently, has been recommended (Lezak et al., 2004). For example, in

the Tinkertoy Test (Lezak et al., 2004) examinees are provided with fifty Tinkertoy pieces and are allowed to construct anything, calling upon the ability to develop an idea, make plans, and carry out the plan independently.

*Self-regulation and effective performance.* Unlike purposive action, the assessment of self-regulation is aided by the availability of several formal tests. Tests such as the Ruff Figural Fluency Test, the Wisconsin Card Sorting Test (WCST), the Stroop Color Word Test, and the Trail Making Test require cognitive flexibility and the capacity to shift responses as needed. Individuals with impairments in these areas may perseverate on a particular response even when a new response is called for. Self-regulation can also be assessed with the use of executive-motor tests, such as those developed by Luria (e.g., palm-fist-edge; Christensen, 1975; Luria, 1980).

Effective performance overlaps with the capacity for self-regulatory behavior. This involves monitoring one's performance for mistakes and taking steps to self-correct when needed (Lezak et al., 2004). The effective performance of plans also involves recognizing goal achievement and ceasing activity when this occurs (Sbordone, 2000). Sbordone also notes that effective plans should be stored in long-term memory, so that they can be used in future similar situations. Thus, individuals with deficits in this area may have poor work histories, due to their cognitive rigidity, poor task completion, and inability to utilize effective strategies used in the past (Sbordone, 2000).

While there are few neuropsychological tests that explicitly assess effective performance, the capacity for self-monitoring and self-correction can be assessed by observing an examinee's performance across various other tests. To improve ecological validity, Sbordone (2000) recommends observing examinees in real-world settings, an

approach that emphasizes the qualitative aspects of task performance. In addition to naturalistic observation, examiners can use random generation tasks to assess self-monitoring and self-correction. These require the individual to generate numbers or letters, for example, in a random fashion, which calls on the individual's ability to inhibit stereotyped responses (e.g., saying X-Y-Z; Lezak et al., 2004) and monitor the "randomness" of one's responding.

*Assessment*

Difficulty in accurately measuring executive functioning parallels the difficulty in operationalizing these processes. Tests that purport to measure executive processes are somewhat sensitive to frontal lobe or executive function impairment, but a particular test might assess only one or two steps in the process, potentially leading to the inaccurate conclusion that executive functions are intact (Cripe, 1996; Sbordone, 2000). Further, some individuals evidence severe impairments in real-world settings that are not identified by standardized tests (Lezak et al., 2004; Sbordone, 2000).

The nature of neuropsychological testing also hampers the assessment of executive functioning. Lezak et al. (2004) explain that the test setting is structured and controlled, to the point that examinees have little room to show how they approach and solve novel tasks without guidance or support. Further, executive function tests may be chosen for their face validity, with little attention to psychometric properties or the adequacy of normative data (Spreen & Strauss, 1998). Cripe (1996) has proposed another problem with measuring executive functions, what he calls the "mind-data problem" (p. 189); in essence, test scores are merely numbers that oversimplify the complex processes involved in the workings of the human mind. Further, relying on quantitative summary

scores to describe and explain executive functioning results in the exclusion of important information and diminished ecological validity.

In order to improve the use of executive function tests in describing or predicting real-world behavior, the use of qualitative or informal procedures has been proposed (e.g., Channon & Crawford, 1998; Cripe, 1996; Depoy, 1992; Lezak et al., 2004; Sbordone, 2000). For example, Cripe (1996) recommends the use of objective qualitative observation and thematic content analysis in concert with standardized tests. Interviews with family members and observations of the examinee in various settings (e.g., home, work/school) are also recommended (Cripe, 1996; Lezak et al., 2004; Sbordone, 2000). While some neuropsychologists use these methods, they tend to be misunderstood (Cripe, 1996).

*Research With Individuals Who Are Homeless*

The ability to respond appropriately and adaptively in novel situations, using cognitive, emotional, and social skills, relies on adequate executive functioning (Lezak et al., 2004, p. 611). In working with individuals who are homeless, it is important to understand what, if any, difficulties exist in this domain, given its importance for daily activities such as employment and personal relationships. However, few studies have directly assessed the executive functioning of homeless individuals.

Among those that have assessed executive functions (Duerksen, 1995; Foulks et al., 1990; Gonzalez et al., 2001; Lo, 2001; Seidman et al., 1997), few have done so comprehensively, such as covering the domains proposed by Lezak et al. (2004) and Sbordone (2000). Two dissertations and one published study have provided the most thorough assessment of executive functions. Duerksen explicitly addressed four of the

domains (volition, planning, purposive behavior, and effective performance) while Lo and Seidman et al. examined executive functioning with the use several instruments. The remaining studies have included one or two tests of executive functioning without describing the domains that were being assessed.

Duerksen (1995) examined the executive functioning of a small ($N$ = 28) group of homeless Caucasian men, covering the domains outlined above. In the domain of volition (what Duerksen terms "goal formulation"), the Cookie Card Theft Test (CCTT) and Tinkertoy Test (TTT) were used. These tests are traditionally used to assess language (CCTT) and purposive action (TTT), although the CCTT can be used to assess situational awareness, an aspect of volition (Lezak et al., 2004). In using these tests to assess volitional capacity, Duerksen developed new qualitative scoring systems (e.g., awarding points based on quality of task completion) and indicated that both tests were used "experimentally." Duerksen stated that high scores tend to reflect an increased capacity for goal formulation, but the issue of construct validity was not formally addressed. Further, data regarding interrater reliability were not reported, and there are no norms to aid interpretation of the sample's performance on these tests.

In a similar fashion, and using a combination of traditional and experimental procedures, Duerksen assessed the domain of planning by using Porteus Mazes, the Bender-Gestalt, the RCFT, the Block Design and Object Assembly subtests of the WAIS-R, and the Rorschach. Porteus Mazes and the Bender-Gestalt are both considered to tap planning skills (Lezak et al., 2004), and the RCFT, Block Design, and Object Assembly can be used to assess planning skills when scored in a qualitative manner (Lezak et al., 2004). However, Duerksen used standard scoring procedures for the RCFT, Block

Design, and Object Assembly, as opposed to describing or qualitatively rating the manner in which the tasks were completed. As such, these tests were actually used to measure their "intended" constructs (e.g., RCFT as a measure of construction ability and visuospatial memory), as opposed to measuring the construct of "planning." Further, the use of the Rorschach to assess planning is poorly justified by Duerksen. Spreen and Strauss (1998) and Lezak et al. (2004) note that performance on the Rorschach can reflect impairment in perception and indicate the presence of brain impairment, but the test is primarily intended as a measure of personality, adjustment, or emotional functioning. In addition, Duerksen used the Developmental Quality measure of the Rorschach to assess planning skills, but provided no rationale or indication of the construct validity of using this approach. Due to these methodological problems, only scores for Porteus Mazes and the Bender-Gestalt are considered when discussing the planning abilities of Duerksen's sample.

Similar methodological problems were found in Duerksen's manner of assessing purposive action. In this domain, the Stroop Color Word Test and a line-tracing test were used, again in an experimental manner. The Stroop tests, as noted previously, are considered to be best used as a measure of attention and concentration (Lezak et al., 2004). However, Strauss et al. (2006) also classify the Stroop test as a measure of executive functioning, particularly the capacity for cognitive flexibility. Therefore, Duerksen's inclusion of this test as a measure of executive functioning has some support, but it would appear to fit more closely with the domain of self-regulation. The results of the Stroop test by Duerksen were presented in a previous section and will be only briefly mentioned here.

Duerksen's use of the line-tracing test to assess purposive action is also questionable. The test involves tracing figures as quickly as possible, with attention to how well the individual traces the lines. Citing Lezak (1983), Duerksen explains that this test is used to assess fine motor regulation, but later operationalizes it as a test of the capacity to carry out plans. A qualitative scoring system was developed based on Lezak's (1983) criteria, despite the fact that Lezak did not define this as a test of purposive behavior. Again, construct validity and interrater reliability were not addressed. Further, there are no norms for Duerksen's adaptation of the line-tracing test and thus the results cannot be adequately interpreted.

Finally, in assessing the effective performance domain of executive functioning, Duerksen used select measures from the Rorschach Inkblot Test, although no rationale was provided. As mentioned previously, this test is best used to assess personality, adjustment, and emotional functioning, or as a secondary means of assessing neuropsychological functioning (Lezak et al., 2004; Spreen & Strauss, 1998). Thus, the results of the Rorschach will not be discussed here.

In addition to these methodological concerns, the characteristics of Duerksen's sample must be considered. The selection criteria required that all participants be Caucasian men between the ages of 25 to 45 years of age. In addition, all were recruited from homeless shelters. It is unclear as to whether the results obtained with this sample are generalizable to a more diverse group of homeless individuals. In addition, a slightly older group of homeless individuals may have obtained different results, given the link between age and neuropsychological functioning. It is notable that Duerksen provided no rationale for these particular selection criteria. In particular, it is unclear as to why only

Caucasian individuals were selected, given that race, in itself, has not been strongly linked to cognitive performance (see Lezak et al., 2004 for discussion).

In summary, Duerksen's study is to be commended for attempting to measure executive functions across multiple domains. However, there are many methodological concerns with this study, the primary concern being the experimental use of tests without any apparent exploration of construct validity. Further, the data from these experimental scoring procedures are difficult to interpret in the absence of normative data. Thus, the results of this study will be considered with these limitations in mind.

A second dissertation (Lo, 2001) retrospectively examined neuropsychological functioning – including executive functions – among clients of an assessment clinic who had reported at least one episode of homelessness. The purpose of the study was to determine if neuropsychological functioning differed among formerly or currently homeless individuals with different histories of traumatic brain injury (multiple TBI, one TBI, or no TBI). Several measures of executive functioning were used, including the Trail Making Test, Color Trails, the Ruff Figural Fluency Test, the Stroop Color and Word Test, and the Wisconsin Card Sorting Test, although Lo did not discuss the particular domains of executive functioning that were being examined. The classification of these particular instruments varies, with many considered to primarily measure complex attention as opposed to executive functioning (e.g., Lezak et al., 2004; Ponsford, 2000; Strauss et al., 2006). In addition, the design of this study emphasized history of TBI as opposed to history or length of homelessness; thus, it may be better classified as a study of the neuropsychological functioning of TBI patients, as opposed to that of homeless individuals. Further, comparisons between homeless and non-homeless persons

were not made, making it difficult to interpret whether the results relate to homelessness, TBI history, or both.

Seidman and colleagues (1997) also assessed executive functioning with the use of several instruments. They included the Porteus Mazes Test, the WCST, the Visual-Verbal Test, and an adaptation of Luria's fist-edge-palm technique (Christensen, 1975; Luria, 1980). The remaining studies included one or two tests to assess executive functions. Foulks et al. (1990) chose the Porteus Mazes Test and Stroop Color-Word Test, while Gonzalez and colleagues (2001) included the Trail Making Test as a means of assessing executive functioning. As in Lo (2001), none of these studies reported the domains of executive functioning that were purportedly being assessed, and several of the tests have been primarily classified as tools to measure attentional processes, as opposed to executive functions. This is particularly true of the Stroop Test and Trail Making Test (e.g., Lezak et al., 2004; Ponsford, 2000). Finally, none of the authors addressed the issue of mono-operation bias (e.g., Heppner, Kivlighan & Wampold, 1999) and its impact on construct validity. This is particularly important in the case of a complex construct such as executive functioning.

Given the limited number of studies that directly assessed executive functioning, as well as the overall lack of research adequately assessing the various domains of executive functions, conclusions regarding the executive functioning of homeless individuals are limited. This is particularly true in the case of volition. Homeless men in Duerksen's study performed statistically significantly worse on the CCTT than non-homeless men (homeless: $M = 3.12$, $SD = 1.81$; non-homeless: $M = 1.97$, $SD = 2.14$), and also obtained lower scores on the TTT compared to non-homeless men (homeless: $M =$

8.07, *SD* = 2.61; non-homeless: *M* = 9.50, *SD* = 2.19). While these results indicate that homeless men performed worse than non-homeless men on tests that supposedly measure volition, questions regarding the construct validity of the CCTT and TTT as they were used in this study make it difficult to draw conclusions about the volitional capacity of homeless individuals. Further, there are no norms for Duerksen's administration of the CCTT and TTT, which makes the data uninterpretable.

In the domain of planning, three studies reported results for the Porteus Mazes test (Duerksen, 1995; Foulks et al., 1990; Seidman et al., 1997). Foulks et al. and Seidman et al. used the "test quotient" while Duerksen used "test age" to report the findings. Foulks et al. found that homeless men performed above average (*M* = 114.2, *SD* = 17.3), compared to the general population, while Seidman et al. found that participants performed below average (*M* = 82.0, *SD* = 24.7). This is perhaps not surprising, given the differences in the samples for these studies; Foulks et al. used a sample of relatively well-educated and highly trained military veterans, compared to participants in Seidman et al. who had histories of serious mental health and substance use disorders and fewer years of education. Duerksen's results indicate that homeless men performed worse than non-homeless men on the Porteus Mazes test, with a mean test age of 12.59 (*SD* = 2.86) for homeless men and 15.86 (*SD* = 1.75) for non-homeless men, a difference that was statistically significant. Test ages range from 3 to 17 for adults (Lezak et al., 2004; Porteus, 1959), but the mean test age for the general population is unknown. Further, these results cannot be easily compared to those from Foulks et al. and Seidman et al.

In addition to the Porteus Mazes Test, Duerksen found that homeless and non-homeless men performed similarly on the Bender-Gestalt test, with both groups

performing relatively well (*M* = 2.50, *SD* = 1.50 and *M* = 2.17, *SD* = 1.49, respectively) according to norms provided in Lacks (2000). Duerksen used Lacks' scoring system, in which the number of errors is tabulated, with a maximum of twelve errors and a cutoff score of five used to classify brain impairment. This approach was developed as a means to screen for impairment, and Lacks notes that the Bender-Gestalt "casts a broad net" (p. 410) in terms of the cognitive functions it measures. Duerksen's findings with the Bender-Gestalt suggest an absence of brain impairment and adequate planning skills among homeless men, despite data from the Porteus Maze Test suggesting at least slight impairment in planning skills among these same individuals.

In terms of purposive action, very little information is available. Duerksen attempted to measure purposive action via the Stroop Test and a line-tracing test; as previously discussed, these tests are inappropriate for the assessment of purposive action. However, Duerksen's data from the TTT speaks to purposive action; the administration of this test followed Lezak and colleagues' (2004) recommendations, and Lezak et al. classified the TTT as a measure of purposive action. Homeless participants in Duerksen's study obtained scores nearly equivalent to normal control subjects (Lezak et al., 2004), suggesting that purposive action may have been relatively unimpaired in this sample. However, this is a tentative conclusion, based on the very small control group (*n* = 10) used by Lezak (see Lezak et al., 2004).

There is more information available regarding self-regulation abilities of homeless individuals. Several studies examined cognitive flexibility and perceptual set-shifting ability, using the WCST (Lo, 2001; Seidman et al., 1997), the Ruff Figural Fluency Test (RFFT; Lo, 2001), and the Visual-Verbal Test (VVT; Seidman et al., 1997).

In addition, the Stroop Color Word Test, the Trail Making Test, and Luria's hand positions test can fit in the domain of self-regulation (Lezak et al., 2004; Strauss et al., 2006); information regarding the results of these tests has been previously discussed.

The results of the WCST across two studies (Lo, 2001; Seidman et al., 1997) suggest low average to average performance, based on normative data in Mitrushina et al. (2005) that takes into consideration the age and educational level of participants. Further, participants in both studies correctly completed, on average, fewer than four categories, whereas adults typically complete at least four (Lezak et al., 2004). WCST data in Lo were grouped by number of TBI (three groups) with no aggregated data reported; however, no differences were found among the groups. In this study, participants' average number of perseverative errors was in the low average range and the mean number of trials to complete the first category was in the average range.

The RFFT was used in one study to assess cognitive flexibility, but the results cannot be interpreted. Lo indicated that participants were scored on both the number of unique patterns and the number of pattern repetitions; however, only one score was reported without any indication of its meaning. Results of the VVT (Seidman et al., 1997) are also somewhat difficult to interpret. The authors report the average number of misses ($M$ = 44.7, $SD$ = 15.3) and use a cutoff score of 13 to classify impairment; this strategy was based on the results of a prior study, in which individuals with schizophrenia obtained an average of thirteen misses on the VVT (Faraone et al., 1995). Based on this approach, participants in Seidman et al. would appear to be severely impaired in cognitive flexibility and abstract thought. The availability of additional norms would aid the interpretation of these findings.

In terms of the effective performance domain of executive functioning, there is essentially no information on how homeless individuals fare in this regard. The only study to explicitly address this domain used the Rorschach (Duerksen, 1995). No other study of homeless individuals has specifically assessed the domain of effective performance, although data from the WCST, for example, could be used to draw conclusions about the capacity for self-correction and self-monitoring.

*Summary*

Overall, the available empirical research on the executive functioning of homeless individuals is severely limited. Only one study (Duerksen, 1995) has assessed several domains of executive functioning (volition, planning, purposive action, and effective performance), and this study suffered from multiple methodological flaws. Most studies in this area have attempted to measure executive functioning with the use of one or two tests, an approach that is rather inappropriate given the complexity of the construct (Heppner et al., 1999; Lezak et al., 2004). In addition to the limited amount of information in this area is the difficulty in interpreting the data. The problem of how to operationalize and measure executive functions is present across several studies. For example, Duerksen attempted to measure different aspects of executive functioning, but used various tests in experimental ways and provided vague rationale for doing so. This calls into question the validity of the data generated in this study.

In considering the data that are available for interpretation, few conclusions can be confidently drawn. Homeless samples have in some cases performed more poorly than non-homeless control groups in aspects of executive functioning, but in other studies homeless individuals have performed average or above average. Other findings suggest

that homeless and non-homeless men with similar histories perform similarly in the area of executive functions, often scoring below general population norms. It is also difficult to select normative data for interpreting the results of these studies, as performance on many of the tests is influenced by age, gender, level of education, and hand preference (Mitrushina et al., 2005), and researchers have not grouped test data by these variables.

It is difficult to say how homeless individuals fare in executive functioning given the discrepancies in the existing data. The findings indicate that planning skills and cognitive flexibility are areas in which homeless individuals have performed below average or in the impaired range. Given the paucity of research and the limitations in the existing data, there is a great need to further explore the executive functioning of homeless individuals.

### *Summary*

The literature regarding the neuropsychological functioning of homeless individuals has, to date, produced mixed results. The overall picture based on these results is that individuals who are homeless may be more likely than non-homeless individuals to evidence impairments in attention span, processing speed, sustained and selective attention, verbal memory, prose recall, visuospatial memory, expressive language, motor-sensory functioning, and domains of executive functioning. However, homeless individuals have also performed in the average range on several tests of neuropsychological functioning. Consistent findings are lacking across the handful of studies in this area, thus further research into the neuropsychological functioning of homeless individuals is needed to better understand the issue.

# Conclusion

The homeless population in the United States is large and diverse, and individuals who experience homelessness are in need of a variety of services, including assistance with housing, education, employment, and health care. At the same time, mental health disorders, substance misuse, neurological disorders, chronic illnesses, and head injuries are prevalent among homeless individuals, all of which have been linked to neuropsychological impairment. Diminished functioning in areas such as attention, memory, planning, and problem solving can hinder one's ability to manage a household, obtain and maintain competitive employment, maintain appointments, or engage in rehabilitation programs. Thus, knowledge of the neuropsychological functioning of homeless individuals is a critical issue for professionals who work with this population. Such information can be used to identify needed services and develop interventions tailored to the capacities of the individual, as well as improve the quality of interaction between provider and client by reducing inaccurate assumptions and stereotypes about the homeless (Backer & Howard, 2007).

Although empirical data regarding the neuropsychological functioning of homeless individuals are desirable for various reasons, the research in this area is limited to nine studies ($N$ = 579) that vary in comprehensiveness, quality, and generalizability. The domains assessed across this group of studies include attention, memory, language, motor-sensory functions, and executive functions. The domain of attention has been the most extensively examined, followed by memory and executive functions. On the other hand, the areas of language and motor-sensory functions have received very little attention. There is currently evidence of deficits in attention span, processing speed,

sustained and selective attention, memory, language functioning, motor-sensory functioning, and executive functioning. Rarely have all of these domains been included in one study, which makes it difficult to draw conclusions regarding where impairments are more or less likely to occur. The degree of impairment has also varied; in some cases, homeless individuals show no more impairment than non-homeless individuals with similar backgrounds, while in other cases homeless persons have performed quite poorly on standardized tests.

The ability to draw firm conclusions from these studies is also limited by methodological issues. All have been descriptive in terms of research design; some have compared the performance of homeless individuals to non-homeless individuals (i.e. matched control subjects), while others have interpreted homeless participants' performance in light of established test norms. Most of the studies that utilized a non-homeless comparison group focused on finding differences between the two groups, as opposed to interpreting the data using established norms. For consumers of research without access to normative data these studies are limited in their utility (Anastasi & Urbina, 1997). Further complications arise in interpreting the data from these studies because norms for many neuropsychological tests are most appropriately grouped by variables such as age, gender, education, IQ, or a combination of these (Mitrushina et al., 2005). Researchers have sometimes failed to provide this information when describing the sample or have not grouped test data by these variables.

To be of maximal use, descriptive research must attend to two critical issues: the quality of observations and the generalizability of the results to the target population (Heppner et al., 1999). As discussed in this review, some researchers have purported to

measure particular domains of neuropsychological functioning while not attending to the issue of construct validity. Even when the same test was used across several studies there were variations in test administration and scoring, which hinders the synthesis of findings from the particular test. Finally, the assessment of particular domains of neuropsychological functioning has been incomplete, making it difficult to draw accurate conclusions. This is particularly true for complex constructs such as memory and executive functioning. Some researchers have assessed these domains with the use of one or two instruments, an approach that can lead to mono-operation bias and reduces the quality of observations (Heppner et al., 1999).

Generalizability is also a concern in the literature on the neuropsychological functioning of homeless individuals. Some researchers have chosen samples that are relatively more representative of the homeless population in the U.S., while others have excluded individuals with mental health diagnoses, substance use disorders, a history of TBI, and so forth. The results of this latter group of studies may not generalize well to the homeless population, given the prevalence of such concerns among homeless individuals. In their review of the literature on cognitive impairment in the homeless population, Spence et al. (2004) recommend the inclusion of participants with mental health and substance use disorders, as this speaks to the issue of external validity. Backer and Howard (2007) also recommend that variables such as schizophrenia, substance misuse, traumatic brain injury, acquired brain injury, neurological disorders, developmental disabilities, and prenatal drug exposure be considered when assessing the cognitive functioning of homeless individuals.

The generalizability of the existing research is also hampered by the manner in which “homelessness” has been operationalized. An adequate operationalization of homelessness is important for research that aims to describe the neuropsychological functioning of the homeless population; without this, it is difficult to generalize the findings to the target population. Definitions have varied from study to study, with some taking a categorical approach (e.g., never vs. ever homeless) or assigning the label of homeless to those who had ever slept in a shelter. Others have used stricter definitions, such as more than one week without permanent residence. The manner in which homelessness is defined has important implications on how extensively the results can be generalized.

In addition to distinguishing “homeless” from “non-homeless” is the issue of variation within the homeless population in terms of length and frequency of homelessness. Few studies have provided information in this regard. Foulks et al. (1990) reported that participants had spent an average of 7.7 months homeless, although “homeless” was not operationally defined. Duerksen (1995) reported that participants had spent an average of 84 months without permanent residence, but it is unclear as to whether this latter figure refers to continuous months homeless or a sum of all homeless episodes. The approach used by Seidman et al. (1997) has been the most thorough; participants were asked the age at which they first became homeless (defined as more than one week on the streets or in shelter) and the total time they had spent homeless. The majority of participants were able to answer these questions and more than 75% had spent at least one year homeless. Solliday-McRoy et al. (2004) did not assess duration of homelessness but did obtain information on length of time spent in shelter; on average,

participants had spent approximately 88 days out of the past four years in shelters. Clearly, the generalizability of the data from these studies to homeless individuals who have been homeless for extended periods of time (i.e. more than one year) is questionable.

Another dimension along which the homeless population varies is location. All of the existing research regarding the neuropsychological functioning of homeless persons has been conducted with individuals recruited from homeless shelters, hostels, residential programs for the homeless, or hospitals. While these are convenient settings in which to find homeless individuals, these are not the only locations in which homeless persons dwell. It has been suggested that homeless individuals sampled from shelters are relatively good representatives of the homeless population as a whole (Hannappel et al., 1989), yet the empirical evidence of this is lacking. It is unclear as to whether individuals who seek services at clinics, shelters, or homeless-specific programs are higher-functioning than those who are not similarly service-engaged.

Thus, across the nine studies that exist in this area, the findings would appear to generalize best to individuals living in shelters and/or receiving services through a social service agency or hospital, and perhaps to those who have been “acutely” as opposed to “chronically” homeless. While this is helpful for clinicians who work within these settings or who primarily assist individuals who cycle in and out of homelessness, it leaves a gap in our understanding of how to work with other subgroups of the homeless population. This includes individuals who remain homeless for long periods of time, those who live outdoors, and those who choose not to – or are unable to – participate in the social service system. Further, there is little information that generalizes to homeless

individuals who have mental health disorders, substance use disorders, and TBIs or other neurological disorders. This is an important limitation, given the prevalence of these issues in the homeless population.

The process of describing the neuropsychological functioning of the homeless population has been ongoing for several decades, and many gains have been made. However, further research that addresses the limitations discussed herein is necessary in order to understand fully the existence and nature of neuropsychological functioning of individuals who experience homelessness. Such knowledge has the potential to transform service delivery with this population. Therefore, the current study aims to expand the current research regarding the neuropsychological functioning of homeless individuals through a descriptive research design.

# CHAPTER III
# METHOD

In the following sections, the research design, participants, instruments, and procedure for this study will be described.

## Research Design

This study was descriptive in nature, with a goal of describing the neuropsychological functioning of men residing in a homeless shelter. Of considerable importance in this type of research are obtaining high quality observations and detailing characteristics of the sample (Heppner et al., 1999).

The target population for this study was defined as adult men (i.e., age 18 and older) residing in homeless shelters who are fluent in the English language and who do not have sensory impairments (e.g., visually impaired) that hinder neuropsychological testing. The participant pool was limited to men residing at the Guest House of Milwaukee, a homeless shelter for adult men, between June and December 2008 who volunteered to participate and who did not meet the exclusion criteria. These criteria included 1) conditions that would significantly interfere with testing or hinder the production of valid and reliable test data, such as the presence of a visual, auditory, or other sensory/motor impairment; and 2) an observed tendency (during recruitment or the initial interview) toward violent or aggressive behavior. The latter was included in order to ensure research team members' safety during test administration.

Although some descriptive designs utilize random selection, this study employed nonprobability sampling, in that participants were not randomly selected from the participant pool (Trochim, 2001). Samples that are selected in this manner are considered

"good enough" for making valid generalizations to populations similar to the sample (Heppner et al., 1999). Thus, it is especially important to carefully document sample characteristics (Heppner et al., 1999, p. 326). In this particular study, all men residing at the Guest House of Milwaukee between June and December 2008 were eligible to express interest in becoming a participant.

## Participants

The sample for this study included 51 men participants, all of whom were receiving shelter and other services at the Guest House of Milwaukee (GHOM), a comprehensive social services agency located just outside downtown Milwaukee, Wisconsin. GHOM provides shelter, case management services, educational programming, and drug treatment for adult men in the Milwaukee area. The shelter houses 70 to 80 men ("guests") on any given day, and the majority of men receiving services through GHOM are African American. There are variations in length of stay (e.g., ranging from one night to several months) and extent of involvement in shelter-based services. Based on the average length of stay of participants in this study (38 days), it is estimated that 300 to 400 men resided at GHOM during the six months of data collection. Current data from GHOM regarding the average length of stay, number of guests served per year, and demographic characteristics of guests are unavailable. Therefore, the extent to which the sample in this study represents the GHOM population is unclear.

### *Demographic and Background Characteristics*

Table 3.1 outlines the demographic and background characteristics of the sample. Participants were, on average, in their mid-40s and had the equivalent of a high school

education. Regarding ethnic identity, the sample was nearly evenly split between African American and non-African American participants. An overview of additional participant characteristics can be found in Table 3.2; these areas will be explored in detail in forthcoming sections.

The overwhelming majority of participants were unemployed (*n* = 47, 92.2%); the remaining participants were employed temporarily (*n* = 2) or had a permanent part-time job (*n* = 2). Information regarding length of unemployment was inconsistently reported among participants; therefore, this information is not reported here. Participants were asked about their work histories, and nearly all had most recently been employed in labor (*n* = 13, 25.5%), services (*n* = 14, 27.5%), or skilled trades (*n* = 18, 35.3%). Few participants had been employed in manufacturing (*n* = 2, 3.9%) or managerial positions (*n* = 3, 5.9%).

Participants were also asked about involvement in special education during their school years, and 82.4% (*n* = 42) reported no such involvement. Four participants (7.8%) said they had been involved in special education for cognitive or academic reasons, and two participants (3.9%) said they had been placed in special education for reasons unknown to them. Finally, three participants (5.9%) were unsure if they had been involved in special education services.

Most participants had no prior military involvement (78.4%, *n* = 40). Among those who had been enlisted, 13.7% (*n* = 7) had been in the Army, 3.9% (*n* = 2) Navy, 2.0% (*n* = 1) Marine Corps, and 2.0% (*n* = 1) Air Force. Combat involvement was rare; one participant described himself as a Vietnam veteran, and two participants had been involved in other conflicts. One participant reported that he had been exposed to toxic

materials during his military involvement, and another three participants were unsure if they had been exposed. All participants with military involvement had been discharged, and most (70.0%, *n* = 7) reported having an honorable discharge status.

Table 3.1

*Participant Demographic Characteristics* (*N* = 51)

| Variable | *n* | % | *M* | *SD* | *Mdn* | Mode | Range |
|---|---|---|---|---|---|---|---|
| Age | | | 46.37 | 8.83 | 47.0 | 44; 51 | 22 – 61 |
| Years of education | | | 11.59 | 2.41 | 11.0 | 11 | 3 – 18 |
| Highest level of education | | | | | | | |
| No GED/diploma | 12 | 23.5 | | | | | |
| GED/HS equiv. | 15 | 29.4 | | | | | |
| High school diploma | 14 | 27.5 | | | | | |
| Technical training | 5 | 9.8 | | | | | |
| Associate's degree | 2 | 3.9 | | | | | |
| Bachelor's degree | 2 | 3.9 | | | | | |
| Master's degree | 1 | 2.0 | | | | | |
| Race/ethnicity | | | | | | | |
| African American | 24 | 47.0 | | | | | |
| Caucasian | 24 | 47.0 | | | | | |
| Latino/Hispanic | 1 | 2.0 | | | | | |
| Biracial/Multiracial | 1 | 2.0 | | | | | |
| Other | 1 | 2.0 | | | | | |
| Native language | | | | | | | |
| English | 50 | 98.0 | | | | | |
| Spanish | 1 | 2.0 | | | | | |

Table 3.1, continued

| Variable | *n* | % | *M* | *SD* | *Mdn* | Mode | Range |
|---|---|---|---|---|---|---|---|
| Marital status | | | | | | | |
| Single | 30 | 58.8 | | | | | |
| Married | 2 | 3.9 | | | | | |
| Separated | 3 | 5.9 | | | | | |
| Divorced | 15 | 29.4 | | | | | |
| Widowed | 1 | 2.0 | | | | | |
| Parental status | | | | | | | |
| No children | 19 | 37.3 | | | | | |
| Children | 32 | 62.7 | | | | | |
| Handedness | | | | | | | |
| Right | 34 | 84.3 | | | | | |
| Left | 7 | 13.7 | | | | | |
| No preference | 1 | 2.0 | | | | | |

*Note. Mdn* = median.

Table 3.2

*Additional Sample Characteristics* (*N* = 51)

| Variable | *M* | *SD* | *Mdn* | *Mode* | *Range* |
|---|---|---|---|---|---|
| Cumulative Days Homeless[a] | 566.57 | 798.92 | 253.0 | 37; 80 | 14 – 3,816 |
| Last Meal (hrs)[a] | 14.60 | 20.05 | 14.0 | 16 | 0.5 – 137 |
| Head Injuries[b] | 1.86 | 1.27 | 2.0 | 2 | 0 – 4 |
| No. Mental Health Dx[a] | 2.18 | 2.15 | 1.0 | 1 | 0 – 8 |
| No. Medical Problems[a] | 1.22 | 1.33 | 1.0 | 0 | 0 – 4 |
| No. CNS Medications[a] | 0.92 | 1.32 | 0 | 0 | 0 – 4 |
| No. Services Utilized[a] | 3.65 | 1.78 | 4.0 | 4 | 1 – 8 |
| No. Sleep Problems[a] | 1.94 | 1.56 | 2.0 | 1 | 0 – 5 |
| No. Neurological Problems[a] | 2.94 | 2.49 | 2.0 | 1 | 0 – 10 |
| No. Adaptive Behavior Problems[a] | 3.37 | 2.86 | 3.0 | 0 | 0 – 12 |

[a]Continuous variable [b]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries

Due to the small number of participants who identified as other than African American or Caucasian, ethnicity was collapsed into two categories (African American, *n* = 24, and non-African American, *n* = 27) for data analysis purposes. Demographic and background characteristics for the two groups were compared to determine if any significant differences existed. Additionally, the groups were compared on such factors as self-reported number of head injuries, presence of alcohol and drug use diagnoses, number of mental health diagnoses, and number of medical concerns. A listing of means, standard deviations, and the results of Mann-Whitney *U* tests can be found in Table 3.3.

The only significant differences between African American and non-African American participants were in the number of CNS medication being currently taken and the number of self-reported medical problems. Non-African American participants reported more medical concerns and more CNS medications than did African American participants.

Although African American and non-African American participants did not differ significantly in terms of years of education, further examination of educational achievements between the two groups was examined. None of the African American participants had completed an advanced degree, whereas 18.5% of non-African American participants had. Twice as many African American participants had neither a high school diploma nor a GED compared to non-African American participants. This information is outlined in Table 3.4.

Table 3.3

*Comparisons Between African American and Non-African American Participants*

| | African American ($n$ = 24) | | Non-African American ($n$ = 27) | | | |
|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | *M* | *SD* | *z* | *p* |
| Age[a] | 45.33 | 8.49 | 47.30 | 9.18 | -1.00 | .32 |
| Education (yrs)[a] | 11.44 | 1.21 | 11.72 | 3.13 | -0.63 | .53 |
| Cumulative Days Homeless[a] | 667.46 | 1011.07 | 476.89 | 552.63 | -0.60 | .55 |
| Last Meal (hrs)[a] | 13.75 | 10.23 | 15.35 | 26.06 | -0.97 | .33 |
| No. Head Injuries[b] | 1.75 | 1.26 | 1.96 | 1.29 | -0.60 | .55 |
| No. Mental Health Dx[a] | 2.04 | 2.24 | 2.30 | 2.11 | -0.53 | .60 |
| TAAD Alcohol Dx[c] | .67 | .48 | .63 | .49 | -0.20 | .78 |
| TAAD Drug Dx[c] | .63 | .50 | .48 | .51 | -1.02 | .31 |
| No. Medical Problems[a] | 0.79 | 1.18 | 1.59 | 1.37 | -2.23 | .03 |
| No. CNS Medications[a] | 0.29 | 0.86 | 1.48 | 1.42 | -3.50 | .00 |
| No. Services Utilized[a] | 3.50 | 1.84 | 3.78 | 1.74 | -0.64 | .52 |
| No. Sleep Problems[a] | 1.67 | 1.49 | 2.19 | 1.59 | -1.16 | .25 |
| No. Neurological Problems[a] | 3.00 | 2.69 | 2.89 | 2.34 | -0.01 | .99 |
| No. Adaptive Beh. Problems[a] | 3.46 | 3.30 | 3.30 | 2.48 | -0.20 | .84 |

*Note.* Mann-Whitney *U* test used to compare groups. [a]Continuous variables [b]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries [c]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

Table 3.4

*Educational Achievements of African American and non-African American Participants*

| | African American (n = 24) | | Non-African American (n = 27) | |
|---|---|---|---|---|
| Highest Level | *n* | % | *n* | % |
| No GED/HS diploma | 8 | 33.3 | 4 | 14.8 |
| GED/HS equivalency | 8 | 33.3 | 7 | 25.9 |
| HS diploma | 6 | 25.0 | 8 | 29.6 |
| Technical training | 2 | 8.3 | 3 | 11.1 |
| Associate's degree | 0 | -- | 2 | 7.4 |
| Bachelor's degree | 0 | -- | 2 | 7.4 |
| Master's degree | 0 | -- | 1 | 3.7 |

No GED/HS diploma vs. ≥ GED/HS diploma: $\chi^2$ (1, $n$ = 51) = 1.50, $p$ = .22

*Note.* Continuity correction was applied to chi-square test.

## *Current Physical Health Status*

### *Meal Regularity and Body Mass Index*

During the initial interview, participants were asked to report on the day and time of their last meal; however, the definition of "meal" varied somewhat from person to person (e.g., "square" meal vs. snack). The length of time since a participant last ate was calculated by the interviewer; on average, this was 14.60 hours ago (*SD* = 20.05). There was a wide range of responses to this question (0.5 to 137.0 hours ago; *Mdn* = 14.0).

Most participants reported that they ate two or more "meals" per day (*n* = 35, 68.6%), and only one individual said that he did not eat any meals (i.e., full meals vs. snacks).

Participants also provided information about their current height and weight, and a standard formula for body mass index (BMI) was used to classify participants into BMI categories (Sarafino, 2008; [(704.5 * weight (lbs)) / height (in)] / height (in)). Approximately 40% of participants were classified as being at a healthy weight (BMI = 18.5-24.9; *n* = 20, 39.2%), but classification in the overweight (BMI = 25.0-29.9; *n* = 14, 27.5%) and obese (BMI = 30.0-39.9; *n* = 15, 29.4%) categories was also common. Two participants were categorized as being extremely obese (BMI > 39.9; 3.9%).

*Current Medical Concerns*

Over half of the participants (56.9%; *n* = 29) reported at least one current physical health problem, and within this group, 62% (*n* = 18) reported two or more such concerns. Across all participants the mean number of self-reported medical concerns was 1.22 (*SD* = 1.33; *Mdn* = 1.0; range = 0 – 4). Hypertension, liver disease (including Hepatitis C) and musculoskeletal concerns (e.g., back pain, arthritis) were the top three medical issues reported by participants. A full description of participants' medical concerns can be found in Table 3.5.

Table 3.5

*Current Health Concerns by Self-Report* (*N* = 51)

| Variable | *n* | % |
|---|---|---|
| Specific Conditions[1] | | |
| Hypertension | 15 | 29.4 |
| Liver disease | 10 | 19.6 |
| Arthritis, other musculoskeletal concerns | 10 | 19.6 |
| Diabetes | 6 | 11.8 |
| Neuropathy, other nervous system concerns | 4 | 7.8 |
| Asthma, other respiratory system concerns | 4 | 7.8 |
| Acid reflux, other digestive system concerns | 3 | 5.9 |
| Cancer | 2 | 3.9 |
| Heart disease | 2 | 3.9 |
| Seizure disorder | 2 | 3.9 |
| Kidney disease | 1 | 2.0 |
| Number of Reported Concerns | | |
| None | 22 | 43.1 |
| 1 | 11 | 21.6 |
| 2 | 6 | 11.8 |
| 3 | 9 | 17.6 |
| 4 | 3 | 5.9 |

[1]Percentages and *n*s do not total 100% and 51, respectively, due to multiple responses per participant.

*Sleep-Related Concerns*

Over three-fourths of participants (78.4%; *n* = 40) stated that they had at least one current sleep-related problem, and this was typically difficulty with staying asleep or falling asleep. The average number of sleep-related concerns across the entire sample was 1.94 (*SD* = 1.56). However, among those who reported having sleep problems, nearly half had three or more such concerns (*n* = 18; 45%). Table 3.6 provides a full description of participants' self-reported sleep concerns.

Table 3.6

*Sleep-Related Concerns* (*N* = 51)

| Variable | *n* | % |
|---|---|---|
| Specific Concerns[1] | | |
| Difficulty staying asleep | 28 | 54.9 |
| Difficulty falling asleep | 24 | 47.1 |
| Daytime sleepiness | 21 | 41.2 |
| Breathing problems (e.g. sleep apnea) | 10 | 19.6 |
| Chronic insomnia | 9 | 17.6 |
| Difficulty waking up | 6 | 11.8 |
| Recurrent nightmares | 1 | 2.0 |
| Number of Reported Concerns | | |
| None | 11 | 21.6 |
| 1 | 13 | 25.5 |
| 2 | 9 | 17.6 |
| 3 | 6 | 11.8 |
| 4 | 10 | 19.6 |
| 5 | 2 | 3.9 |

[1]Percentages and *n*s do not total 100% and 51, respectively, due to multiple responses per participant.

*Neurological Symptoms*

Participants were asked to report on any current neurological symptoms, and nearly all (84.3%; *n* = 43) reported having at least one such symptom. Within this group, over half reported three or more symptoms (53%; *n* = 23). On average, participants reported 2.94 neurological symptoms (*SD* = 2.49), with the most common being memory problems and difficulty concentrating. Table 3.7 illustrates this information.

Table 3.7

*Self-Reported Neurological Symptoms* (*N* = 51)

| Variable | *n* | % |
|---|---|---|
| | Specific Symptoms[1] | |
| Memory problems | 28 | 54.9 |
| Difficulty concentrating | 27 | 52.9 |
| Lack of motivation | 20 | 39.2 |
| Coordination problems | 14 | 27.5 |
| Confusion | 14 | 27.5 |
| Dizziness | 13 | 25.5 |
| Vision problems | 13 | 25.5 |
| Frequent headaches | 8 | 15.7 |
| Speech problems | 7 | 13.7 |
| Hearing problems | 6 | 11.8 |
| | Number of Reported Symptoms | |
| None | 8 | 15.7 |
| 1 | 10 | 19.6 |
| 2 | 9 | 17.6 |
| 3 | 5 | 9.8 |
| 4 | 7 | 13.7 |
| 5 or more | 12 | 23.6 |

[1]Percentages and *n*s do not total 100% and 51, respectively, due to multiple responses per participant.

### *Vision, Hearing, and Motor-Sensory Limitations*

The majority of participants reported needing corrective lenses (84.3%; *n* = 43), but only 53.5% (*n* = 23) actually had them. Participants most commonly reported that they required reading glasses. Although not formally asked, several participants stated that their glasses had been stolen or were broken. Including both individuals who did not need glasses and those who needed them and had them, 60.8% (*n* = 31) of the sample had adequate vision. None of the participants wore hearing aids, although 21.6% (*n* = 11) reported experiencing partial hearing loss.

Limitations of movement were frequently reported by participants, with 80.4% (*n* = 41) acknowledging at least one such concern. Most often, this was difficulty or pain associated with moving legs, knees, or feet (52.9%; *n* = 27). Limitations and/or pain with moving arms, hands, or fingers was another common concern (29.4%; *n* = 15). These difficulties were typically attributed to old injuries, recent accidents or injuries, and arthritis.

## *Current Medications*

### *Prescription Drugs*

Over half of the participants (54.9%; *n* = 28) were taking at least one prescribed medication at the time of their involvement in the study, and among these participants, central nervous system (CNS) agents were the most commonly reported at 71.4% (*n* = 20). Within this subgroup, participants were taking, on average, two CNS medications (*M* = 2.0, *SD* = 1.0, *Mdn* = 2.0, range = 1 – 4), and most were taking an antidepressant. Due to the possibility of some participants stopping, forgetting to take, or refusing to take prescribed CNS medications, the numbers presented here do not reflect the actual

percentage of participant who should be taking CNS medications, based on physician recommendations. Further information regarding CNS medications can be found in Table 3.8.

Table 3.8

*Types of CNS Medications Reported by Participants* (*n* = 20)

| Variable | *n* | % |
|---|---|---|
| Specific Class of Medication[1] | | |
| Antidepressants | 14 | 70.0 |
| Antipsychotics | 11 | 55.0 |
| Analgesics | 6 | 30.0 |
| Anticonvulsants | 6 | 30.0 |
| Sedative-hypnotics | 6 | 30.0 |
| Addiction/withdrawal agents | 2 | 10.0 |
| Antiparkinson agents | 1 | 5.0 |
| Antimanics | 1 | 5.0 |
| Number of CNS Medications Reported | | |
| 1 | 5 | 25.0 |
| 2 | 6 | 30.0 |
| 3 | 6 | 30.0 |
| 4 | 3 | 15.0 |

[1]Percentages do not total 100% due to multiple responses per participant.

The Mann-Whitney *U* test was used to compare participants who reported taking CNS medications and those who did not on a variety of background factors. Most comparisons were not statistically significant. However, the groups differed significantly in terms of number of reported medical problems ($z$ = -2.34, $p$ = .02), sleep problems ($z$ = -3.25, $p$ = .00), and services used ($z$ = -2.87, $p$ = .00). Participants who reported taking one or more CNS medication also reported more problems in all three areas. The results of these comparisons, along with descriptive statistics, can be found in Table 3.9.

Table 3.9

*Comparisons Between Participants Taking and Not Taking CNS Medications*

| | No CNS Meds ($n$ = 31) | | ≥ 1 CNS Med ($n$ = 20) | | | |
|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | *M* | *SD* | *z* | *p* |
| Age[a] | 45.71 | 8.74 | 47.40 | 9.10 | -0.65 | .52 |
| Education (yrs)[a] | 11.27 | 1.50 | 12.08 | 3.36 | -1.11 | .27 |
| Cumulative Days Homeless[a] | 594.32 | 917.70 | 523.55 | 588.82 | -0.31 | .76 |
| Last Meal (hrs)[a] | 12.18 | 10.03 | 18.35 | 29.57 | -0.41 | .69 |
| No. Head Injuries[b] | 1.81 | 1.25 | 1.95 | 1.32 | -0.36 | .72 |
| No. Mental Health Dx[a] | 1.68 | 1.82 | 2.95 | 2.44 | -1.92 | .06 |
| TAAD Alcohol Dx[c] | .74 | .45 | .50 | .51 | -1.75 | .08 |
| TAAD Drug Dx[c] | .65 | .49 | .40 | .50 | -1.70 | .09 |
| No. Medical Problems[a] | 0.84 | 1.13 | 1.80 | 1.44 | -2.34 | .02 |
| No. Services Utilized[a] | 3.13 | 1.77 | 4.45 | 1.50 | -2.87 | .00 |
| No. Sleep Problems[a] | 1.39 | 1.43 | 2.80 | 1.36 | -3.25 | .00 |
| No. Neurological Problems[a] | 2.71 | 2.66 | 3.30 | 2.20 | -1.24 | .22 |
| No. Adaptive Beh. Problems[a] | 3.10 | 3.15 | 3.80 | 2.38 | -1.31 | .19 |

*Note.* Mann-Whitney *U* test used to compare groups. [a]Continuous variable [b]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries [c]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

Other than CNS agents, 46.4% (*n* = 13) of participants who reported taking prescription drugs were taking a cardiovascular agent and 25.0% (*n* = 7) were taking diabetic medications. Less frequently reported were gastrointestinal medications (*n* = 3), respiratory medications/devices (e.g., inhalers; *n* = 3), prescribed nutritional products (*n* = 2), and genitourinary medications (*n* = 1). Again, these numbers reflect self-reported medications; participants may have forgotten or failed to report medications that were not currently being taken, despite being prescribed by medical professionals. Table 3.10 outlines the specific medications reported by participants.

Table 3.10

*List of Reported Medications, By Frequency* (*N* = 51)

| Name of Medication (*n*) | | |
|---|---|---|
| Lisinopril (6) | Doxepin (1) | Methadone (1) |
| Prozac (6) | Flomax (1) | Novolin (1) |
| Seroquel (6) | Geodon (1) | Oxycodone (1) |
| Wellbutrin (4) | Haldol (1) | Paxil (1) |
| Albuterol (3) | Humalog (1) | Percocet (1) |
| Depakote (3) | Hydrochlorothiazide (1) | Proventil (1) |
| Vicodin (3) | Interferon (1) | Proxilin (1) |
| Advair (2) | Lantus (1) | Ribovarin (1) |
| Atenelol (2) | Lasix (1) | Risperdal (1) |
| Dilantin (2) | Labetalol (1) | Temazepam (1) |
| Diovan (2) | Levothyroxine (1) | Tramadol (1) |
| Gabapentin (2) | Lexapro (1) | Trazodone (1) |
| Glyburide (2) | Librium (1) | Trileptal (1) |
| Norvasc (2) | Lipitor (1) | Valium (1) |
| Abilify (1) | Lithium (1) | Xanax (1) |
| Ambien (1) | Lorazepam (1) | Zocor (1) |
| Campral (1) | Lunesta (1) | Zyprexa (1) |
| Clonidine (1) | Lyrica (1) | |
| Cogentin (1) | Metformin (1) | |

*Note.* All medications were self-reported by participants. Not all medications being taken by participants are represented in this list due to inability of some participants to provide a specific medication name.

### *Over-the-Counter Medications*

Just over 60% of participants reported taking over-the-counter (OTC) medications either currently or as needed (60.8%; *n* = 31). OTC pain relievers (e.g., aspirin) were the most commonly reported (64.5%; *n* = 20), followed by vitamins/minerals (35.5%; *n* = 11), cold/allergy medication (16.1%; *n* = 5), herbal supplements (9.7%; *n* = 3), and digestive aids (3.2%; *n* = 1).

## *Health History*

### *Pre- and Perinatal Birth Complications*

Few participants reported a history of birth complications (15.7%; *n* = 8). The limited information here likely reflects participants' lack of awareness of prenatal or birth complications (i.e., they may not have been told about such issues); "don't know" was a common response to these items. Among those who reported complications, four said they had been born premature and one participant reported oxygen deprivation during the birth process; the remaining three participants said they were unsure of the nature of the birth complication.

### *Childhood Health History*

Participants were asked about any health or medical concerns they had experienced through age 18 years, excluding head injuries. Physical injuries, such as broken bones and gun shot wounds, were the most frequently reported at 27.5% of the sample (*n* = 14). Other concerns included hernias and other digestive system problems (13.7%; *n* = 7), asthma and other respiratory system concerns (13.7%; *n* = 7), serious infections (9.8%; *n* = 5), and nervous system problems (e.g., migraines; 7.8%; *n* = 4).

### *Head Injuries*

Head injuries were frequently reported by participants; 84.3% (*n* = 43) had experienced at least one head or brain injury in their lifetime. Of this subgroup, approximately two-thirds reported a history of two or more head injuries. The incidences reported by participants were typically older, occurring more than five years ago. Table 3.11 provides further information regarding head injuries.

For those participants who reported at least one head injury, questions regarding loss of consciousness were asked. The majority (*n* = 36, 83.7%) reported experiencing some degree of loss of consciousness; this was typically described as lasting "seconds" (*n* = 10, 27.8%) or more than one hour (*n* = 8, 22.2%), or of unknown duration (*n* = 7, 19.4%). Full information regarding loss of consciousness can be found in Table 3.12.

Table 3.11

*Description of Head Injuries* (*n* = 43)

| Variable | *n* | % |
|---|---|---|
| Number of head injuries, lifetime | | |
| One | 13 | 30.2 |
| 2-3 | 15 | 34.9 |
| 4-5 | 8 | 18.6 |
| More than 5 | 7 | 16.3 |
| Time since last head injury | | |
| Past month | 1 | 2.3 |
| Past 6 months | 4 | 9.3 |
| Past year | 3 | 7.0 |
| Past 2 years | 4 | 9.3 |
| 2 – 5 years ago | 5 | 11.6 |
| More than 5 years ago | 26 | 60.5 |

Table 3.12

*Description of Loss of Consciousness* (*n* = 43)

| Variable | *n* | % |
|---|---|---|
| Loss of consciousness | | |
| No | 4 | 9.3 |
| Don't know/can't remember | 3 | 7.0 |
| Yes | 36 | 83.7 |
| Seconds | 10 | 27.8 |
| Under 5 minutes | 6 | 16.7 |
| 6-10 minutes | 2 | 5.5 |
| 11-20 minutes | 1 | 2.8 |
| 21-60 minutes | 2 | 5.5 |
| More than 60 minutes | 8 | 22.2 |
| DK/can't remember | 7 | 19.4 |

## *Behavioral Health Status*

### *Self-Reported Behavioral Health Disorders*

History of mental health and substance use disorders was assessed in two ways. Participants were asked to self-report any known current and past diagnoses and, in addition, two diagnostic interviews were completed to determine current and lifetime diagnoses based on the current edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; APA, 2000).

Based on self-report, 60.8% (*n* = 31) of participants surmised or were certain that they had been diagnosed with a mental health and/or substance use disorder in their lifetime. The most frequently reported diagnosis was any type of substance use disorder (35.5%; *n* = 11), followed by bipolar disorder (32.3%; *n* = 10), depression (19.4%; *n* = 6), any type of anxiety disorder (19.4%; *n* = 6), schizophrenia (9.7%; *n* = 3), and ADHD (3.2%; *n* = 1). Several participants (22.6%; *n* = 7) were unsure of or had not been told their exact diagnosis.

*Behavioral Health Disorders By Assessment*

All participants completed the Mini International Neuropsychiatric Interview (eMINI), and a complete description of psychological diagnoses for the sample can be found in Table 3.13. Over three-fourths of the sample received at least one diagnosis (76.5%; *n* = 39), and 64% of this group received two or more diagnoses (*n* = 25; see Table 3.14). The mean number of eMINI diagnoses across the entire sample was 2.18 (*SD* = 2.15; *Mdn* = 1.0; range = 0 – 8).

Results of the eMINI indicated that approximately three-fourths of the sample met criteria for a substance dependence disorder of any kind (72.5%; *n* = 37). Further, the most prevalent disorder, based on the eMINI, was Alcohol Dependence (49.0%; *n* = 25). In comparison, results of the Triage Assessment for Addictive Disorders (TAAD) found that 58.8% (*n* = 30) met criteria for this disorder. This latter figure may be more accurate, as the TAAD contains more questions regarding alcohol use and its consequences than the eMINI, and thus may be more sensitive. TAAD results also indicated that 5.9% of participants (*n* = 3) met criteria for Alcohol Abuse; this was similar to the eMINI finding of 3.9% (*n* = 2). Drug dependence was also prevalent in the sample. Results of the TAAD

indicated that 47.1% (*n* = 24) of participants met criteria for Drug Dependence and 7.8% (*n* = 4) met criteria for Drug Abuse. Cocaine Dependence (*n* = 18, 35.3%) and Marijuana Dependence (*n* = 15, 29.4%) were the most common drug use disorders identified by the eMINI.

Mood and anxiety disorders were also common among participants, according to the results of the eMINI. One-third of the sample met criteria for Major Depressive Episode or Disorder (33.3%; *n* = 17), and nearly 40% were diagnosed with Agoraphobia (37.3%; *n* = 19). Fewer than half of those diagnosed with Agoraphobia had an accompanying diagnosis of Panic Disorder (42.1%; *n* = 8), a somewhat unusual finding in that Agoraphobia and Panic Disorder typically occur together (APA, 2000). It is possible that homeless men experience anxiety in and/or avoid particular places or situations (e.g., parks, bus stops) because of realistic fears, such as being mugged, physically assaulted, or arrested. This may explain the elevated incidence of Agoraphobia in the sample.

The eMINI also contains questions about current suicidal thoughts and past suicide attempts. Most participants (56.9%; *n* = 29) were rated as having no current suicide risk. Approximately one-fourth, however, were considered to be at low risk for suicide (23.5%; *n* = 12), and several participants were at medium to high risk (19.6%; *n* = 10).

Table 3.13

*Psychological Disorders, Current and Lifetime, by eMINI* (*N* = 51)

| Diagnosis | *n* | % |
|---|---|---|
| Alcohol Dependence | 25 | 49.0 |
| Agoraphobia | 19 | 37.3 |
| With Panic Disorder | 8 | 15.7 |
| Without Panic Disorder | 11 | 21.6 |
| Cocaine Dependence | 18 | 35.3 |
| Major Depressive Episode/Disorder | 17 | 33.3 |
| Marijuana Dependence | 15 | 29.4 |
| Panic Disorder/Attacks | 14 | 27.5 |
| With Agoraphobia | 8 | 15.7 |
| Without Agoraphobia | 6 | 11.8 |
| Psychotic Disorder | 13 | 25.5 |
| Antisocial Personality Disorder | 13 | 25.5 |
| OCD/OCD-type symptoms | 10 | 19.6 |
| Social Anxiety Disorder | 8 | 15.7 |
| Dysthymic Disorder | 5 | 9.8 |
| PTSD | 5 | 9.8 |
| Generalized Anxiety Disorder | 5 | 9.8 |
| Mood Disorder w/Psychotic Features | 2 | 3.9 |
| Alcohol Abuse | 2 | 3.9 |
| Marijuana Abuse | 2 | 3.9 |

Table 3.13, continued

| Diagnosis | *n* | % |
|---|---|---|
| Narcotics Dependence | 2 | 3.9 |
| Heroin Dependence | 1 | 2.0 |
| Hallucinogen Dependence | 1 | 2.0 |

*Note.* Percentages and *n*s do not total 100% and 51, respectively, due to multiple responses per participant.

Table 3.14

*Number of Psychological Disorders, Current and Lifetime, by eMINI* (*N* = 51)

| Number of Disorders | *n* | % |
|---|---|---|
| None | 12 | 23.5 |
| 1 | 14 | 27.5 |
| 2 | 7 | 13.7 |
| 3 | 7 | 13.7 |
| 4 | 3 | 5.9 |
| 5 | 2 | 3.9 |
| 6 | 3 | 5.9 |
| 7 | 2 | 3.9 |
| 8 | 1 | 2.0 |

*Adaptive Functioning*

A formal measure of adaptive functioning was not used in this study, but participants were asked about various activities of daily living (e.g., attending appointments, personal hygiene) over the past year. A large percentage (80.4%; *n* = 41) of the sample reported difficulty with at least one item from the list. On average, participants reported approximately three specific adaptive behavior difficulties (*M* = 3.37, *SD* = 2.86, *Mdn* = 3.0), and the top three concerns were being taken advantage of by others, being tricked or fooled by others, and missing scheduled appointments. Additional information regarding adaptive functioning difficulties is detailed in Table 3.15.

Table 3.15

*Self-Reported Adaptive Behavior Problems, Past Year* (*N* = 51)

| Variable | *n* | % |
|---|---|---|
| Specific Area of Difficulty[1] | | |
| Taken advantage of by others | 25 | 49.0 |
| Tricked/fooled by others | 19 | 37.3 |
| Attending appointments | 16 | 31.4 |
| Making decisions | 14 | 27.5 |
| Following rules/laws | 13 | 25.5 |
| Reading/writing | 13 | 25.5 |
| Speaking/communicating with others | 12 | 23.5 |
| Getting along with others | 10 | 19.6 |
| Personal safety | 8 | 15.7 |
| Personal hygiene | 6 | 11.8 |
| Using transportation | 6 | 11.8 |
| Handling money | 2 | 3.9 |
| Number of Reported Problems | | |
| None | 10 | 19.6 |
| 1 | 5 | 9.8 |
| 2 | 9 | 17.6 |
| 3 | 6 | 11.8 |
| 4 | 3 | 5.9 |
| 5 or more | 18 | 35.4 |

[1]Percentages and *n*s do not total 100% and 51, respectively, due to multiple responses per participant.

## *Service Use*

### *Professional Services*

Over half of the participants (56.9%; *n* = 29) said they were receiving medical and/or dental treatment; although not formally asked, most participants volunteered that these services were provided through a free or low-cost clinic near the shelter. Drug and alcohol treatment was also reported by approximately half of the sample (*n* = 27, 52.9%), most typically for alcohol (*n* = 17, 63.0%) or cocaine (*n* = 17, 63.0%) misuse. Mental health treatment was reported by 41.2% of participants (*n* = 21), with most reporting that they were receiving help with mood or anxiety disorders (depression: *n* = 15, 71.4%; anxiety: *n* = 13, 61.9%). Specific information about the nature of mental health services was not obtained; participants may have been involved in medication management with a psychiatrist, mental health counseling, or both.

### *Community Services*

Nearly all of the participants (88.2%; *n* = 45) reported that they utilized free meal programs in the community (e.g., soup kitchens). Involvement in other community services/programs was rather uncommon; 15.7% (*n* = 8) were involved in educational or vocational services (e.g., Department of Vocational Rehabilitation), 5.9% (*n* = 3) were receiving legal or criminal justice services (e.g., community integration for recently released offenders), and 5.9% (*n* = 3) took part in 12-step programs such as Alcoholics Anonymous. Finally, all participants had an assigned case manager through GHOM who assisted them with obtaining bus tickets, finding employment, and securing stable housing. Including both professional and community services, participants were involved in, on average, 3.65 different service programs (*SD* = 1.78; *Mdn* = 4.0; range = 1 – 8).

*Disability Benefits*

Over half of the participants (60.8%; *n* = 31) reported having past or current experience with the process of applying for Social Security Disability Insurance (SSDI). Of these individuals, 38.7% (*n* = 12) said their application for SSDI had been denied, 22.6% (*n* = 7) were awaiting a decision on a pending application, and 12.9% (*n* = 4) were in the process of putting together an application. Only four individuals in this group (7.8% of the entire sample) were receiving SSDI at the time of their involvement in the study.

*History of Homelessness*

Information regarding participants' experiences with homelessness in adulthood can be found in Table 3.16. Most participants found it difficult to construct a timeline of their experiences with homelessness. Participants frequently reported that they could not remember how long they had stayed in a particular shelter, or how many weeks had passed between episodes of homelessness. Further, participants often reported being in and out of several different settings (e.g., shelters, transitional housing, temporary housing, outdoors) within a short period of time. Frequently, participants said they had stayed outdoors (e.g., in the park, by the lake, or in a car) for one night at a time, a pattern that was sometimes described as occurring "hundreds of times" over the course of several years, particularly during the summer months.

Due to these difficulties, the number of shelter episodes, outdoor episodes, and other episodes was not calculated. Based on the information a participant was able to provide, an estimate of the total number of days spent homeless was calculated. A conservative approach was taken in the calculations (e.g., when participants reported

spending two to three months in a shelter, an estimate of 2.5 months was used); therefore, these figures may underestimate the actual duration of homelessness experienced by participants.

The mean number of days spent homeless as an adult (i.e., across shelter, outdoor, and other episodes) was 566.57 (*SD* = 798.92), or approximately 1.55 years. However, due to the wide range (14 – 3,816 days), the median may be a better estimate. The median was 253.0 days, or roughly 8.3 months of homelessness as an adult. In terms of length of current stay at GHOM, the mean was 37.80 days (*SD* = 33.50), with a range of 2 to 180 days. Relationships between background factors and length of homelessness were also examined (Table 3.17). Number of self-reported sleep problems (*r* = .32), neurological problems (*r* = .36), and adaptive behavior problems (*r* = .48) were all linked to length of homelessness.

Table 3.16

*Experiences With Homelessness in Adulthood* (*N* = 51)

| Type of Episode | *n* | % |
|---|---|---|
| Shelter | | |
| Current stay only | 15 | 29.4 |
| One other episode | 13 | 25.5 |
| More than 2 episodes | 23 | 45.1 |
| Outdoors | | |
| Never | 16 | 31.4 |
| Once | 11 | 21.6 |
| 2 or more times | 24 | 47.1 |
| Other (e.g., transitional housing) | | |
| Never | 28 | 54.9 |
| Once | 9 | 17.6 |
| 2 or more times | 14 | 27.5 |

Table 3.17

*Correlations: Background Factors and Length of Homelessness*

| Variable | Cumulative Days Homeless[a] |
|---|---|
| Age[a] | .11 |
| Education (yrs)[a] | .05 |
| Last Meal (hrs)[a] | .15 |
| No. Head Injuries[b] | .26 |
| No. Mental Health Dx[a] | .06 |
| TAAD Alcohol Dx[c] | -.05 |
| TAAD Drug Dx[c] | .07 |
| No. Medical Problems[a] | .11 |
| No. CNS Medications[a] | .07 |
| No. Services Utilized[a] | .17 |
| No. Sleep Problems[a] | .32 |
| No. Neurological Problems[a] | .36 |
| No. Adaptive Beh. Problems[a] | .48 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, was used for relationships between ordinal and continuous variables. The point-biserial correlation was used for relationships between dichotomous and continuous variables. [a]Continuous variable [b]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries [c]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

*Reasons For Homelessness*

Participants reported a wide range of reasons for their current homeless status, with the top three being job loss, loss of housing, and alcohol/drugs. A complete listing can be found in Table 3.18. Participants were not asked to provide further details as to why they selected particular responses, but several offered that unemployment (sometimes related to alcohol/drugs) had led to loss of housing, ultimately resulting in their arrival at the shelter. Several participants also reported that alcohol or drug use had contributed to the loss of housing with family or friends (e.g., relatives did not want this kind of behavior in their home).

Table 3.18

*Reasons for Current Homeless Status* (*N* = 51)

| Reason | *n* | % |
|---|---|---|
| Lost job | 38 | 74.5 |
| Lost own house/apartment | 35 | 68.6 |
| Alcohol/drugs | 31 | 60.8 |
| Lost housing w/family or friend | 22 | 43.1 |
| Personal reasons | 5 | 9.8 |
| Family problems | 4 | 7.8 |
| Mental health problems | 4 | 7.8 |
| Moved from another city/state | 4 | 7.8 |
| Prefer to be homeless | 2 | 3.9 |
| Recent release from jail/prison | 2 | 3.9 |
| Health problems | 1 | 2.0 |
| Not sure why | 1 | 2.0 |

*Note.* Percentages and *n*s do not total 100% and 51, respectively, due to multiple responses per participant.

### *Test Day Symptomatology*

On the day of neuropsychological testing, each participant completed two self-report symptom measures, the Beck Anxiety Inventory (BAI) and the Beck Depression Inventory (BDI). On average, participants were experiencing mild anxiety and depressive symptoms on the day of testing. These results can be found in Table 3.19.

Table 3.19

*Self-Report Symptom Assessment Results* (*N* = 51)

| Variable | *n* | % | Mean | *SD* | Median | Range |
|---|---|---|---|---|---|---|
| BAI, Raw Score | | | 12.88 | 11.16 | 10.0 | 0 – 46 |
| None/Minimal Anxiety | 19 | 37.3 | | | | |
| Mild Anxiety | 15 | 29.4 | | | | |
| Moderate Anxiety | 9 | 17.6 | | | | |
| Severe Anxiety | 8 | 15.7 | | | | |
| BDI, Raw Score | | | 18.55 | 13.45 | 15.0 | 0 – 51 |
| None/Minimal Depression | 24 | 47.1 | | | | |
| Mild Depression | 6 | 11.8 | | | | |
| Moderate Depression | 10 | 19.6 | | | | |
| Severe Depression | 11 | 21.6 | | | | |

## Instruments

The battery used in this study included a broad range of neuropsychological tests, as well as several additional measures used to assess reading ability, intellectual functioning, and symptoms of depression and anxiety on the day of testing. Table 3.20 outlines the specific neuropsychological tests that were utilized, grouped by functional domain. In addition, a questionnaire was developed to gather background/demographic and health information and history of homelessness. Structured diagnostic interviews were also used to assess for mental health and substance use disorders. All participants received the same questionnaire, diagnostic interviews, and test battery.

Table 3.20

*Neuropsychological Tests by Functional Domain*

| Domain | Test(s) |
|---|---|
| Attention | CPT-II |
| | WAIS-III Digit Span |
| | WAIS-III Digit Symbol-Coding |
| Working Memory | WAIS-III Digit Span |
| | WAIS-III Letter-Number Sequencing |
| Visual/Verbal Memory | WRAML2 (Screening, Verbal, and Visual Indices) |
| | RCFT (Immediate and Delayed Recall) |
| Executive Functioning | DKEFS (Trail Making, Verbal Fluency, Tower) |
| | FrSBe (Self-Rating) |
| Construction Ability | RCFT (Copy Trial) |
| Language Functioning | BNT |
| Motor-Sensory Functioning | D-WSMB Sensory Functioning (Object Identification, Finger Identification) |
| | D-WSMB Motor Functioning (Gait and Station, Romberg, Finger Tapping, Grip Strength) |
| | Grooved Pegboard Test |

*Note.* CPT-II = Conners' Continuous Performance Test; WAIS-III = Wechsler Adult Intelligence Scale—Third Edition; WRAML2 = Wide Range Assessment of Memory and Learning—Second Edition; RCFT = Rey Complex Figure Test; DKEFS = Delis-Kaplan Executive Function System; FrSBe = Frontal Systems Behavior Scale; BNT = Boston Naming Test; D-WSMB = Dean-Woodcock Sensory Motor Battery

## *Neuropsychological Test Battery*

In this section, the measures comprising the neuropsychological portion of the test battery will be described, along with information on scores utilized in data analyses.

### *Conners' Continuous Performance Test II*

Conners' Continuous Performance Test II (CPT-II; Conners & MHS Staff, 2000) is a computerized visual continuous performance task that is used to assess sustained attention and response inhibition (Strauss et al., 2006). Letters appear on the computer screen at varying speeds and the examinee must press the spacebar for all stimuli except the letter "X." Testing begins with a practice round and is followed by six "blocks" of testing; each block consists of three sub-blocks of twenty trials each. Examinees must maintain a continuous response set and inhibit the spacebar-pressing response when the letter X appears. The test takes fourteen minutes to complete.

The CPT-II generates twelve scores and two confidence indices for adults age 18 and older. Conners and MHS Staff (2000) have categorized the twelve scores into three deficit types: inattentiveness, impulsivity, and vigilance. Scores in the inattentiveness category include Omissions, Commissions, Hit Reaction Time (Hit RT), Hit RT Standard Error (Hit RT SE), Variability, Detectability (*d'*), Hit RT ISI Change, and Hit SE ISI Change. The impulsivity category includes Commissions, Hit RT, Response Style, and Perseverations, and the vigilance category is comprised of Hit RT Block Change and Hit SE Block Change. Raw scores for these areas are corrected for negative skew and converted to *T* scores based on one of three normative groups (Strauss et al., 2006). Higher *T* scores are for the most part indicative of poorer performance, except in the case of Hit RT and Response Style; low scores in these areas are also suggestive of attention

difficulties. *T* scores greater than or equal to 65 are typically considered markedly atypical (Strauss et al., 2006).

In addition to these scores is the Confidence Index Associated with ADHD Assessment. Using discriminant function analysis, an examinee's performance is compared to a clinical (i.e., ADHD) and non-clinical profile to determine the closeness of a match with each (Strauss et al., 2006). The computer-generated report presents this as a percentage of confidence.

The CPT-II standardization sample is comprised of data from two separate studies. A multisite study of both adults and children was conducted ($N$ = 1,108), as well as a smaller epidemiological study of only children and adolescents ($N$ = 812). No information about the composition of the multisite study sample is available. The combined sample consisted of individuals aged 6 to 55 and above, divided into nine age bands. Females comprised 53% of the entire sample, although 71% of the adults were women. In terms of ethnicity, 47% of participants were White, 27% were Black, 5% were Asian, and 21% were labeled "other." Age and gender have both been linked to CPT-II performance, but gender-based norms are only provided for the children's subsample (Strauss et al., 2006).

The CPT-II has been shown to produce generally reliable data. Internal reliability coefficients have been found to be very high for Hit RT ($r$ = .95) and Omissions ($r$ = .94), and high for Commissions ($r$ = .83), Hit RT SE ($r$ = .87), and Distractability ($r$ = .83; Strauss et al., 2006). Response Style and Variability are adequate ($r$ = .73) and marginal ($r$ = .66), respectively (Strauss et al., 2006). In terms of test-retest reliability, stability coefficients are in the .80 to .89 range for Omissions and the ADHD Confidence Index,

the .70 to .79 range for Distractability, and the .60 to .69 range for Commissions, Hit RT SE, Variability, and Response Style (Strauss et al., 2006).

Information regarding validity is more limited. The CPT-II manual provides no information regarding correlations between the CPT-II and similar tests (Strauss et al., 2006). Performance on the CPT has been found to correlate positively with performance on an auditory CPT ($r$ = .34; McGee, Clark, & Symons, 2000), although these results were obtained from a sample of children. Research with children has also found that CPT performance is unrelated to visual-motor ability but is negatively correlated with phonological awareness (McGee et al., 2000). The results of a principle components factor analysis identified two factors for the CPT-II, an inattention factor and an inhibition factor; Omissions, Hit RT SE, and Variability loaded on the inattention factor, and Commissions and Hit Rate loaded on the inhibition factor (Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001). Similarly, Ballard (2000) found that Conners' CPT differs from other CPTs, in that it taps response inhibition abilities in addition to the capacity for sustained attention. In terms of clinical utility, adults with ADHD have been found to make more commission errors on the CPT-II compared to adults with anxiety disorders, suggesting the utility of the test in identifying attention-related problems (Epstein, Johnson, Varia, & Conners, 2001).

In this study, data for the twelve performance measures are reported in terms of *T* scores. ADHD Confidence Index data are also reported.

*Digit Span*

The Digit Span subtest of the WAIS-III is a measure of attention/concentration, working memory, rote recall, and auditory sequencing (Groth-Marnat, Gallagher, Hale, &

Kaplan, 2000; The Psychological Corporation, 1997). As part of the WAIS-III it was standardized on a nationally representative sample of 2,450 adults between the ages of 16 and 89 (The Psychological Corporation, 1997). The sample was stratified by age, sex, race/ethnicity, education, and geographic region based on U.S. Census data.

Digit Span consists of two parts, Digits Forward and Digits Backward. Both include seven pairs of random number sequences but appear to tap somewhat different abilities (Lezak et al., 2004). In the Forward task the examiner reads increasingly longer strings of numbers and the examinee must recite them back correctly; this requires adequate attention capacity and freedom from distraction (Lezak et al., 2004). The Backward task requires the examinee to recite the numbers in reverse order, a more effortful activity that calls upon working memory (Groth-Marnat et al., 2000; Lezak et al., 2004). Combining performance on the two tasks to generate the Digit Span score results in a loss of valuable information, thus examiners are encouraged to evaluate raw scores for the two tasks (Lezak et al., 2004). A raw score of six or better on the Forward task is considered within normal limits, while a raw score of 4 or 5 is normal for the Backward task.

Data produced by the Digit Span subtest are generally highly reliable. The average split-half coefficient for the standardization sample is .90, and the average test-retest reliability coefficient is .83 (The Psychological Corporation, 1997). In terms of subtest specificity, or the variance that is unique to the particular subtest, Digit Span has an ample amount of specificity (Kaufman and Lichtenberger, 1999). In factor analytic research that identified a six-factor solution, Digit Span loaded most significantly on the "working memory" factor (Burton, Ryan, Axelrod, & Schellenberger, 2002).

*Digit Symbol-Coding*

Digit Symbol-Coding, also a subtest of the WAIS-III, was standardized using the sample described above. This timed symbol substitution task requires examinees to fill in the correct symbol for a particular number. A practice test is used to orient examinees to the symbol-number pairings and ensure adequate understanding of test directions. Examinees then have 120 seconds to correctly fill in as many symbols as possible. This is primarily a test of psychomotor performance, particularly copy speed, with other contributing factors being persistence, sustained attention, response speed, and visuomotor coordination (Lezak et al., 2004).

The moderate correlation between Digit Symbol-Coding and Symbol Copy ($r$ = .70) suggests that approximately half of the variance in Digit Symbol performance is explained by psychomotor speed (The Psychological Corporation, 1997). Data from the standardization sample indicates high test-retest reliability ($r$ = .84; The Psychological Corporation, 1997), and factor analytic research has identified Digit Symbol-Coding as a component of the processing speed factor of the WAIS-III (Burton et al., 2002). Subtest specificity for Digit Symbol-Coding is considered to be ample (Kaufman & Lichtenberger, 1999). Performance on this subtest shows prominent age effects, particularly after age 60, and individuals with a history of alcohol abuse typically evidence poor performance as well (Lezak et al., 2004). The test is also sensitive to minimal brain damage and dementia, and performance is correlated with coma duration among TBI patients (Lezak et al., 2004).

*Letter-Number Sequencing*

Letter-Number Sequencing is a subtest of the WAIS-III that is part of the working memory index (The Psychological Corporation, 1997). Examinees are presented with random series of letters and numbers and must recite these back to the examiner with numbers first, in ascending order, followed by letters in alphabetical order. This taps attention/concentration, working memory, sequencing ability, learning ability, and facility with numbers (Groth-Marnat et al., 2000). Data from the standardization sample indicate high split-half reliability ($r$ = .82; The Psychological Corporation, 1997), adequate test-retest reliability ($r$ = .75; Kaufman & Lichtenberger, 1999), and ample subtest specificity (Kaufman & Lichtenberger, 1999). Support for the assignment of Letter-Number Sequencing to the working memory index comes from factor analysis research (Burton et al., 2002). Along with Digit Symbol and Digit Span, Letter-Number Sequencing is less likely than other WAIS-III subtests to reflect premorbid intellectual ability (Lezak et al., 2004, p. 654).

*Wide Range Assessment of Memory and Learning – Second Edition*

The second edition of the Wide Range Assessment of Memory and Learning (WRAML2; Sheslow & Adams, 2003) is a battery used to assess memory skills in children and adults. The core battery consists of six subtests, and these subtests are used to calculate three index scores (Verbal, Visual, and Attention/Concentration) and the General Memory Index. The Verbal Index is comprised of Story Memory and Verbal Learning, and the Visual Index includes the Design Memory and Picture Memory subtests. A four-subtest screener can also be administered, consisting of Story Memory, Verbal Learning, Design Memory, and Picture Memory. This yields three scores: the Verbal Index, Visual Index, and Screening Memory Index. Optional subtests can also be

included in the administration of the WRAML2, such as the working memory, delay recall, and recognition subtests. The screening version of the WRAML2 takes approximately twenty minutes to administer, while the full battery takes approximately one hour.

The standardization sample for the WRAML2 consisted of 1,200 individuals between the ages of 5 and 90, divided into fifteen age bands of eighty participants each (Strauss et al., 2006). The sample was stratified by geographical region, education, gender, and race/ethnicity in accordance with the 2001 U.S. Census. This was a significant updating from the first edition of the WRAML, which was normed on a sample of children. Interestingly, performance does not appear to be significantly influenced by gender, education, or ethnic background, and age-related effects on performance do not appear until after age 65 (Sheslow & Adams, 2003; Strauss et al., 2006).

The WRAML2 tends to produce highly reliable data. Internal consistency ranges from .82 to .96 for the core indices and from .71 to .95 for the core subtests (Strauss et al., 2006). In particular, internal consistency reliability estimates for the General Memory Index, Screening Memory Index, Verbal Memory Index, and Story Memory are very high ($r \geq .90$; Strauss et al., 2006). The Verbal Memory Index also produces high test-retest reliability estimates, in the range of .80 to .89, while test-retest reliability for the Visual Memory Index is considered to be adequate (Strauss et al., 2006).

The validity of the WRAML2 has been examined via comparisons with similar tests. For example, the General Memory Index of the WRAML2 is moderately correlated with the WMS-III General Memory Index ($r = .60$; Sheslow & Adams., 2003).

WRAML2 performance is also correlated with general intelligence, as measured by the WAIS-III full-scale IQ ($r$ = .67; Sheslow & Adams, 2003). In clinical studies, individuals with TBI and alcohol use disorders performed significantly worse than healthy participants on the WRAML2 (Sheslow & Adams, 2003). Also of interest is the finding that the Screening Memory Index correlates very highly ($r$ = .91) with the General Memory Index (Strauss et al., 2006).

In this study, the four-subtest screening battery was administered, and scores for the Visual Index, Verbal Index, and Screening Memory Index are reported.

*Rey Complex Figure Test*

The Rey Complex Figure Test and Recognition Trial (RCFT; Meyers & Meyers, 1995) is one of several versions of the Rey-Osterrieth Complex Figure Test introduced by Rey and further developed by Osterrieth (Corwin & Bylsma, 1993). The RCFT is a test of visuospatial construction ability and visual memory. It consists of a copy trial, an immediate recall trial, a delayed recall trial, and a recognition task; normative data for the RCFT is based on this manner of administration (Meyers & Meyers, 1995). Examinees are presented with a blank sheet of paper and a card displaying the complex figure for the first task and must copy it as accurately as possible; the amount of time required to complete the copy trial is recorded in seconds. The complex figure is then removed from sight and the examiner engages the examinee in a verbal task for three minutes. Following this delay the examinee is asked to recreate the complex figure from memory; this is the immediate recall trial. Thirty minutes after the completion of the copy trial the examinee is again asked to recreate the complex figure from memory for the delayed recall trial.

Scoring for the RCFT follows Rey's method, in which eighteen units of the complex figure are scored for accuracy and placement (Meyers & Meyers, 1995). Raw scores for copy, immediate recall, and delayed recall trials range from 0 to 36. Raw scores are converted to normalized T scores, and the pattern of scores can be used to assign one of five memory profile patterns (Meyers & Meyers, 1995).

Normative data for the RCFT are based on a non-clinical sample of 601 adults between the ages of 18 and 89 (Meyers & Meyers, 1995). Participants were recruited from universities and suburban communities; other participants were family members of patients at a head injury treatment center. A subsample of this group was stratified by age according to U.S. Census data, as age has been found to influence RCFT performance (Meyers & Meyers, 1995). Other variables, such as gender and education, have not been linked to performance on this test.

The interrater reliability for RCFT scoring is typically very good, with coefficients ranging from .93 to .99 (Meyers & Meyers, 1995). Test-retest reliability coefficients for immediate recall, delayed recall, and recognition trials over an average retesting interval of 184 days are .76, .89, and .87, respectively (Meyers & Meyers, 1995). Evidence for convergent validity comes from correlation of RCFT variables with each other and with other tests. The immediate and delayed recall trials are highly correlated ($r$ = .88 for standardization sample), a result that was also found in a sample of patients with brain damage (Meyers & Meyers, 1995). RCFT copy scores have been found to correlate more highly with nonverbal WAIS-III subtests (e.g., Block Design, $r$ = .58; Picture Arrangement, $r$ = .57) than verbal WAIS-III tests (e.g., Vocabulary, $r$ = .13). Copy scores are also correlated with BVRT total scores ($r$ = .61), the Hooper Visual

Organization Test ($r$ = .48), and the Benton Judgment of Line Orientation ($r$ = .54). Further, immediate and delayed recall scores are statistically significantly correlated with performance IQ ($r$ = .49 for both) but not with verbal IQ. Immediate recall scores are also correlated with BVRT error scores ($r$ = .56), RAVLT Trial 5 scores ($r$ = .55), and Part B of the Trail Making Test ($r$ = .49; Meyers & Meyers, 1995). A similar pattern of correlations has been found for the delayed recall trial. Factor analytic research supports the idea that the RCFT measures visuospatial construction ability and visual memory, with immediate and delayed recall loading on the visuospatial recall factor and copy scores loading on the visuospatial construction factor (Meyers & Meyers, 1995). These results were obtained with both the standardization sample and a sample of individuals with brain damage.

For the purposes of assessing visual memory ability, scores on the immediate and delayed recall trials are reported in terms of percentile category. Performance on the copy trial, used to assess construction ability, is reported in terms of time to complete the copy task and percentile category for copy score.

*Delis-Kaplan Executive Function System*

The Delis-Kaplan Executive Function System (D-KEFS; The Psychological Corporation, 2001) is a collection of nine subtests that tap higher-level cognitive skills, or the executive functions. Examiners can administer all or a portion of the nine subtests. Each subtest generates several “primary” and “optional” scores; the primary scores tap into the key components of the particular task (Strauss et al., 2006). Many of the subtests have a longstanding history in the field of neuropsychology (e.g., Trail Making Test).

The standardization sample for the D-KEFS consisted of 1,750 children and adults between the ages of 8 and 89, divided into sixteen age groups. Men and women were equally represented in all age groups except in the oldest group (ages 80-89) which had more women than men. This was a national sample, stratified according to 2001 U.S. Census data regarding race/ethnicity, education, and geographic region (Delis, Kaplan & Kramer, 2001). Individuals with sensory, substance abuse, medical, psychiatric, or motor conditions that would have negatively influence test performance were excluded from the standardization sample (Strauss et al., 2006, p. 446).

Three subtests from the D-KEFS were chosen for this study. The goal was to select a small group of subtests that would provide information regarding different aspects of executive functioning in a short time period. These subtests included the Trail Making Test, Verbal Fluency, and the Tower Test.

*Trail Making Test.* The Trail Making Test consists of five tasks, one of which (Number-Letter Switching) is similar to "Part B" of other trail-making tests. There are four tasks to assess the examinee's skills in visual scanning, number sequencing, letter sequencing, and motor speed (Delis, Kaplan, et al., 2001). The number-letter switching task is the primary executive function measure of the test, and requires more cognitive flexibility than the other tasks. Scores are based on the time to complete each task. The inclusion of the four "easier" tasks allows the examiner to more fully understand the reason for a poor performance on the switching task. Performance on the Trail Making Test tends to be influenced by age, particularly for the Number-Letter Switching task (Delis, Kaplan, et al., 2001). The youngest and oldest individuals in the standardization sample made the most errors on this task. Education and IQ have also been linked to

performance on similar trail-making tests (Mitrushina et al., 2005), with individuals of higher educational/IQ backgrounds tending to obtain higher scores than individuals of lower educational/IQ backgrounds.

The internal consistency reliability of data from the Trail Making Test tends to be adequate, based on calculations with the Number and Letter Sequencing composite score (e.g., $r$ = .74 for adults ages 40-49; Delis, Kaplan, et al., 2001; Strauss et al., 2006). Test-retest reliability ranges from low ($r$ = .36; Switching) to adequate ($r$ = .73; Motor Speed) for adults between the ages of 20 and 49 (Delis, Kaplan, et al., 2001; Strauss et al., 2006); the average retesting interval was 25 days. In terms of validity, the Trail Making Test has not been subjected to factor analysis due to the reported inappropriateness of this approach with process-oriented tests (Delis, Kramer, Kaplan & Holdnack, 2004). However, research with patients who have lateral prefrontal cortex lesions found statistically significantly poorer performance on the Switching condition compared to healthy controls, even after controlling for performance on baseline conditions (e.g., Motor Speed; Yochim, Baldo, Nelson, & Delis, 2007), suggesting that the Trail Making Test can distinguish between impaired and non-impaired individuals.

In this study, the primary scores generated by administering the Trail Making Test are reported. These scores include Visual Scanning, Number Sequencing, Letter Sequencing, Number-Letter Switching, Motor Speed, and the Number and Letter Composite Score.

*Verbal Fluency Test.* The Verbal Fluency Test consists of three conditions: Letter Fluency, Category Fluency, and Category Switching (Delis, Kaplan, et al., 2001). The Letter Fluency condition, for example, assesses the examinee's ability to generate words

that start with a particular letter. The Category Switching task is more complex and taps set-shifting ability (Strauss et al., 2006). Scores are based on the number of correct words produced or the number of correct switches between categories. Contrast scores (e.g., comparing letter and category fluency) can also be calculated. Performance on the Verbal Fluency Test tends to peak between the ages of 30 to 39 and stays relatively stable through ages 40 to 49 (Delis, Kaplan, et al., 2001). Further, the rate of decline among older adults tends to be mild (Delis, Kaplan, et al.).

The internal consistency reliability of data from the Verbal Fluency Test ranges from low to high, depending on the task. For example, Letter Fluency has internal reliability coefficients of a greater magnitude (e.g., average $r$ = .86 for adults; Delis, Kaplan, et al., 2001) than Category Switching Total and Total Switching (e.g., $r$ = .72 for adults; Delis, Kaplan, et al., 2001). Test-retest reliability coefficients tend to follow a similar pattern. The stability coefficients for Letter and Category Fluency tasks are .80 and .79, respectively, for the entire standardization sample (Delis, Kaplan, et al., 2001). Information regarding the validity of Verbal Fluency as a measure of executive functions comes from a study using Positron Emission Tomography (PET); areas of the brain that were activated during the test included the left dorsolateral prefrontal cortex and left inferior frontal cortex (Ravnkilde, Videbech, Rosenberg, Gjedde, & Gade, 2002).

For the present study, the five primary scores from the Verbal Fluency Test are reported: Letter Fluency, Category Fluency, Switching Correct, Switching Accuracy, Letter—Category Contrast, and Switching Correct—Category Contrast.

*Tower Test.* The Tower Test of the D-KEFS is similar to other tower tests (e.g., Tower of London) in its purpose and administration. Examinees are required to build

towers using various discs in the fewest number of moves possible, calling upon skills such as planning, response inhibition, and rule-learning (Delis, Kaplan, et al., 2001). Scores are based on the number of moves, total completion time, and task outcome (i.e., correct or incorrect tower). Additional process-oriented scores can also be calculated (e.g., time to first move). Accuracy in Tower Test performance tends to peak in late adolescence and remains rather stable through the 20s, after which time performance begins to decline (Delis, Kaplan, et al., 2001). The influence of education/IQ or other demographic variables is unknown (Strauss et al., 2006).

Data from the Tower Test tend to be adequate in terms of internal consistency reliability. Reliability coefficients for the Total Achievement Score range from .56 to .78 for adults (ages 20 to 89), with a mean of .68 (Delis, Kaplan, et al., 2001). Test-retest reliability has been found to be somewhat low ($r$ = .41) for adults ages 20 to 49. However, this is perhaps of greater concern for longitudinal as opposed to one-time assessment (Strauss et al., 2006). In terms of validity, performance on the Tower Test was found to correlate significantly with the Executive Processes cluster of the Woodcock-Johnson III ($r$ = .25); no significant correlations were found with any other clinical clusters of the Woodcock-Johnson III (Floyd et al., 2006). Functional magnetic resonance imaging research has found that the dorsolateral prefrontal cortex is activated while working on the Tower of London task (Lazeron, Rombouts, Machielsen, Scheltens, Witter, Uylings et al., 2000). This finding lends support to the idea that tower tests tap planning skills, as the dorsolateral prefrontal cortex is associated with such functions (Rains, 2002).

The primary score generated by the D-KEFS Tower Test is the Total Achievement Score, and this score is used for data analyses in the present study.

*Frontal Systems Behavior Scale*

The Frontal Systems Behavior Scale (FrSBe; Grace & Malloy, 2001) is a 46-item rating scale used to assess behavioral syndromes that are often found in individuals with frontal lobe damage. It has been noted that such individuals may perform in the normal range on standardized tests, yet exhibit impairments in activities of daily living (Lezak et al., 2004; Sbordone, 2000). Qualitative assessment of executive functioning has been recommended in this regard (e.g., Sbordone, 2000), and rating scales that quantify behavioral observations are one such approach. Thus, a tool such as the FrSBe can supplement traditional methods for assessing executive functioning.

The FrSBe can be completed by family members/caregivers (Family Rating Form) or by the identified individual (Self-Rating Form). Each item is rated using a five-point Likert scale, and separate ratings can be given for pre- and post-injury. The FrSBe produces an overall Total Score, as well as scores for the three subscales, Apathy, Disinhibition, and Executive Dysfunction.

Norms for the FrSBe are provided in the test manual (Grace & Malloy, 2001). The standardization sample consisted of 436 men and women, and normative data is presented in terms of educational background (fewer than or greater than 12 years). Additionally, normative data for several clinical samples is also available (e.g., individuals with dementia, frontal lesions, head injuries, etc.).

In terms of reliability, the internal consistency of scores from the Self-Rating Form have ranged from .72 (Apathy subscale) to .88 (Total Score; Grace & Malloy,

2001) for the standardization sample. Similarly, internal consistency coefficients were .78 or higher for the clinical samples. Slightly higher reliability coefficients have been obtained with the Family Rating Form, leading some to suggest that it is preferred to self-rating (e.g., Kane & Acheson, 2003). However, it has also been suggested that certain FrSBe items are best rated by the individual due to the degree of self-reflection involved (e.g., use of memory strategies; interest in sex; Stout, Ready, Grace, Malloy, & Paulsen, 2003).

As with reliability, research regarding the validity of FrSBe data is limited. The results of a factor analytic study using the Family Rating Form suggest that the FrSBe consists of three factors: Executive dysfunction (29% of the variance), disinhibition (7%), and apathy (4%; Stout et al., 2003). The majority of items loaded on the expected factor, yet only 41% of the total variance was explained by this three-factor solution. Despite this potential shortcoming, other studies using the FrSBe support its utility. Ready, Ott, Grace, and Cahn-Weiner (2003) found that Apathy and Executive Dysfunction subscale scores were elevated for individuals diagnosed with Alzheimer disease or Mild Cognitive Impairment, and that these scores were significantly different from pre-illness scores. A study examining eating behaviors and prefrontal-subcortical functioning found that high scores on the FrSBe Executive Dysfunction subscale were linked to more disinhibited eating, a finding that was supported by functional neuron-imaging research (Spinella & Lyke, 2004). Finally, research with criminal offenders and individuals who rate highly in psychopathic tendencies have been found to have elevated Executive Dysfunction scores on the self-report version of the FrSBe, lending support to the impulsive aspect of psychopathic and criminal behavior (Ross, Benning, & Adams, 2007).

Due to the nature of this study, the Self-Report Form of the FrSBe was used. Participants had the option of completing the scale independently or with the assistance of the examiner, depending on the participant's reading level. The Total Score and three subscale scores (Apathy, Disinhibition, and Executive Dysfunction) are reported.

*Boston Naming Test*

The Boston Naming Test (BNT; Goodglass et al., 2000) is a well-established instrument used to assess visual naming ability (Strauss et al., 2006). It consists of sixty line drawings of different objects; examinees receive credit for correctly naming each object, which increase in difficulty as the test proceeds. Examinees are allowed twenty seconds to provide an answer and stimulus and/or phonemic cues are given for failed items. There is also a multiple choice option for those items that are failed after cues have been provided. The entire test takes approximately ten to twenty minutes to administer. The total BNT score is the sum of spontaneous correct responses and correct responses after stimulus cueing, with a maximum score of sixty. Raw scores are then converted to demographically corrected (age, gender, and education) *T* scores (Strauss et al., 2006).

The BNT standardization sample consisted of 178 adults between the ages of 18 and 79, with an average of fourteen years of education (Strauss et al., 2006). No information was provided regarding the geographic region(s) from which participants were drawn, or participants' ethnic backgrounds. Strauss et al. note that the normative data included in the BNT test manual may lead to an overestimation of performance for individuals of lower education or IQ, due to the education level of the standardization sample. Normative data for the BNT are also available from other sources. For example, the BNT was included in the Mayo Clinic's Older African Americans Normative Studies

(Lucas et al., 2005); these studies used a sample of healthy older African American adults (ages 56 to 94). These researchers also present normative data for both "rigorous" and "lenient" administration and scoring approaches; the lenient approach considers regional differences (e.g., "harp" for "harmonica") as correct responses (Strauss et al., 2006). Due to the influence of age, IQ/education, English proficiency, and familiarity with American culture on test scores, Strauss et al. recommend that these factors be considered when choosing normative data for interpreting individual scores.

The BNT has produced reliable data across several studies. Internal reliability coefficients range from .78 to .96 (Strauss et al., 2006), and test-retest reliability over a one to two week retesting period is estimated at .91 (Flanagan & Jackson, 1997). However, test-retest reliability has been found to be marginal for longer retest intervals (e.g., $r$ = .62 to .89; Strauss et al., 2006). Several studies have also investigated the validity of the BNT. Performance on the BNT is highly correlated ($r$ = .76 – .86) with the Visual Naming Test of the Multilingual Aphasia Examination (Axelrod, Ricker, & Cherry, 1994; Schefft, Testa, Dulay, Privitera, & Yeh, 2003), a conceptually similar test. Further, Axelrod et al. found that performance on the BNT is highly dependent on verbal comprehension ability, as measured by the WAIS-R, but is not influenced by perceptual organization ability. Schefft et al. also found that BNT scores were more highly correlated with VIQ than with PIQ ($r$ = .61 vs. .43), suggesting that language ability is tapped by the BNT. In terms of its clinical utility, the BNT is most valuable for identifying poor performance and does not discriminate well among high-scoring individuals (Strauss et al., 2006).

*Dean-Woodcock Sensory Motor Battery*

The Dean-Woodcock Sensory Motor Battery (D-WSMB; Dean & Woodcock, 2003) is a standardized battery of eighteen sensory and motor subtests that are routinely included in neurological and neuropsychological exams (Woodward, Ridenour, Dean, & Woodcock, 2002). It has been a useful addition to the neuropsychological assessment field because of its standard administration procedures and behavioral scoring criteria (Woodward et al.). The D-WSMB was normed on a sample of over 1,000 children and adults from age 4 years to 90-plus years, stratified by sex, age, ethnicity, and education in accordance with U.S. Census data (D'Amato & Walker, 2003; Davis, Finch, Dean, & Woodcock, 2006). Subtests of the D-WSMB are scored by converting raw scores to W scores, and these W scores are then compared to age- and gender-appropriate Reference-W scores. The difference between W and Reference scores (W-Diff) provides an indication of the degree of impairment for the particular motor or sensory subtest.

Data from the subtests of the D-WSMB tend to be quite reliable, with most split-half internal consistency reliability coefficients at .90 or greater (D'Amato & Walker, 2003). However, Schneider (2003) notes that the D-WSMB was developed from an Item Response Theory perspective, in that reliability is jointly based on the test and the examinee's ability level. Therefore, reliability will differ for individuals of varying ability levels. In terms of validity, most of the subtests have a long, established history in the field of neuropsychology, and thus validity research on the D-WSMB has only recently been undertaken. Factor analytic research has identified three factors: simple sensory skills, cortical motor and complex sensory skills, and subcortical motor tasks and auditory/visual acuity skills (Davis, Finch, Dean, et al., 2006), a solution that corresponds with the type of subtests included in the battery. The D-WSMB has also been found to

correctly differentiate between impaired and non-impaired individuals. In one study, 93% of participants were correctly classified as impaired or non-impaired (Volpe, Davis, & Dean, 2006), while another study correctly classified 71% of impaired participants using a more stringent classification technique (Davis, Finch, Trinkle, Dean, & Woodcock, 2006).

Several subtests from the D-WSMB were chosen for this study. The selection of these tests was based on an effort to obtain information that was not duplicated in other tests (e.g., the RCFT provides information similar to the D-WSMB Construction subtest), as well as tests that would most likely be sensitive to impairment due to substance abuse, TBI, or other neurological conditions. These subtests included Object Identification, Finger Identification, Gait and Station, Romberg, Finger Tapping, and Grip Strength. A sensory functioning index is obtained by calculating the mean W-Diff score for the sensory subtests; a motor functioning index is similarly obtained using W-Diff scores for the motor subtests. An overall motor-sensory functioning index can be obtained by calculating the mean W-Diff score across all subtests administered.

*Object Identification.* Object Identification is one of the D-WSMB sensory subtests. Examinees are blindfolded or close their eyes and an object is placed in either the right or left hand; the examinee earns points for each object that is correctly identified, and scores for both the right and left hand are calculated. Object Identification is useful for assessing astereognosis, the inability to identify an object on the basis of touch alone (Davis, Finch, Dean, et al., 2006).

*Finger Identification.* Finger Identification, also a sensory subtest, is used to assess finger agnosia (Davis, Finch, Dean, et al., 2006). Each finger is numbered (e.g.,

thumb is “1”) and the examinee, with eyes closed, must correctly identify the assigned number for a finger that is touched by the examiner. Scores for both the right and left hand are calculated, based on the number of correct responses. Age, gender, and education do not appear to influence performance (Strauss et al., 2006).

*Gait and Station.* Gait and Station is a D-WSMB motor subtest that has long been used in neurological exams. Examinees perform four tasks: free walking, heel-to-toe walking, hopping, and standing still (“station”). Performance of these tasks is rated on a scale of 0 to 4, with higher scores indicating better performance. Gait and Station is used to assess for ataxia, gross motor functioning, coordination, and subcortical lesions (Davis, Finch, Dean, et al., 2006). Research suggests that Gait and Station is a strong indicator of impairment; in one study it was the primary factor in distinguishing impaired from non-impaired individuals (Davis, Finch, Trinkle, et al., 2006).

*Romberg.* The Romberg test is somewhat similar to Gait and Station, with the exception being that examinees must close their eyes for the Romberg test. Examinees are asked to stand in three different positions: with feet together, in a heel-to-toe fashion, and on one foot; scoring is based on how much the examinee sways or loses balance (scale of 0 to 4, with 4 = very little swaying). The Romberg test is used to assess for dizziness and cerebellar dysfunction (Davis, Finch, Dean, et al., 2006). It, like Gait and Station, has long been included in neurological examinations, and a positive Romberg is considered to be a hallmark sign of sensory ataxia (Khasnis & Gokula, 2003).

*Finger Tapping.* The Finger Tapping test, which has appeared in various forms over the years, is a test of fine motor speed and manual dexterity (Davis, Finch, Dean, et al., 2006; Mitrushina et al., 2005). The D-WSMB version of this test includes five ten-

second trials per hand, with the final scores reflecting the average number of taps per hand. Performance on finger tapping tests tends to decrease with age, with slowing first appearing in the age 50 to 59 bracket and continuing thereafter (Lezak et al., 2004; Mitrushina et al., 2005). Gender effects have also been found, with men tending to tap faster than women (Mitrushina et al.).

The reliability of finger tapping performance over various retesting intervals has varied from marginal ($r$ = .64-.87; Goldstein & Watson, 1989) to good ($r$ = .71-.76; Ruff & Parker, 1993). Clinical research has found that individuals with diffuse brain injury evidence a slowed tapping rate one year post-injury, even when Grip Strength has improved (Haaland, Temkin, Randahl, & Dikmen, 1994).

*Grip Strength.* The Grip Strength test, like Finger Tapping, has a long history in neuropsychological assessment (Mitrushina et al., 2005). Examinees are required to grip a hand dynamometer three times with each hand, and the final scores are the average number of kilograms per hand. Performance on the Grip Strength test is used to assess upper body motor strength and the overall integrity of the cerebral hemispheres (Davis, Finch, Dean, et al., 2006). Further, a difference in grip strength between the hands is a potential indicator of contralateral brain damage (Strauss et al., 2006). Grip Strength tends to be greater for men than women, and decreased strength with increasing age has also been found (Strauss et al., 2006).

The Grip Strength test tends to produce highly reliable data (Lezak et al., 2004). Test-retest reliability coefficients are typically very high for both men ($r$ = .91) and women ($r$ = .94; Reddon, Stefanyk, Gill, & Renney, 1985). In one study, test-retest reliability was nearly perfect ($r$ = .98; Lewis & Kupke, 1992). Most of the stability

coefficients for Grip Strength are greater than .70 (Strauss et al., 2006). Further, internal consistency reliability is also good ($r$ = .82; Christensen, Mackinnon, Korten, & Jorm, 2001). In terms of validity, data from factor analytic research with several sensory and motor tests found that Grip Strength loaded on a "sensorimotor" factor (MacDonald, Dixon, Cohen, & Hazlitt, 2004). Clinical research suggests that Grip Strength performance is a reliable indicator of biological aging, independent of disease processes (MacDonald et al., 2004), and provides information on the capacity to complete tasks of daily life (Strauss et al.).

*Grooved Pegboard*

The Grooved Pegboard task (Lafayette Instrument Company, 2002) is a test of manual dexterity and visual-motor coordination. It has been included in neuropsychological test batteries for over 30 years (Mitrushina et al., 2005). Various versions of the test are in existence; the Lafayette Grooved Pegboard (Model #32025) has 25 pegs that must be manipulated to fit into matching holes, in a lock-and-key fashion. Thus, it requires more complex coordination ability to successfully complete the task (Lezak et al., 2004). The test includes two trials, one for each hand. When using the right hand the examinee must place the pegs in order from left to right, and from right to left when using the left hand. Scores are reported in terms of the number of seconds to complete the task, and the test is discontinued after five minutes. Additional scores include the number of pegs that are unintentionally dropped and the number of correctly placed pegs per trial.

The manual accompanying the Lafayette Grooved Pegboard provides little information regarding the normative sample. The adult norms are based on a group of

individuals ages 15 and up, but it is unclear as to the composition of this sample in terms of ethnicity, gender, and so forth. Additional norms are available (see Mitrushina et al., 2005) for adults up to age 85 years and of varying educational backgrounds. Mitrushina et al. recommend that normative data be reported by age group, education level, and gender, as all three have been linked to performance. Age appears to have the largest effect, with time to completion increasing with age (Lezak et al., 2004; Strauss et al., 2006).

Data generated by the Grooved Pegboard test tend to fare well in terms of reliability and validity. Test-retest coefficients have ranged from marginal to high (e.g., *r* = .82; Dikmen, Heaton, Grant, & Temkin, 1999), with some of the variation based on administration procedures (Strauss et al., 2006). In terms of validity, performance on pegboard tasks tends to be more closely related to finger tapping tasks than to grip strength (Corey, Hurley, & Foundas, 2001). Further, clinical research has found that individuals with various conditions such as stroke, heart disease, toxic exposure, and cocaine abuse tend to perform poorer on the Grooved Pegboard test (Bleecker, Lindgren, & Ford, 1997; Haaland & Delaney, 1981; Putzke et al., 2000; Smelson, Roy, Santana, & Engelhart, 1999).

In this study, the time to completion for dominant and non-dominant hands is reported, as most of the available normative data reflects this manner of scoring (Mitrushina et al., 2005).

### *Additional Test Battery Measures*

In addition to testing participants on the domains described above, two self-report measures, the Beck Depression Inventory and the Beck Anxiety Inventory, were used to

assess symptoms of depression and anxiety on the day of testing. These were included for the purpose of determining a participant's state of mind during the test session, as such symptoms can interfere with test performance (e.g., Lezak et al., 2004).

The test battery for this study also included measures of general intellectual functioning and reading ability. Estimated intelligence quotients were obtained using the Wechsler Abbreviated Scale of Intelligence, and reading ability was determined via the Wechsler Test of Adult Reading.

*Beck Depression Inventory*

The revised Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) is a 21-item self-report inventory aligned with DSM-IV diagnostic criteria for depressive disorders (Groth-Marnat, 2003). It has been used widely since its inception over forty years ago. Each item is scored on a 4-point scale (0-3), with a maximum score of 63. The total raw score is interpreted according to the scheme developed by Beck et al. (1996), although others have also developed cutoff scores (e.g., Dozois, Dobson, & Ahnberg, 1998).

The BDI-II tends to produce highly reliable data, with internal consistency coefficients of .92 for outpatients (Beck et al., 1996) and .92 for college-age students (Dozois et al., 1998). Test-retest reliability is similarly high at .93 (Beck et al., 1996). In terms of validity, Beck et al. found that BDI-II scores were more highly correlated with Hamilton Psychiatric Rating Scale scores ($r$ = .71) than with scores from the Hamilton Rating Scale for Anxiety ($r$ = .47). A recent factor analytic study found a two-factor solution for the BDI-II, representing cognitive-affective and somatic-vegetative dimensions (Dozois et al., 1998), which fits well with the factor identified by Beck et al.

(somatic-affective and cognitive). In all, the BDI-II is generally considered the "gold standard" for assessing depressive symptoms, and it is commonly used in neuropsychological evaluations as a means of assessing emotional functioning (Stringer & Nadolne, 2000). The BDI-II has also been used successfully to screen for depression among individuals who are homeless (e.g., Jarjoura et al., 2004).

*Beck Anxiety Inventory*

The assessment of anxiety symptoms is an important part of a neuropsychological evaluation, due to the potential negative influence of anxiety and stress on test performance (Lezak et al., 2004; Strauss et al., 2006). The Beck Anxiety Inventory (BAI; Beck & Steer, 1993) is a 21-item self-report scale used to measure the severity of anxiety symptoms in adolescents and adults. The BAI was designed to assess symptoms of anxiety that are minimally shared with those of depression (Beck & Steer, 1993). Each item is rated on a 4-point scale, with a maximum total score of 63. The test manual provides guidelines for the interpretation of scores.

As with the BDI-II, the BAI tends to produce highly reliable data. Internal consistency reliability coefficients are very high ($r$ =.92-.94 across both clinical and non-clinical samples (Beck & Steer, 1993; Hewitt & Norton, 1993), and test-retest reliability is adequate ($r$ = .75; Beck & Steer, 1993). Validity studies have found that BAI scores are moderately correlated with other self-report measures of anxiety, such as the Hamilton Anxiety Rating Scale – Revised ($r$ = .51) and the State-Trait Anxiety Inventory ($r$ = .58; Beck & Steer, 1993). Factor analytic research has identified two factors for the BAI, a cognitive factor and a somatic factor (Hewitt & Norton, 1993); a similar factor solution is presented in the test manual (Beck & Steer, 1993).

*Wechsler Abbreviated Scale of Intelligence*

The Wechsler Abbreviated Scale of Intelligence (WASI; The Psychological Corporation, 1999) is a brief, individually administered test used to estimate general intelligence. It includes four subtests covering both verbal and nonverbal abilities; these subtests are similar to those found in the WAIS-III and consist of Vocabulary, Similarities, Block Design, and Matrix Reasoning. The WASI can be administered in either a four- or two-subtest form, with the latter producing only an estimated full-scale IQ (FSIQ-2). The two-subtest version uses the Vocabulary and Matrix Reasoning subtests and takes approximately fifteen minutes to complete. The Vocabulary subtest consists of 42 items; words are presented both orally and visually and the examinee must furnish definitions. Four picture-naming items are also included. This task is a measure of verbal knowledge and fund of information (The Psychological Corporation, 1999). Matrix Reasoning, a test of nonverbal fluid reasoning, consists of 35 grid patterns that the examinee must complete (The Psychological Corporation, 1999).

The normative sample for the WASI was representative of the English-speaking U.S. population and included 2,245 people between the ages of 6-89 years (The Psychological Corporation, 1999). Twenty-three age groupings were formed, with 75-100 individuals in each group. The sample was also stratified by gender (36% male, 64% female), race/ethnicity (84% White, 12% African American, 4% Hispanic), and educational level (75% $\leq$12 years). Participants were recruited from the West, North Central, South and Northeast regions of the United States. Exclusionary criteria included visual or hearing impairments, current involvement in alcohol or drug treatment, identified memory or thinking problems, a history of head injury resulting in

hospitalization for more than 24 hours, and medical or psychiatric conditions that affect cognitive functioning (The Psychological Corporation, 1999).

In addition to the standardization sample, a small sub-sample of individuals with moderate to severe traumatic brain injuries (TBI) was also administered the WASI, to determine how performance would vary compared to the normal control group (The Psychological Corporation, 1999). Not surprisingly, scores on the individual subtests, the Verbal scale, the Performance scale, and the FSIQ-4 and FSIQ-2 were all statistically significantly lower for the brain injury group compared to the matched control group (The Psychological Corporation, 1999). For example, the TBI group obtained a mean FSIQ-2 score of 82.2 (*SD* = 18.5) compared, while the matched control group obtained a mean FSIQ-2 score of 95.6 (*SD* = 10.2). Such differences should be considered when interpreting the WASI scores of participants with histories of TBI or other conditions that affect brain functioning.

WASI scores tend to fare well in terms of reliability and validity. Among adults, average internal consistency reliability coefficients for the subtests range from .92 to .94. The average reliability coefficients for the FSIQ-4 and FSIQ-2 are .98 and .96, respectively (The Psychological Corporation, 1999). Similarly, Axelrod (2002) obtained an alpha coefficient of .96 for the FSIQ-2 using a clinical sample of men with histories of neurological and psychiatric disorders. Test-retest reliability over an average of 31 days is also good, with average stability coefficients of .88 for FSIQ-2 and .92 for FSIQ-4 in the adult sample (The Psychological Corporation, 1999). Practice effects have been found, most often with Block Design and least often with Vocabulary (The Psychological

Corporation, 1999), although Axelrod (2002) found no practice effects with same-day retesting.

The construct validity of the WASI has been explored through intercorrelations of the WASI subtests, comparisons of the WASI with similar tests, and factor analysis. The WASI subtests are moderately correlated with each other, with coefficients in the .50 to .70 range, suggesting that the test measures a general intelligence factor (The Psychological Corporation, 1999). Evidence of convergent and discriminant validity comes from the higher correlations between similar subtests (e.g., verbal tests) and lower correlations between less-similar subtests (e.g., verbal and nonverbal). Comparisons between the WASI and WAIS-III subtests are also suggestive of convergent validity, with correlations range from .66 to .88; the higher end represents correlations between Vocabulary subtests and the lower end represents Matrix Reasoning (The Psychological Corporation, 1999). The average correlations between the WASI and WAIS-III performance and verbal IQ scales are .84 and .88, respectively, and the WAIS-III full-scale IQ has an average correlation of .92 with FSIQ-4 and .87 with FSIQ-2 (The Psychological Corporation, 1999). Further evidence of convergent validity was found in the high ($r$ = .89) correlation between the WASI and a similar brief intelligence test, the Kaufman Brief Intelligence Test (Hays, Reas, and Shaw, 2002). Finally, exploratory and confirmatory factor analytic studies support the presence of two factors: Verbal Comprehension (comprised of Vocabulary and Similarities subtests) and Perceptual Organization (comprised of Matrix Reasoning and Block Design; Ryan et al., 2003; The Psychological Corporation, 1999).

In this study, the two-subtest version of the WASI was administered. Reported scores include scaled scores for the Vocabulary and Matrix Reasoning subtests and the FSIQ-2, an IQ estimate based on the sum of age-corrected *T* scores for the Vocabulary and Matrix Reasoning subtests.

*Wechsler Test of Adult Reading*

The Wechsler Test of Adult Reading (WTAR; The Psychological Corporation, 2001) is a test of reading ability as well as a means for assessing premorbid intellectual functioning (Strauss et al., 2006). It consists of a list of fifty irregularly spelled words that the examinee must read aloud. Administration proceeds until twelve consecutive scores of zero are obtained; total administration time is approximately ten minutes. Raw scores (maximum = 50) are converted to standard scores using age-based normative data, and examiners can use demographic characteristics and WTAR scores to predict WAIS-III and WMS-III scores.

The WTAR was co-normed with the WAIS-III using a sample of 1,134 U.S. adults between the ages of 16 and 89; the sample was stratified by age, gender, and education using U.S. Census data (Strauss et al., 2006). Data generated by the WTAR tend to be reliable and valid. Internal consistency reliability coefficients range from .90 to .97, and test-retest correlations over an average retesting period of 35 days are above .90 (Strauss et al., 2006). In terms of construct validity, the WTAR has been found to correlate highly with other reading tests, such as the American National Adult Reading Test ($r$ = .90) and the reading subtest of the Wide Range Achievement Test ($r$ = .73; Strauss et al., 2006). Further evidence for convergent validity comes from relatively high correlations between the WTAR and the WAIS-III verbal intelligence quotient ($r$ = .75),

the verbal comprehension index ($r$ = .74), and the full-scale IQ ($r$ = .73). Discriminant validity, on the other hand, is suggested by the relatively low correlations between the WTAR and the WAIS-III working memory index ($r$ = .62), the performance intelligence quotient ($r$ = .59), the perceptual organizational index ($r$ = .56), and the performance speed index ($r$ = .47; Strauss et al., 2006).

### *Rationale for Selection of Tests*

Although a flexible battery or hypothesis testing approach to neuropsychological assessment afford tremendous benefits (e.g., Lezak et al., 2004; Strauss et al., 2006), such an approach is not practical for a research study. Thus, a basic test battery, covering a wide variety of domains, was designed for the present study. This was done for two main purposes. First, it allowed for a large amount of information about neuropsychological functioning to be obtained in one 3-4 hour test session. Second, a goal of this study was to extend the current knowledge of neuropsychological functioning of homeless individuals by including domains that had not been covered in prior studies (e.g., language). Therefore, screening several areas was preferred over in-depth investigation of selected domains.

In addition to considering the goals of the study, the selection of specific neuropsychological tests for the battery was based on psychometric considerations, the issues of sensitivity and specificity, and practical concerns (e.g., Lezak et al., 2004; Strauss et al., 2006). The assumed psychometric properties of data obtained using particular neuropsychological tests, based on prior research, were carefully considered during the selection process. Test manuals and the scientific literature were reviewed (see previous section of the present chapter) to assess the potential validity and reliability of

data produced by each test. As shown previously, the tests included in the battery for this study have solid evidence in this regard.

The sensitivity of a test involves its usefulness in identifying an abnormality, while specificity addresses the ability to elucidate the specific nature of the abnormality (Lezak et al., 2004). Due to the screening nature of the battery designed for this study, emphasis was placed on including sensitive tests. For example, drawing tasks, such as the copy task of the RCFT, tend to be sensitive to a variety of neuropsychological deficits (Lezak et al., 2004). The same is true for Digit Span, Letter-Number Sequencing, Digit Symbol-Coding, and RCFT recall tasks (Lezak et al.).

In addition to sensitivity, tests that tapped into multiple functions were also targeted for inclusion in the battery. This was the case for the Grooved Pegboard test. Although motor functioning and dexterity were addressed by including the Finger Tapping and Grip Strength tests, the Grooved Pegboard is a more challenging task that calls upon attention and self-monitoring skills (Strauss et al., 2006). Thus, a wealth of information could be provided by one quick, easy to administer task. This was also one reason for including the CPT-II, as it provides information about sustained attention, selective attention, reaction time, and cognitive flexibility.

The test selection process was also influenced by recommendations from experienced clinicians and knowledge regarding well-established tests in the field of neuropsychology. For example, the BNT, arguably the most popular test of visual confrontational naming, is frequently used by neuropsychologists (Strauss et al., 2006). As language had not been assessed in previous research with homeless individuals, the use of a familiar instrument that would likely produce reliable and valid data was

preferred. However, in some cases, a well-known test was not selected. For example, the WRAML2 was used to test memory, as opposed to the better-known Wechsler Memory Scale – Third Edition (WMS-III). The WRAML2 has been found to have adequate floors and ceilings for most of the subtests (including those used in this study), which is an advantage over the WMS-III (Strauss et al., 2006).

Finally, practical issues were considered when selecting tests. Timing was a major concern, as men residing at the shelter were known to have structured daily schedules, in addition to off-site work responsibilities and appointments. Whenever possible, tests that could efficiently test functioning in a particular domain were selected over longer tests, even though the longer tests may have provided more information. Further, the use of graduate student research assistants prompted the selection of tests that were easy to administer and score, in order to minimize measurement error. Additionally, tests with a game-like aspect were preferred (e.g., Tower Test) because of the increased likelihood of engaging participants in the test session.

### *Questionnaire*

A questionnaire (Appendix A), covering demographics, educational background, work history, prior experiences with homelessness, and other background variables was designed for this study. Items reflecting factors related to neuropsychological functioning were also included; these items were based on the current literature and were developed in consultation with licensed psychologists and a neuropsychologist. For example, participants were asked about current medical concerns because of the potential impact of certain physical health problems, such as diabetes and hypertension (e.g., Silver & Felix, 1999) and seizures (e.g., Lezak et al., 2004), on neuropsychological functioning. Further,

information regarding head trauma was obtained due to the various neuropsychological consequences of such injuries (e.g., Lezak et al., 2004). Similarly, substance use was assessed both with formal assessment tools (TAAD, eMINI) and questionnaire items because of the abundant literature on the effects of alcohol and drug use on neuropsychological functioning (e.g., Brust, 2004; Hartman, 1995; Knight & Longmore, 1994; Lezak et al., 2004; Parsons, 1987). Additional items, addressing such issues as nutrition/meal regularity, medication use, and sleep problems, were included because of the potential impact on test performance (e.g., medication side effects, fatigue; Lezak et al., 2004; Silver & Felix, 1999). Finally, items regarding experiences with homelessness, service use, work/military history, and current symptoms were included so that a detailed description of the sample could be provided.

In order to utilize questionnaire data in correlational and cluster analyses, summated scales were constructed for some subsets of questions. This was the case for question groups regarding sleep problems, neurological symptoms, adaptive behavior problems, current medical illnesses problems, mental health diagnoses based on the eMINI, current central nervous system medications, and involvement in social or community services. In each case, a summed variable was created, reflecting the number of responses (e.g., total number of sleep problems) for the particular domain.

### *Diagnostic Tests*

Two diagnostic interviews were utilized to determine if participants met criteria for mental health and/or substance use disorders. These measures are discussed in turn.

#### *Mini International Neuropsychiatric Interview*

The Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) is a short, structured psychiatric interview based on DSM-IV diagnostic criteria. The MINI includes sixteen modules covering the following categories: Major Depressive Disorder, Dysthymia, suicidality, manic/hypomanic episode, Panic Disorder, Agoraphobia, Social Anxiety Disorder, Obsessive-Compulsive Disorder, Post-Traumatic Stress Disorder, Alcohol Abuse/Dependence, Substance Abuse/Dependence, psychotic disorders, Anorexia Nervosa, Bulimia, Generalized Anxiety Disorder, and Antisocial Personality Disorder. The computerized version of the MINI (eMINI, English version 5.0.0) was used in this study. The MINI has been found to have good interrater reliability, with kappa coefficients ranging from .79 to 1.00, and adequate to excellent test-retest reliability ($r$ = .35 – 1.00; Sheehan et al., 1998).

*Triage Assessment for Addictive Disorders*

Given the prevalence of substance use disorders in the homeless population, and the documented neuropsychological effects of chronic substance use, a tool for further examining alcohol and drug use was used in addition to the MINI. The Triage Assessment for Addictive Disorders (TAAD; Hoffmann, 1995) is a brief assessment tool used to identify substance use disorders based on DSM-IV criteria. The TAAD has been found to produce data that are highly reliable (Campbell, Hoffmann, Madson, & Melchert, 2003). Campbell et al. obtained alpha coefficients of .92 for both the alcohol and drug dependence scales, .83 for the alcohol abuse scale, and .84 for the drug abuse scale.

## Procedure

### *Recruitment*

Participants were recruited from the Guest House of Milwaukee (GHOM), a comprehensive social services agency located just outside downtown Milwaukee, Wisconsin. GHOM provides shelter, case management services, educational programming, and drug treatment for men in the Milwaukee area. The majority of men receiving services through GHOM are African American, and all are at least 18 years of age. The shelter houses approximately 80 men ("guests"), and all guests are eligible to participate in programming at GHOM.

Recruitment at GHOM took place from June through December 2008, with a goal of obtaining 50 complete cases for the final dataset. Normative data sets generated with samples of this size have been viewed as adequate for interpreting individual neuropsychological test performance (Crawford & Howell, 1998; Mitrushina et al., 2005). Recruitment and retention rates for research with a homeless population can vary considerably, with recruitment rates typically being higher than retention rates (Hough, Tarke, Renker, Shields, & Glatstein, 1996). For example, Hough et al. reported retention rates ranging from 30-86%. Previous research at GHOM had suggested that retention rates for this study would be in the 65-70% range (Hegerty, Dolan, Campbell, & Meyer, 2007; Solliday-McRoy et al., 2004). Thus, it was estimated that 70 to 80 individuals would need to be recruited in order to obtain 50 participants.

Several recruitment strategies were utilized, including speaking with GHOM guests about the study (typically in the "lounge" area of the shelter or outside in the designated smoking area), posting advertisements in common areas of the shelter, and obtaining referrals from GHOM case managers or counselors. The main office of GHOM is prominently located within the shelter; all guests pass through this area on a daily

basis. Therefore, an “information station” was displayed here throughout the course of the study. Interested parties were invited to leave a note for the primary investigator (in a secure mailbox within the office) or call a dedicated phone line for the research study.

In the initial stages of recruitment, most participants initiated contact by leaving notes or phone messages in response to the posted information. However, as the study progressed, there was a “snowball” effect; guests who had participated told other guests to contact the primary investigator. Further, guests became familiar with the primary investigator due to her regular presence at GHOM. Those who had heard about the study through word of mouth approached the primary investigator with questions about signing up. To accommodate the many requests, group information sessions were arranged. Often, additional interested individuals would “tag along” to the information session. Most participants were recruited in these somewhat informal ways; this is often the case in research with the homeless population (e.g., see Marcus, 2003 for a description of research methods). Nearly half (49%) of the participants were recruited by the end of August. Recruitment peaked in July, which seemed to correspond to increased word of mouth referrals, and again in September; this appeared to be related to “summer guests” moving out and new guests moving in.

In all, 61 men consented to participate in the study and 51 were retained for the final dataset, for a retention rate of 84%. Toward the end of the data collection, some “over-recruitment” was done to guard against dropouts; however, there were no dropouts in the final month of the study, and thus 51 complete cases were obtained. Of the ten individuals not included in the final sample, four did not show for the interview or test session (and efforts to reschedule failed), three left the shelter prior to the test session,

and one elected to discontinue his involvement in the study during the initial interview. Another participant, who had initially been accepted into the study, was un-enrolled due to the researcher's discovery that he had symptoms of a severe sleep disorder that would have interfered with testing. Finally, one individual completed the test session but his data could not be used due to missing test data resulting from test administration error.

Demographic information was available for seven of the individuals in the dropout group. The median age was 44.0 years ($M$ = 45.71, $SD$ = 10.80) and median years of education was 11.0 ($M$ = 11.29, $SD$ = 1.60). Four individuals were African American and three were Caucasian. Information regarding history of homelessness was collected for six individuals in this group; the median number of days spent homeless was 761.50 ($M$ = 900.17, $SD$ = 872.21).

### *Screening Process*

As mentioned previously, all men residing at GHOM were eligible to express interest in and/or attend an information session about the study. Screening of recruits occurred during the information session; all screening was completed by the primary investigator. Several questions were asked regarding sensory/motor impairments or limitations that would seriously interfere with testing (see Appendix B). When potential concerns were identified, the principal investigator consulted with the supervising neuropsychologist to determine whether the individual would be eligible to participate. This occurred only once, with the participant described earlier who had sleep-related concerns, although the concerns were not fully realized until after enrollment into the study. Individuals who expressed interest in the study were also observed for signs of violent or aggressive behavior, and a brief checklist of various types of aggressive

behavior (see Appendix C) was completed for each potential participant. Individuals who demonstrated aggressive behavior in any of the domains were to be placed on hold, and the decision to enroll these individuals was to be based on consultation with the supervising neuropsychologist. However, none of the recruits exhibited such behaviors; therefore, no one was excluded on this basis.

Potential participants were also informed that they could not be under the influence of recreational drugs or alcohol at the time of testing and must abstain from using alcohol and/or abusing drugs at least eight hours prior to the test session. None of the participants voiced concerns about this requirement, primarily because of the abstinence policy and random urine analyses at GHOM. Potential participants who took prescribed medications for attention-related problems (e.g., Ritalin, Adderall) were to be asked to refrain from taking these medications on the day of testing. However, none of the potential participants reported taking such medications; thus, this was not an issue in the study.

### *Informed Consent*

The informed consent process included explaining the purpose of the study, interview and testing procedures, time commitments, confidentiality policies, and the possibility of receiving feedback about one's performance. Participants were ensured that their involvement in the study would not jeopardize their stay at GHOM, and that they were free to discontinue their involvement at any time. Any questions or concerns about the study were answered during this time. All participants signed the consent form. An additional form was then presented; this form allowed a participant to release a brief report of his test performance to a service provider of his choosing. Most participants

(58.8%; *n* = 30) consented to the release of the test report, typically to a GHOM case manager and/or counselor, but in some cases to a psychiatrist or primary care physician.

### *Interview Session*

Participants were scheduled for an individual interview following the informed consent process. The interviews were usually one hour long and included the eMINI, the TAAD, and the background information questionnaire. The primary investigator completed all of the interviews. At the end of the interview session, participants were given a $5 Walgreens gift card and were scheduled for the test session. All efforts were made to schedule participants within one week of the interview session and on a day that minimally interfered with their schedules. Appointment cards were provided to all participants. In addition, reminders were given as the test day approached; this was done either in writing or in person.

### *Test Session*

Test sessions took place Monday through Saturday at GHOM. Nearly all sessions started at 9:00 am, but in order to accommodate participants' morning schedules (e.g., cleaning or cooking duties in the shelter) sessions were allowed to start as early as 8:00 am but no later than 10:00 am. The testing room was located in the GHOM Counseling Clinic, which is in the lower level of the shelter. This area afforded more privacy and was relatively quieter than most areas of the shelter. Participants were allowed short breaks as needed throughout the test session, and all were offered a 20-30 minute break at a specified point in the test battery. Test sessions were, on average, 3.3 hours long, with a range of 2.5 to 4.3 hours. Participants were allowed to discontinue testing at any time; this occurred only once, when a participant reported that his pain level had increased due

to his medications wearing off. Test administrators were also allowed to discontinue testing if it was found to be necessary; however, there were no instances of this occurring.

The tests were administered in the following order: (1) RCFT-Copy, (2) BAI, (3) RCFT-Immediate Recall, (4) BDI, (5) WASI-Vocabulary, (6) WASI-Matrix Reasoning, (6) WAIS-III-Digit Span, (7) WAIS-III-Digit Symbol Coding, (8) WAIS-III-Letter-Number Sequencing, (9) WTAR, (10) RCFT-Delayed Recall, (11) DKEFS-Trails, (12) DKEFS-Verbal Fluency, (13) DKEFS-Tower, (14) CPT-II, (15) WRAML2-Story Memory, (16) WRAML2-Design Memory, (17) WRAML2-Verbal Learning, (18) WRAML2-Picture Memory, (19) BNT, (20) D-WSMB- Object Identification, (21) D-WSMB-Finger Identification, (22) D-WSMB-Gait and Station, (23) D-WSMB-Romberg, (24) D-WSMB-Finger Tapping, (25) D-WSMB-Grip Strength, (26) Grooved Pegboard, and (27) FrSBe. Slight variations in the order occurred at times due to timing requirements for the RCFT Immediate Recall (3 minutes after Copy trial) and Delayed Recall (30 minutes after Copy trial) trials. Administration and scoring procedures followed those provided in the test manuals.

Following completion of the test session, participants received $15 in Walgreens gift cards. Individuals who discontinued testing prior to completion also received this amount. A brief summary of test performance was prepared for each participant, and participants were invited to attend an individual feedback session with the primary investigator. This test report was forwarded to the party identified on the release form (e.g., GHOM counselor), if it was completed by the participant.

### *Research Assistants*

A team of four research assistants and the primary investigator collected the data for the study. The research assistants (RAs) were current graduate students in the Department of Counseling and Educational Psychology at Marquette University. All of the RAs had completed at least an introductory course in basic counseling skills, as well as an online training module in the ethical conduction of research with human subjects. RAs were responsible for administering the test battery and scoring those tests that must be scored during the course of administration (e.g., WASI Vocabulary subtest). All other scoring and conversion of raw scores to standard scores was performed by the primary investigator.

RAs were trained to administer the battery of tests in the spring semester (April/May 2008) prior to the start of data collection. A licensed psychologist/ neuropsychologist (Dr. Terry Young) supervised the training. Following the training session, RAs met with the primary investigator to complete several practice administrations for each instrument. Three of the RAs (all master's students) were observed by the primary investigator during the first administration of the entire test battery to determine whether basic competencies in test administration were met (see Appendix D for a checklist of competencies based on recommendations in Sattler (2001)). The fourth RA (an advanced doctoral student) was not observed due to extensive prior experience with neuropsychological test administration. In addition to evaluating competencies, the primary investigator offered assistance during the administration when questions arose and provided general feedback to the RA. The master's level RAs were each observed twice; they were then cleared for independent data collection. For quality control purposes, the primary investigator reviewed all test materials and provided

administration and scoring feedback to RAs. The RAs also document any concerns or questions regarding test administration and reviewed these with the primary investigator shortly after completion of the test session. Of the 51 completed test sessions, 16 were conducted by RAs.

### *Data Analysis*

All data entry, database management, and data analyses was coordinated and conducted by the primary investigator. All data analyses were completed using the Statistical Package for the Social Sciences (SPSS 16.0).

Data analyses were primarily descriptive in nature, owing to the descriptive research design used for this study. The first phase of data analysis involved calculating descriptive statistics for the various neuropsychological tests. For interpretive purposes, raw scores were converted to standard scores, although in some cases raw scores were used; this was done when the reporting of raw scores was deemed appropriate in the neuropsychological assessment literature. Additionally, for some tests, scores were assigned to percentile or standardized score categories, and statistical analyses were performed using these ordinal variables (e.g., categories ranging from “extremely low” to “very superior” performance). This was done when several participants’ scores were difficult to interpret in standardized form for a particular test (e.g., RCFT scores labeled as “$T < 20$” in the test manual).

Relationships between cognitive/neuropsychological test performance and demographic and background factors were explored in the second phase of data analysis. Additionally, relationships between tests were explored. Several background variables were chosen for correlational analyses, with an emphasis on those variables that have

been known to affect neuropsychological test performance (e.g., age, education, head injuries, mental health/substance use disorders). Variables that might have an effect on test performance (e.g., race/ethnicity) or that might be affected by neuropsychological functioning (e.g., adaptive behavior) were also included. Summed variables and summated scales were used where appropriate.

The Pearson product-moment correlation was used for relationships between continuous variables, and special cases of Pearson's *r* were used when appropriate (e.g., $r_{pb}$, the point-biserial correlation; $r_{RI}$, to assess relationships between ordinal and continuous variables). The correlations calculated for this study were used only for descriptive purposes (i.e., assessing the strength of relationships), and therefore non-normally distributed variables were not transformed for the purposes of conducting statistical significance tests. This phase of data analysis also involved, where appropriate, an exploration of differences between subgroups. The primary example of this was examining differences between African American and non-African American participants. The Mann-Whitney *U* test was used to make these comparisons.

The final phase of data analysis involved using cluster analysis to explore possible subgroups of participants based on cognitive and neuropsychological test performance. Cluster analysis is an exploratory, descriptive technique that can be used to group or classify participants in a sample based on shared characteristics (Hair, Black, Babin, Anderson, & Tatham, 2006; Kaufman & Rousseeuw, 1990). Unlike other multivariate techniques, cluster analysis is noninferential; thus, assumptions regarding normality, linearity, and homoscedasticity are not of importance (Hair et al., 2006). Further, the sample size recommendations for cluster analysis are not grounded in statistical power or

other statistical inference issues. Hair et al. recommend a “sufficiently large” sample size for adequately representing all relevant groups in the population (p. 571), and Everitt, Landau, and Leese (2001) note that large, representative samples are needed when generalizations are to be made. In other situations, more leeway in terms of sample size and composition is allowable (Everitt et al.).

Multivariate cluster analysis was used in this study, due to the inclusion of multiple measures. The variables used for cluster analysis were: (1) RCFT Copy, (2) RCFT Immediate Recall, (3) RCFT Delayed Recall, (4) WASI 2-subtest IQ estimate, (5) WAIS-III Digit Symbol-Coding, (6) WAIS-III Digit Span, (7) WAIS-III Letter-Number Sequencing, (8) WTAR, (9) Trail Making Test – Conditions 1 through 5, (10) Verbal Fluency Test – Conditions 1 through 4, (11) Tower Test, (12) WRAML2 Screening Index, (13) BNT, (14) CPT-II Confidence Index, (15) Sensory-Motor Impairment Index, and (18) Grooved Pegboard – Dominant and Non-Dominant Hands.

As this was a descriptive study, with a goal of obtaining detailed information about the participants and their neuropsychological functioning, cluster analysis was employed as a way to further explore the obtained findings. For example, when sample means are emphasized, the performance of smaller subgroups, possibly underrepresented in the sample, can be obscured. Cluster analysis is a means of identifying these potential subgroups. This strategy was preferred over discriminant analysis, which uses pre-defined groups. No particular assumptions about subgroups were made prior to conducting the cluster analysis, as the goal was to see if any adequate (i.e., large enough) clusters would emerge.

# CHAPTER IV
# RESULTS

The purpose of this chapter is to present findings that address the following research question: (1) what do the results of a neuropsychological battery reveal about the neuropsychological functioning of men residing at the Guest House of Milwaukee; (2) how does neuropsychological functioning relate to demographic characteristics and background factors (e.g., medical conditions, substance use) of participants; and (3) what subgroups of participants can be identified on the basis of cognitive and neuropsychological functioning, and what characterizes these subgroups. The clinical and research implications of these findings will be addressed in the next chapter. Results will be presented in three sections: (1) description of cognitive and neuropsychological test performance for the sample, (2) relationships between test variables, and (3) cluster analysis findings.

## Cognitive and Neuropsychological Test Performance

### *General Intelligence and Reading Ability*

The mean estimated IQ for the sample was in the average range ($M$ = 94.2, $SD$ = 16.37; average range = 90-109). However, approximately 40% of the sample obtained IQs in the low average range (80-89) or lower. Reading ability was slightly lower than IQ for the sample as a whole, and most participants scored in the borderline to average range (72 – 108). Over half of the participants' scores on the WTAR were below the average range. Table 4.1 illustrates the sample's performance on the WASI and the WTAR.

Table 4.1

*WASI and WTAR Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| | | | WASI Results | | | |
| Vocabulary, *T*-score | | | 43.63 | 12.78 | 45.0 | 20 – 72 |
| Matrix Reasoning, *T*-score | | | 47.98 | 10.43 | 49.0 | 27 – 64 |
| Estimated IQ, Standard Score | | | 94.20 | 16.37 | 92.0 | 64 – 126 |
| Extremely Low | 3 | 5.9 | | | | |
| Borderline | 6 | 11.8 | | | | |
| Low Average | 12 | 23.5 | | | | |
| Average | 21 | 41.2 | | | | |
| High Average | 4 | 7.8 | | | | |
| Superior | 5 | 9.8 | | | | |
| | | | WTAR Results | | | |
| Standard Score | | | 90.24 | 17.81 | 87.0 | 52 – 122 |
| Extremely Low | 7 | 13.7 | | | | |
| Borderline | 5 | 9.8 | | | | |
| Low Average | 17 | 33.3 | | | | |
| Average | 11 | 21.6 | | | | |
| High Average | 9 | 17.6 | | | | |
| Superior | 2 | 3.9 | | | | |

Relationships between demographic and background characteristics and WASI and WTAR performance were explored. These results can be found in Table 4.2. Estimated IQ and reading ability were both positively correlated with years of education ($r$ = .49 and .51, respectively) and ethnicity ($r$ = .34 and .43, respectively). To explore this latter finding, the Mann-Whitney $U$ test was used to compare WASI estimated IQs and WTAR scores between African American and non-African American participants. A significant difference was found for estimated IQ ($z$ = -2.36, $p$ = .02) and for reading ability ($z$ = -2.92, $p$ = .00), with non-African American participants scoring higher on both tests. African American participants obtained scores in the low average range, while non-African Americans obtained scores in the average range. These results can be found in Table 4.3.

Table 4.2

*Correlations: Sample Characteristics and Cognitive Test Performance*

| | Test Variable[a] | | | |
|---|---|---|---|---|
| Variable | WASI Vocabulary | WASI Matrix Reasoning | WASI IQ Estimate | WTAR Standard Score |
| Age[a] | -.14 | -.28 | -.21 | .02 |
| Ethnicity[b] | .32 | .26 | .34 | .43 |
| Education (yrs)[a] | .46 | .40 | .49 | .51 |
| Cumulative Days Homeless[a] | -.07 | -.20 | -.13 | .01 |
| Last Meal (hrs)[a] | -.02 | .02 | -.01 | -.02 |
| No. Head Injuries[c] | .16 | 0 | .11 | .22 |
| No. Mental Health Dx[a] | -.09 | -.09 | -.09 | -.17 |
| TAAD Alcohol Dx[d] | .07 | .23 | .16 | -.03 |
| TAAD Drug Dx[d] | .13 | -.03 | .06 | -.01 |
| No. Medical Problems[a] | -.08 | -.07 | -.08 | 0 |
| No. CNS Medications[a] | .19 | .19 | .22 | .34 |
| No. Services Utilized[a] | .17 | .06 | .15 | .13 |
| No. Sleep Problems[a] | -.07 | -.05 | -.06 | .06 |
| No. Neurological Problems[a] | -.17 | -.08 | -.13 | -.05 |
| No. Adaptive Beh. Problems[a] | -.09 | -.21 | -.16 | -.05 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

Table 4.3

*Racial/Ethnic Group Comparisons: WASI Estimated IQ and WTAR Score*

| Variable | *M* | *SD* | *Mdn* | Range | *z* | *p* |
|---|---|---|---|---|---|---|
| WASI Estimated IQ | | | | | -2.36 | .02 |
| African American (*n* = 24) | 88.38 | 13.03 | 86.0 | 64 – 120 | | |
| Other (*n* = 27) | 99.37 | 17.49 | 102.0 | 65 – 126 | | |
| WTAR Score | | | | | -2.92 | .00 |
| African American (*n* = 24) | 82.12 | 13.19 | 83.0 | 63 – 114 | | |
| Other (*n* = 27) | 97.44 | 18.48 | 99.0 | 52 – 122 | | |

*Note.* Mann-Whitney *U* test used to compare groups

## *Attention, Concentration, and Working Memory*

### *WAIS-III Subtests*

The results of the WAIS-III Digit Span, Digit Symbol-Coding, and Letter-Number Sequencing subtests can be found in Table 4.4. Over half of the participants performed in the average range or better on the Digit Span and Letter-Number Sequencing subtests, while performance on Digit Symbol-Coding was relatively lower, with over three-fourths of participants scoring below the average range.

Table 4.4

*Digit Span, Digit Symbol-Coding, and Letter-Number Sequencing Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| | | | Digit Span | | | |
| Scaled Score | | | 8.63 | 2.55 | 8.0 | 4 – 15 |
| Standard Score | | | 93.14 | 12.73 | 90.0 | 70 – 125 |
| Borderline | 5 | 9.8 | | | | |
| Low Average | 14 | 27.5 | | | | |
| Average | 24 | 47.1 | | | | |
| High Average | 5 | 9.8 | | | | |
| Superior | 3 | 5.9 | | | | |
| | | | Digit Symbol Coding | | | |
| Scaled Score | | | 6.67 | 1.85 | 6.0 | 3 – 13 |
| Standard Score | | | 83.33 | 9.26 | 80.0 | 65 – 115 |
| Extremely Low | 1 | 2.0 | | | | |
| Borderline | 12 | 23.5 | | | | |
| Low Average | 26 | 51.0 | | | | |
| Average | 11 | 21.6 | | | | |
| High Average | 1 | 2.0 | | | | |
| | | | Letter-Number Sequencing | | | |
| Scaled Score | | | 8.65 | 3.00 | 8.0 | 3 – 18 |
| Standard Score | | | 93.24 | 14.99 | 90.0 | 65 – 140 |

Table 4.4, continued

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Extremely Low | 3 | 5.9 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 12 | 23.5 | | | | |
| Average | 24 | 47.1 | | | | |
| High Average | 7 | 13.7 | | | | |
| Superior | 1 | 2.0 | | | | |
| Very Superior | 1 | 2.0 | | | | |

*CPT-II*

Most participants were classified as being likely to have an attention-related problem, based on the CPT-II confidence index measure. In terms of specific aspects of CPT-II performance, the highest mean score was in perseveration ($T$ = 78.02). Additional CPT-II scores can be found in Table 4.5.

Table 4.5

*CPT-II Test Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Confidence Index (%) | | | 68.41 | 19.99 | 65.0 | 22.7 – 99.9 |
| Poor Performance[a] | 31 | 60.8 | | | | |
| No Decision | 19 | 37.3 | | | | |
| Good Performance | 1 | 2.0 | | | | |
| Omissions, *T*-score | | | 64.03 | 39.25 | 48.8 | 40.9 – 215.4 |
| Commissions, *T*-score | | | 46.98 | 8.96 | 45.0 | 33.4 – 78.5 |
| Hit Reaction Time (RT), *T*-score | | | 61.51 | 13.74 | 58.8 | 34.4 – 109.8 |
| Standard Error, Hit RT, *T*-score | | | 62.07 | 14.19 | 62.6 | 39.5 – 106.0 |
| Variability, *T*-score | | | 60.67 | 15.61 | 58.8 | 34.5 – 104.9 |
| Detectability, *T*-score | | | 46.32 | 9.17 | 47.6 | 21.3 – 63.1 |
| Response Style, *T*-score | | | 54.60 | 16.60 | 49.2 | 25.0 – 100.0 |
| Perseveration, *T*-score | | | 78.02 | 70.78 | 45.8 | 42.5 – 473.5 |
| Hit RT Block Change, *T*-score | | | 47.30 | 12.65 | 48.0 | 16.6 – 79.3 |
| Standard Error, Hit RT Block Change, *T*-score | | | 57.88 | 12.36 | 56.3 | 28.6 – 89.9 |
| Hit RT Inter-Stimulus Interval (ISI) Change, *T*-score | | | 54.23 | 12.62 | 56.5 | 25.5 – 82.2 |
| Standard Error, Hit RT ISI Change, *T*-score | | | 55.27 | 16.02 | 51.8 | 30.9 – 100.2 |

*Note.* Higher *T* scores (≥ 60) indicate poorer performance, except in the cases of Response Style and Hit RT; for these, both high and low scores are noteworthy. [a]Poor performance = Confidence Index >60%; No decision = Confidence Index between 40-60% Good performance = Confidence Index <40%.

*Correlations*

Correlations between sample characteristics and performance on the attention/ concentration tests can be found in Table 4.6. Age was inversely related to performance on the Coding subtest ($r$ = -.31) and positively correlated with the CPT-II confidence index ($r$ = .25), where higher index scores indicate poorer attention and concentration. Additionally, years of education was positively correlated with performance on the Letter-Number subtest ($r$ = .26). A moderately strong relationship was found between ethnicity and Digit Span ($r$ = .39), as well as between ethnicity and Letter-Number Sequencing ($r$ = .30). Ethnicity was also linked to performance on the CPT-II ($r$ = -.35). Further, drug use status based on the TAAD was linked to all three WAIS-III subtests (Digit Span, $r$ = .24; Letter-Number, $r$ = .25; Coding, $r$ = .29) and to the CPT-II confidence index ($r$ = -.20).

Table 4.6

*Correlations: Sample Characteristics and Attention/Working Memory Test Performance*

| | Test[a] | | | |
|---|---|---|---|---|
| Variable | Digit Symbol-Coding | Digit Span | Letter-Number Sequencing | CPT-II Index |
| Age[a] | -.31 | -.12 | -.12 | .25 |
| Ethnicity[b] | .09 | .39 | .30 | -.35 |
| Education (yrs)[a] | .20 | .22 | .26 | -.09 |
| Cumulative Days Homeless[a] | -.06 | -.01 | .05 | .19 |
| Last Meal (hrs)[a] | .05 | .02 | .20 | .11 |
| No. Head Injuries[c] | -.18 | .11 | .21 | .08 |
| No. Mental Health Dx[a] | -.22 | .02 | -.15 | .03 |
| TAAD Alcohol Dx[d] | 0 | -.03 | -.05 | -.13 |
| TAAD Drug Dx[d] | .29 | .24 | .25 | -.20 |
| No. Medical Problems[a] | -.08 | .01 | .03 | .03 |
| No. CNS Medications[a] | -.05 | 0 | .08 | -.04 |
| No. Services Utilized[a] | 0 | .09 | .07 | -.06 |
| No. Sleep Problems[a] | -.13 | .02 | -.03 | .08 |
| No. Neurological Problems[a] | -.15 | .05 | .07 | .23 |
| No. Adaptive Behavior Problems[a] | -.06 | .04 | -.01 | .08 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

*Group Comparisons*

*Ethnicity*. Comparisons between ethnic groups using the Mann-Whitney *U* test found statistically significant differences for both Digit Span ($z = -2.78$, $p = .01$) and Letter-Number Sequencing ($z = -2.30$, $p = .02$). African American participants obtained lower scores on both tests compared to non-African American participants. A statistically significant difference was also found between ethnic groups for the CPT-II confidence index ($z = -2.35$, $p = .02$). African American participants obtained higher confidence index scores, indicating more attention-related problems compared to non-African American participants. Ethnic group comparisons can be found in Table 4.7.

Table 4.7

*Racial/Ethnic Group Comparisons: Digit Span, Letter-Number Sequencing, and CPT-II*

| Variable | *M* | *SD* | *Mdn* | Range | *z* | *p* |
|---|---|---|---|---|---|---|
| Digit Span, standard score | | | | | -2.78 | .01 |
| African American (*n* = 24) | 87.92 | 10.42 | 87.5 | 70 – 110 | | |
| Other (*n* = 27) | 97.78 | 12.96 | 95.0 | 75 – 125 | | |
| Letter-Number Seq., standard score | | | | | -2.30 | .02 |
| African American (*n* = 24) | 88.54 | 8.14 | 90.0 | 70 – 110 | | |
| Other (*n* = 27) | 97.41 | 18.31 | 100.0 | 65 – 140 | | |
| CPT-II Confidence Index | | | | | -2.35 | .02 |
| African American (*n* = 24) | 75.71 | 19.68 | 76.0 | 42.1 – 99.9 | | |
| Other (*n* = 27) | 61.93 | 18.25 | 60.0 | 22.7 – 99.9 | | |

*Note.* Mann-Whitney *U* test used to compare groups.

*Drug use.* Comparisons between participants who met criteria for a drug use disorder and those who did not resulted in a statistically significant difference for Coding performance ($z = -2.18$, $p = .03$). Participants with a drug use disorder obtained higher scores on the Coding test, compared to participants without. Other comparisons were not statistically significant. Table 4.8 outlines these results.

Table 4.8

*Drug Use Disorder Comparisons: WAIS-III Subtests and CPT-II Confidence Index*

| Variable | *M* | *SD* | *Mdn* | Range | *z* | *p* |
|---|---|---|---|---|---|---|
| Digit Span, standard score | | | | | -1.33 | .18 |
| No DUD (*n* = 23) | 89.78 | 8.32 | 90.0 | 75 – 110 | | |
| Abuse/Dep (*n* = 28) | 95.89 | 15.03 | 95.0 | 70 – 125 | | |
| Coding, standard score | | | | | -2.18 | .03 |
| No DUD (*n* = 23) | 80.43 | 8.65 | 80.0 | 65 – 105 | | |
| Abuse/Dep (*n* = 28) | 85.71 | 9.20 | 85.0 | 75 – 115 | | |
| Letter-Number, standard score | | | | | -1.77 | .08 |
| No DUD (*n* = 23) | 89.13 | 13.54 | 90.0 | 65 – 115 | | |
| Abuse/Dep (*n* = 28) | 96.61 | 15.52 | 92.5 | 65 – 140 | | |
| CPT-II Confidence Index | | | | | -1.41 | .16 |
| No DUD (*n* = 23) | 72.86 | 18.97 | 72.0 | 48.7 – 99.9 | | |
| Abuse/Dep (*n* = 28) | 64.76 | 20.40 | 63.5 | 22.7 – 99.9 | | |

*Notes.* Mann-Whitney *U* test used to compare groups. No DUD = Did not meet criteria for Drug Abuse or Dependence. Abuse/Dep = Met criteria for either Drug Abuse or Drug Dependence.

*Self-reported attention problems.* The Mann-Whitney *U* test was used to compare participants who had self-reported attention difficulties during the initial interview (*n* = 27) and those who reported no such difficulties (*n* = 24), in terms of performance on the attention and concentration tests. The results revealed no statistically significant differences for Coding (*z* = -.92, *p* = .36), Digit Span (*z* = -.63, *p* = .53), or Letter-Number Sequencing (*z* = -.19, *p* = .85). For the CPT-II confidence index, a comparison between participants with self-reported attention difficulties and those without was also not statistically significant (*z* = -.62, *p* = .54).

## *Visual and Verbal Memory*

### *Verbal Memory*

Table 4.9 outlines performance on the verbal memory subtests of the WRAML2, as well as the overall Verbal Index. Most participants scored in the borderline to average range in the area of verbal memory, with approximately half of the sample (49.1%) scoring in the average to high-average range.

Table 4.9

*WRAML2 Verbal Memory Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Story Memory, scaled | | | 8.06 | 2.48 | 8.0 | 4 – 14 |
| Story Memory, standard | | | 90.29 | 12.39 | 90.0 | 70 – 120 |
| Borderline | 9 | 17.6 | | | | |
| Low Average | 14 | 27.5 | | | | |
| Average | 22 | 43.1 | | | | |
| High Average | 5 | 9.8 | | | | |
| Superior | 1 | 2.0 | | | | |
| Verbal Learning, scaled | | | 7.96 | 2.21 | 8.0 | 1 – 13 |
| Verbal Learning, standard | | | 89.80 | 11.04 | 90.0 | 55 – 115 |
| Extremely Low | 1 | 2.0 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 18 | 35.3 | | | | |
| Average | 26 | 51.0 | | | | |
| High Average | 3 | 5.9 | | | | |
| Verbal Index, standard score | | | 88.02 | 12.21 | 88.0 | 59 – 114 |
| Extremely Low | 2 | 3.9 | | | | |
| Borderline | 9 | 17.6 | | | | |
| Low Average | 15 | 29.4 | | | | |
| Average | 24 | 47.1 | | | | |
| High Average | 1 | 2.0 | | | | |

*Visual Memory*

*WRAML2.* Visual memory was assessed by both the WRAML2 and the two memory tasks of the RCFT. Correlations between the WRAML2 Visual Index and RCFT measures were moderate to large at $r = .47$ for Immediate Recall and $r = .50$ for Delayed Recall.

Table 4.10 details the sample's performance on the two subtests that comprise the Visual Index of the WRAML2. The mean Visual Index score was in the low end of the low average range ($M = 81.59$, $SD = 13.11$; low average = 80-89). Performance on visual memory tasks was relatively lower than verbal memory performance; nearly three-fourths of the sample (72.5%) scored in the low average range or lower in visual memory. Scores for the overall estimate of memory abilities, the Screening Memory Index, can be found in Table 4.11.

Table 4.10

*WRAML2 Visual Memory Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Design Memory, scaled | | | 6.65 | 2.81 | 6.0 | 2 – 14 |
| Design Memory, standard | | | 83.24 | 14.03 | 80.0 | 60 – 120 |
| Extremely Low | 8 | 15.7 | | | | |
| Borderline | 12 | 23.5 | | | | |
| Low Average | 14 | 27.5 | | | | |
| Average | 15 | 29.4 | | | | |
| High Average | 1 | 2.0 | | | | |
| Superior | 1 | 2.0 | | | | |
| Picture Memory, scaled | | | 7.25 | 2.28 | 7.0 | 3 – 12 |
| Picture Memory, standard | | | 86.27 | 11.40 | 85.0 | 65 – 110 |
| Extremely Low | 2 | 3.9 | | | | |
| Borderline | 10 | 19.6 | | | | |
| Low Average | 17 | 33.3 | | | | |
| Average | 21 | 41.2 | | | | |
| High Average | 1 | 2.0 | | | | |
| Visual Index, standard score | | | 81.59 | 13.11 | 79.0 | 56 – 118 |
| Extremely Low | 8 | 15.7 | | | | |
| Borderline | 18 | 35.3 | | | | |
| Low Average | 11 | 21.6 | | | | |
| Average | 13 | 25.5 | | | | |
| High Average | 1 | 2.0 | | | | |

Table 4.11

*WRAML2 Screening Memory Index Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Standard Score | | | 82.37 | 12.10 | 84.0 | 55 – 114 |
| Extremely Low | 8 | 15.7 | | | | |
| Borderline | 13 | 25.5 | | | | |
| Low Average | 17 | 33.3 | | | | |
| Average | 12 | 23.5 | | | | |
| High Average | 1 | 2.0 | | | | |

*RCFT.* Performance on the Immediate and Delayed Recall trials of the RCFT can be found in Table 4.12. Mean standardized scores for these tests are unavailable due to the manner of converting raw scores to age-corrected *T* scores in the test manual (Meyers & Meyers, 1995). As several participants' scores were indicated only as "T < 20," scores are presented categorically.

Mean performance on Immediate Recall was in the mildly impaired to mildly-moderately impaired range, and over half (62.7%) of the sample obtained scores demonstrating impairment. Performance on Delayed Recall was similar to these results; 60.7% of the sample obtained scores in the mildly to severely impaired range.

Table 4.12

*RCFT Memory Trial Results*

| Variable | *n* | % | *M* | *SD* |
|---|---|---|---|---|
| Immediate Recall[a] | | | 3.43 | 2.30 |
| Above Average | 3 | 5.9 | | |
| Average | 11 | 21.6 | | |
| Below Average | 5 | 9.8 | | |
| Mildly Impaired | 7 | 13.7 | | |
| Mildly to Moderately Impaired | 6 | 11.8 | | |
| Moderately Impaired | 7 | 13.7 | | |
| Moderately to Severely Impaired | 3 | 5.9 | | |
| Severely Impaired | 9 | 17.6 | | |
| Delayed Recall[a] | | | 3.49 | 2.19 |
| Above Average | 2 | 3.9 | | |
| Average | 12 | 23.5 | | |
| Below Average | 6 | 11.8 | | |
| Mildly Impaired | 4 | 7.8 | | |
| Mildly to Moderately Impaired | 10 | 19.6 | | |
| Moderately Impaired | 6 | 11.8 | | |
| Moderately to Severely Impaired | 4 | 7.8 | | |
| Severely Impaired | 7 | 13.7 | | |

[a]Ordinal variable, where 0=severely impaired and 7=above average.

*Correlations*

Correlations between sample characteristics and memory test performance were also conducted, and several moderately strong relationships were found (see Table 4.13). For example, years of education was positively correlated with performance on verbal memory tasks ($r$ = .37). Ethnicity was correlated with WRAML Screening ($r$ = .30), Immediate Recall ($r$ = .37), and Delayed Recall ($r$ = .39). Additionally, medium-sized correlations were found between the number of CNS medications being taken and performance on WRAML Screening ($r$ = .31), Immediate Recall ($r$ = .29), and Delayed Recall ($r$ = .30), with more medications related to higher test scores. Further, the number of self-reported medical problems was related to performance on Immediate Recall ($r$ = .28).

Table 4.13

*Correlations: Sample Characteristics and Memory Test Performance*

| | WRML2 Measures | | | RCFT Measures | |
|---|---|---|---|---|---|
| Variable | Verbal | Visual | Screening | IR | DR |
| Age[a] | -.14 | -.06 | -.10 | .18 | .17 |
| Ethnicity[b] | .23 | .25 | .30 | .37 | .39 |
| Education (yrs)[a] | .37 | -.04 | .16 | .22 | .18 |
| Cumulative Days Homeless[a] | -.23 | -.12 | -.21 | -.03 | -.11 |
| Last Meal (hrs)[a] | -.09 | -.03 | -.09 | .13 | .07 |
| No. Head Injuries[c] | -.01 | -.03 | -.02 | .02 | -.07 |
| No. Mental Health Dx[a] | .01 | -.07 | -.02 | -.06 | .02 |
| TAAD Alcohol Dx[d] | -.14 | -.05 | -.10 | -.13 | -.23 |
| TAAD Drug Dx[d] | .23 | .17 | .21 | -.03 | -.04 |
| No. Medical Problems[a] | .01 | .07 | .06 | .28 | .20 |
| No. CNS Medications[a] | .27 | .21 | .31 | .29 | .30 |
| No. Services Utilized[a] | .20 | .03 | .11 | -.06 | -.02 |
| No. Sleep Problems[a] | .00 | .12 | .09 | .11 | .14 |
| No. Neurological Problems[a] | -.15 | .04 | -.07 | -.05 | .00 |
| No. Adaptive Beh. Problems[a] | -.03 | -.07 | -.08 | .05 | .02 |

*Notes.* IR = Immediate Recall; DR = Delayed Recall. Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4= more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

*Group Comparisons*

*Ethnicity.* The Mann-Whitney *U* test was used to compare African American and non-African American participants in terms of performance on memory tests. Statistically significant differences were found for Screening Memory ($z$ = -2.16, $p$ = .03), Immediate Recall ($z$ = -2.78, $p$ = .01), and Delayed Recall ($z$ = -2.87, $p$ = .00), with non-African Americans obtaining higher scores on all three tests. Table 4.14 outlines these results.

Table 4.14

*Racial/Ethnic Group Comparisons: Selected Memory Tests*

| Variable | *M* | *SD* | *Mdn* | Range | *z* | *p* |
|---|---|---|---|---|---|---|
| WRAML2 Screening Index | | | | | -2.16 | .03 |
| African American ($n$ = 24) | 78.54 | 11.56 | 76.5 | 55 – 100 | | |
| Other ($n$ = 27) | 85.78 | 11.72 | 86.0 | 61 – 114 | | |
| RCFT Immediate Recall | | | | | -2.78 | .01 |
| African American ($n$ = 24) | 1.29 | 1.65 | 0 | 0 – 4 | | |
| Other ($n$ = 27) | 2.59 | 1.65 | 3 | 0 – 4 | | |
| RCFT Delayed Recall | | | | | -2.87 | .00 |
| African American ($n$ = 24) | 1.21 | 1.62 | 0.5 | 0 – 4 | | |
| Other ($n$ = 27) | 2.56 | 1.60 | 3 | 0 – 4 | | |

*Note.* WRAML2 reported as a standard score. RCFT results reported as the mean of an ordinal variable, where 0 = severely impaired and 7 = above average. Mann-Whitney *U* test used to compare groups.

*Self-reported memory problems.* Memory test performance was compared for participants who self-reported memory problems during the initial interview ($n$ = 28) and those who did not ($n$ = 23). The two groups did not differ significantly on WRAML2 Screening ($z$ = -1.64, $p$ = .10), Immediate Recall ($z$ = -0.14, $p$ = .89), or Delayed Recall ($z$ = -0.11, $p$ = .91), based on the Mann-Whitney $U$ test.

### *Language*

A significant proportion (72.6%) of the sample scored below the 50th percentile on the Boston Naming Test, with over one-third scoring below the 10th percentile. A full description of the results can be found in Table 4.15.

Table 4.15

*Boston Naming Test Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Raw Score (max = 60) | | | 51.12 | 7.07 | 54.0 | 34 – 60 |
| Standard Score[a] | | | 77.64 | 31.03 | 87.0 | < 0 – 113.8 |
| Percentile Category[b] | | | | | | |
| < 10th | 19 | 37.3 | | | | |
| 10th – 24th | 10 | 19.6 | | | | |
| 25th – 49th | 8 | 15.7 | | | | |
| 50th – 74th | 11 | 21.6 | | | | |
| 75th – 89th | 2 | 3.9 | | | | |
| ≥ 90th | 1 | 2.0 | | | | |

[a]Standard scores calculated using meta-analytic norms from Mitrushina et al. (2005). [b]Conversion of raw scores to percentile categories based on normative data from Tombaugh & Hubley (1997).

*Correlations*

An examination of relationships between BNT performance and demographic and background factors found that ethnicity ($r$ = .47), age ($r$ = .31), and years of education ($r$ = .20) were related to performance on the BNT (standard score). Another moderate-strength, positive correlation was found between BNT score and number of CNS medications ($r$ = .28), while number of mental health disorders and BNT were inversely related ($r$ = -.25). All correlations can be found in Table 4.16.

Table 4.16

*Correlations: Sample Characteristics and Boston Naming Test Performance*

| | BNT Test Variable | | |
|---|---|---|---|
| Variable | Raw Score[a] | Standard Score[a] | Percentile Category[b] |
| Age[a] | .22 | .31 | .19 |
| Ethnicity[c] | .48 | .47 | .45 |
| Education (yrs)[a] | .23 | .20 | .20 |
| Cumulative Days Homeless[a] | -.19 | -.19 | .04 |
| Last Meal (hrs)[a] | -.07 | -.07 | -.06 |
| No. Head Injuries[d] | .20 | .21 | .03 |
| No. Mental Health Dx[a] | -.23 | -.25 | -.17 |
| TAAD Alcohol Dx[e] | .05 | .04 | .04 |
| TAAD Drug Dx[e] | -.10 | -.13 | .04 |
| No. Medical Problems[a] | .15 | .19 | -.02 |
| No. CNS Medications[a] | .29 | .28 | .29 |
| No. Services Utilized[a] | -.06 | -.08 | .11 |
| No. Sleep Problems[a] | -.08 | -.10 | -.06 |
| No. Neurological Problems[a] | -.18 | -.17 | -.14 |
| No. Adaptive Behavior Problems[a] | -.08 | -.08 | .02 |

*Note.* Pearson's *r* used for continuous – continuous relationships. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. Spearman rank-order correlation used for ordinal – ordinal relationships. $r_{DR}$, a special case of Pearson's *r*, used for dichotomous – ordinal relationships. [a]Continuous variable [b]Ordinal variable, where 0 = <10th percentile and 5 = ≥90th percentile [c]Dichotomous variable: 0=African American, 1=Other [d]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [e]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

*Group Comparisons*

*Ethnicity.* Performance on the BNT by African American and non-African American participants was compared using the Mann-Whitney *U* test, and the difference was statistically significant, $z = -3.79$, $p = .00$. Non-African American participants obtained significantly higher scores ($M = 91.24$, $SD = 23.31$) than did African American participants ($M = 62.33$, $SD = 31.89$).

*Education.* BNT performance by highest level of education was examined, and the Mann-Whitney *U* test was used to compare groups (e.g., those with a high school diploma vs. those without a diploma or GED). These results can be found in Table 4.17. Participants who lacked both a high school diploma and a GED obtained statistically significantly lower BNT scores than participants with a GED ($z = -2.20$, $p = .03$) and those with any amount of post-high school education ($z = -2.80$, $p = .01$). Participants with GEDs and participants with high school diplomas performed similarly on the BNT ($z = -0.13$, $p = .90$), as did participants with high school diplomas and those with post-high school educational attainments ($z = -1.44$, $p = .15$).

Table 4.17

*Boston Naming Test Performance (Raw Score) by Level of Education*

| Highest Level of Education | *M* | *SD* | Range |
|---|---|---|---|
| No HS Diploma/GED (*n* = 12) | 45.92[a,b] | 7.85 | 34 – 57 |
| GED (*n* = 15) | 53.07[a] | 3.97 | 45 – 58 |
| HS Diploma (*n* = 14) | 50.36 | 8.49 | 34 – 58 |
| Post-HS Education/Training (*n* = 10) | 55.50[b] | 3.06 | 50 – 60 |

*Note.* Mann-Whitney *U* test used to compare groups; only statistically significant differences are noted.
[a]$z = -2.20$, $p = .03$ [b]$z = -2.80$, $p = .01$

*Item Analysis*

Due to the unexpectedly low scores on the BNT, particularly for African American participants, an analysis of individual items was conducted. Few participants missed or incorrectly named items 1 through 40 of the test. Of the remaining items, compass (item 50), yoke (item 56), trellis (item 57), palette (item 58), protractor (item 59), and abacus (item 60) were each named correctly by fewer than half of the participants. Reading ability, as measured by the WTAR, had a relatively stronger relationship to performance on these items than did years of education, and those with higher reading scores were more likely to name the items correctly. Table 4.18 outlines these relationships.

Table 4.18

*Performance on Selected BNT Items and Relationship With Reading Ability, Education*

| Item Number | Item | % correct | *n* | WTAR Score *r* | Education (yrs) *r* |
|---|---|---|---|---|---|
| 50 | Compass | 37.3 | 19 | .20 | .07 |
| 52 | Tripod | 62.7 | 32 | .44 | .22 |
| 54 | Tongs | 76.5 | 39 | .34 | .13 |
| 55 | Sphinx | 56.9 | 29 | .47 | .05 |
| 56 | Yoke | 41.2 | 21 | .57 | .12 |
| 57 | Trellis | 29.4 | 15 | .56 | .28 |
| 58 | Palette | 21.6 | 11 | .53 | .19 |
| 59 | Protractor | 27.5 | 14 | .43 | .26 |
| 60 | Abacus | 25.5 | 13 | .64 | .34 |

*Note.* Point-biserial correlation used to assess relationship between item performance (dichotomous variable) and each continuous variable (WTAR score, years of education).

In addition to reading ability and years of education, ethnicity was found to be a factor in BNT item performance. A two-tailed, *z*-approximation test, with a continuity correction applied, was used to compare participants' performances on the BNT items. African American and non-African American participants differed significantly in their performance on ten of the items (e.g., hammock, accordion). The results can be found in Table 4.19.

Table 4.19

*Ethnic Group and Performance on Selected BNT Items*

| Item | $z$[1] | $p$ | Correctly Answered ($n$) AA ($n$=24) | Non-AA ($n$=27) |
|---|---|---|---|---|
| Hammock | 9.53 | .00 | 12 | 25 |
| Knocker | 8.70 | .00 | 14 | 26 |
| Pelican | 4.74 | .03 | 14 | 24 |
| Accordion | 9.53 | .00 | 12 | 25 |
| Noose | 7.19 | .01 | 15 | 24 |
| Asparagus | 4.74 | .03 | 14 | 24 |
| Tripod | 7.00 | .01 | 10 | 22 |
| Tongs | 6.49 | .01 | 14 | 25 |
| Sphinx | 5.52 | .02 | 9 | 20 |
| Trellis | 4.80 | .03 | 3 | 12 |

[1]Results of a two-tailed, $z$ approximation test, with continuity correction applied

## *Executive Functioning*

### *DKEFS Tests*

*Trail Making Test.* Mean scores for the five tasks of the Trail Making Test can be found in Table 4.20. Mean performance on the Number-Letter Switching task was in the low average range, whereas performance on other Trails tasks was in the average range. Nearly half of the sample obtained scores below the average range (49%) on Switching. Performance on the Switching task was moderately to highly correlated with performance

on all other Trails tasks, and the strongest relationship was with Letter Sequencing (*r* = .62).

Table 4.20

*Trail Making Test Results*

| Trail | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| 1, Scanning, scaled | | | 9.27 | 3.01 | 10.0 | 1 – 14 |
| 1, Scanning, standard | | | 96.37 | 15.07 | 100.0 | 55 – 120 |
| Extremely Low | 4 | 7.8 | | | | |
| Borderline | 2 | 3.9 | | | | |
| Low Average | 5 | 9.8 | | | | |
| Average | 29 | 56.9 | | | | |
| High Average | 10 | 19.6 | | | | |
| Superior | 1 | 2.0 | | | | |
| 2, Number Sequencing, scaled | | | 8.61 | 3.44 | 10.0 | 1 – 14 |
| 2, Number Sequencing, standard | | | 93.04 | 17.21 | 100.0 | 55 – 120 |
| Extremely Low | 6 | 11.8 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 8 | 15.7 | | | | |
| Average | 25 | 49.0 | | | | |
| High Average | 7 | 13.7 | | | | |
| Superior | 2 | 3.9 | | | | |
| 3, Letter Sequencing, scaled | | | 8.02 | 3.86 | 9.0 | 1 – 13 |
| 3, Letter Sequencing, standard | | | 90.10 | 19.27 | 95.0 | 55 – 115 |

Table 4.20, continued

| Trail | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Extremely Low | 8 | 15.7 | | | | |
| Borderline | 5 | 9.8 | | | | |
| Low Average | 7 | 13.7 | | | | |
| Average | 18 | 35.3 | | | | |
| High Average | 13 | 25.5 | | | | |
| 4, Switching, scaled | | | 6.55 | 3.92 | 8.0 | 1 – 14 |
| 4, Switching, standard | | | 82.75 | 19.60 | 90.0 | 55 – 120 |
| Extremely Low | 15 | 29.4 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 7 | 13.7 | | | | |
| Average | 22 | 43.1 | | | | |
| High Average | 3 | 5.9 | | | | |
| Superior | 1 | 2.0 | | | | |
| 5, Motor Speed, scaled | | | 9.82 | 2.71 | 10.0 | 1 – 14 |
| 5, Motor Speed, standard | | | 99.12 | 13.55 | 100.0 | 55 – 120 |
| Extremely Low | 2 | 3.9 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 2 | 3.9 | | | | |
| Average | 29 | 56.9 | | | | |
| High Average | 14 | 27.5 | | | | |
| Superior | 1 | 2.0 | | | | |

Results of the Trail Making Test also include five contrast measures, which parcel out performance on the "foundational" tasks (e.g., number sequencing ability) when interpreting number-letter switching performance. These data can be found in Table 4.21. Only a few participants performed poorly on the switching task because of difficulties with visual scanning ($n$ = 6), number and letter facility ($n$ = 5), or motor speed ($n$ = 2).

Table 4.21

*Trail Making Test: Contrast Measures, Scaled Scores*

| Contrast | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| 1: Switching vs. Scanning | | | 8.08 | 3.48 | 8.0 | 2 – 17 |
| Switching Difficulty | 17 | 33.3 | | | | |
| Scanning Difficulty | 6 | 11.8 | | | | |
| Equal Performance | 28 | 54.9 | | | | |
| 2: Switching vs. Number | | | 8.31 | 3.86 | 8.0 | 2 – 19 |
| Switching Difficulty | 21 | 41.2 | | | | |
| Number Difficulty | 7 | 13.7 | | | | |
| Equal Performance | 23 | 45.1 | | | | |
| 3: Switching vs. Letter | | | 8.84 | 3.55 | 9.0 | 1 – 19 |
| Switching Difficulty | 21 | 41.2 | | | | |
| Letter Difficulty | 7 | 13.7 | | | | |
| Equal Performance | 23 | 45.1 | | | | |
| 4: Switching vs. Number + Letter | | | 8.35 | 3.57 | 9.0 | 1 – 19 |
| Switching Difficulty | 21 | 41.2 | | | | |
| Number/Letter Difficulty | 5 | 9.8 | | | | |
| Equal Performance | 25 | 49.0 | | | | |
| 5: Switching vs. Speed | | | 7.04 | 3.52 | 7.0 | 1 – 17 |
| Switching Difficulty | 28 | 54.9 | | | | |
| Speed Difficulty | 2 | 3.9 | | | | |
| Equal Performance | 21 | 41.2 | | | | |

*Note.* Switching difficulty indicated when contrast score ≤ 7; difficulty with comparison condition (e.g., speed) indicated when contrast score ≥ 13. Scores in the 8-12 range indicate equal performance on both conditions.

*Verbal Fluency Test.* The results of the Verbal Fluency Test can be found in Table 4.22. Most participants performed well on all fluency tasks including Switching Accuracy, with 86.2% scoring at or above the average range. Contrast measures for Verbal Fluency (see Table 4.23) indicate that, for a few participants ($n$ = 7), low performance on switching was due to category fluency difficulty. However, most participants performed similarly on the foundational and switching tasks.

Table 4.22

*Verbal Fluency Test Results*

| Fluency Task | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| 1, Letter, scaled | | | 9.22 | 3.52 | 9.0 | 1 – 16 |
| 1, Letter, standard | | | 96.08 | 17.59 | 95.0 | 55 – 130 |
| Extremely Low | 2 | 3.9 | | | | |
| Borderline | 4 | 7.8 | | | | |
| Low Average | 10 | 19.6 | | | | |
| Average | 20 | 39.2 | | | | |
| High Average | 10 | 19.6 | | | | |
| Superior | 3 | 5.9 | | | | |
| Very Superior | 2 | 3.9 | | | | |
| 2, Category, scaled | | | 9.47 | 3.74 | 9.0 | 1 – 18 |
| 2, Category, standard | | | 97.35 | 18.69 | 95.0 | 55 – 140 |
| Extremely Low | 3 | 5.9 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 10 | 19.6 | | | | |
| Average | 18 | 35.3 | | | | |
| High Average | 10 | 19.6 | | | | |
| Superior | 4 | 7.8 | | | | |
| Very Superior | 3 | 5.9 | | | | |
| 3, Switching Correct, scaled | | | 9.12 | 3.30 | 9.0 | 2 – 16 |
| 3, Switching Correct, standard | | | 95.59 | 16.48 | 95.0 | 60 – 130 |

Table 4.22, continued

| Fluency Task | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Extremely Low | 4 | 7.8 | | | | |
| Borderline | 3 | 5.9 | | | | |
| Low Average | 6 | 11.8 | | | | |
| Average | 27 | 52.9 | | | | |
| High Average | 5 | 9.8 | | | | |
| Superior | 5 | 9.8 | | | | |
| Very Superior | 1 | 2.0 | | | | |
| 4, Switching Accuracy, scaled | | | 11.00 | 3.30 | 11.0 | 3 – 18 |
| 4, Switching Accuracy, standard | | | 105.00 | 16.49 | 105.0 | 65 – 140 |
| Extremely Low | 2 | 3.9 | | | | |
| Borderline | 2 | 3.9 | | | | |
| Low Average | 3 | 5.9 | | | | |
| Average | 21 | 41.2 | | | | |
| High Average | 15 | 29.4 | | | | |
| Superior | 4 | 7.8 | | | | |
| Very Superior | 4 | 7.8 | | | | |

Table 4.23

*Verbal Fluency Test: Contrast Measures, Scaled Scores*

| Contrast | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| 1: Letter vs. Category | | | 9.75 | 2.79 | 10.0 | 4 – 15 |
| Letter Difficulty | 13 | 25.5 | | | | |
| Category Difficulty | 8 | 15.7 | | | | |
| Equal Performance | 30 | 58.8 | | | | |
| 2: Switching vs. Category | | | 9.67 | 2.95 | 10.0 | 2 – 13 |
| Switching Difficulty | 12 | 23.5 | | | | |
| Category Difficulty | 7 | 13.7 | | | | |
| Equal Performance | 32 | 62.7 | | | | |

*Note.* Letter and switching difficulty indicated when contrast score ≤ 7; category difficulty indicated when contrast score ≥ 13. Scores in the 8-12 range indicate equal performance on both conditions.

*Tower Test.* The final DKEFS subtest administered was the Tower Test, and a description of the sample's performance can be found in Table 4.24. Most participants (76.5%) did well on this test, scoring at or above the average range.

Table 4.24

*Tower Test Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Achievement Score, scaled | | | 9.35 | 2.55 | 9.0 | 2 – 14 |
| Achievement Score, standard | | | 96.77 | 12.76 | 95.0 | 60 – 120 |
| Extremely Low | 1 | 2.0 | | | | |
| Borderline | 2 | 3.9 | | | | |
| Low Average | 9 | 17.6 | | | | |
| Average | 29 | 56.9 | | | | |
| High Average | 9 | 17.6 | | | | |
| Superior | 1 | 2.0 | | | | |

*FrSBe Self-Rating*

Over half of the participants were classified as having clinically significant problems with executive functioning based on self-report. Mean scores for the FrSBe subscales, as well as the total score, can be found in Table 4.25.

An item analysis of the Executive Dysfunction subscale found that over half of the sample reported having difficulty with remembering to do things (item 25; $M = 2.55$, $SD = 1.19$) or following a sequence of steps (item 5; $M = 2.59$, $SD = 1.30$) at least some

of the time. Other items with high mean ratings (based on a 1 – 5 Likert scale, with 5 indicating "almost always") included being unaware of one's problems or mistakes (*M* = 2.49, *SD* = 1.30), getting stuck on certain ideas (item 3; *M* = 2.39, *SD* = 1.10), and making the same mistakes repeatedly (item 7; *M* = 2.35, *SD* = 1.34). Further, over half of the participants said they seldom or almost never benefited from or accepted constructive feedback (item 40; *M* = 2.37, *SD* = 1.18).

Table 4.25

*FrSBe Self-Report Results, T-scores*

| Variable | *n* | % | Mean | *SD* | Median | Range |
|---|---|---|---|---|---|---|
| Apathy Scale | | | 65.67 | 20.61 | 62.0 | 34 – 124 |
| Clinically Significant | 24 | 47.1 | | | | |
| Disinhibition Scale | | | 58.14 | 21.87 | 54.0 | 29 – 139 |
| Clinically Significant | 13 | 25.5 | | | | |
| Executive Dysfunction Scale | | | 71.02 | 24.34 | 66.0 | 28 – 140 |
| Clinically Significant | 29 | 56.9 | | | | |
| Total Score | | | 69.84 | 26.58 | 64.0 | 28 – 160 |
| Clinically Significant | 25 | 49.0 | | | | |

*Note.* Scores ≥ 65 are classified as clinically significant.

*Correlations*

An examination of correlations between Trail Making Test performance and sample characteristics revealed a moderate-strength, inverse relationship between visual scanning (Trail 1) and length of homelessness ($r$ = -.41); a similar relationship was found between visual scanning and self-reported neurological symptoms ($r$ = -.33). Age was also inversely related to visual scanning ($r$ = -.27). Ethnicity was found to be moderately correlated with number-letter switching (Trail 4; $r$ = .40), as was length of homelessness ($r$ = -.26). A complete listing of correlations can be found in Table 4.26.

Table 4.26

*Correlations: Sample Characteristics and Trail Making Test Performance*

| | Test Variable[a] | | | | |
|---|---|---|---|---|---|
| Variable | 1-Scanning | 2-Number | 3-Letter | 4-Switching | 5-Speed |
| Age[a] | -.27 | -.07 | -.05 | -.22 | -.17 |
| Ethnicity[b] | .09 | .09 | .19 | .40 | .17 |
| Education (yrs)[a] | .18 | .13 | .25 | .16 | .12 |
| Cumulative Days Homeless[a] | -.41 | -.14 | -.07 | -.26 | .03 |
| Last Meal (hrs)[a] | -.01 | .05 | .07 | .07 | .13 |
| No. Head Injuries[c] | -.25 | -.25 | -.17 | -.19 | -.17 |
| No. Mental Health Dx[a] | -.05 | -.01 | -.13 | .07 | .07 |
| TAAD Alcohol Dx[d] | .10 | -.13 | -.02 | .01 | .10 |
| TAAD Drug Dx[d] | .16 | .28 | .18 | .22 | .18 |
| No. Medical Problems[a] | -.20 | -.02 | -.04 | .02 | -.04 |
| No. CNS Medications[a] | .01 | .16 | .22 | .20 | .05 |
| No. Services Utilized[a] | .12 | .04 | -.11 | .04 | .15 |
| No. Sleep Problems[e] | -.21 | -.17 | -.03 | .09 | .03 |
| No. Neurological Problems[e] | -.33 | -.10 | -.09 | .00 | .11 |
| No. Adaptive Beh. Problems[e] | -.08 | .18 | .10 | .04 | .14 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

An examination of relationships between sample characteristics and Fluency Test performance, outlined in Table 4.27, revealed medium-sized, inverse correlations between age and letter fluency ($r$ = -.35), and length of homelessness and letter fluency ($r$ = -.29). Conversely, positive correlations were found between drug use diagnosis and all fluency tasks ($r$s ranging from .31 to .42).

Table 4.27

*Correlations: Sample Characteristics and Verbal Fluency Test Performance*

| | Test Variable[a] | | | |
|---|---|---|---|---|
| Variable | Letter | Category | Switching Total | Switching Accuracy |
| Age[a] | -.35 | -.21 | -.12 | -.24 |
| Ethnicity[b] | .10 | .01 | .22 | .13 |
| Education (yrs)[a] | .24 | .07 | .11 | .09 |
| Cumulative Days Homeless[a] | -.29 | -.07 | -.02 | -.10 |
| Last Meal (hrs)[a] | .20 | .21 | .25 | .27 |
| No. Head Injuries[c] | .12 | .02 | .15 | .02 |
| No. Mental Health Dx[a] | .12 | .07 | .24 | .18 |
| TAAD Alcohol Dx[d] | .19 | .09 | -.09 | -.14 |
| TAAD Drug Dx[d] | .36 | .42 | .31 | .34 |
| No. Medical Problems[a] | .08 | .02 | .14 | .04 |
| No. CNS Medications[a] | .03 | -.05 | .14 | .09 |
| No. Services Utilized[a] | .24 | .15 | .23 | .17 |
| No. Sleep Problems[a] | -.05 | -.16 | .02 | -.02 |
| No. Neurological Problems[a] | -.04 | -.11 | -.03 | -.09 |
| No. Adaptive Beh. Problems[a] | .08 | .24 | .22 | .18 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

Relationships between Tower Test performance and demographic and background factors were primarily small or negligible. Medium-sized correlations were found with cumulative days homeless ($r$ = .26) and length of time since last meal ($r$ = .27). All correlations are listed in Table 4.28.

Table 4.28

*Correlations: Sample Characteristics and Tower Test Performance*

| Variable | Tower Test[a] |
|---|---|
| Age[a] | -.03 |
| Ethnicity[b] | .05 |
| Education (yrs)[a] | .16 |
| Cumulative Days Homeless[a] | .26 |
| Last Meal (hrs)[a] | .27 |
| No. Head Injuries[c] | .05 |
| No. Mental Health Dx[a] | -.14 |
| TAAD Alcohol Dx[d] | -.08 |
| TAAD Drug Dx[d] | .13 |
| No. Medical Problems[a] | -.06 |
| No. CNS Medications[a] | -.07 |
| No. Services Utilized[a] | -.03 |
| Sleep Problems[a] | .13 |
| Neurological Problems[a] | .21 |
| Adaptive Behavior Problems[a] | .08 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

In addition to DKEFS subtests, relationships between sample characteristics and FrSBe results were also examined; these results can be found in Table 4.29. Cumulative days homeless (*r*s ranging from .24 to .30), number of mental health disorders (*r*s ranging from .33 to .47), and number of services (*r*s ranging from .28 to .37) were all correlated with the FrSBe scales. Similar relationships were found between FrSBe scores and self-reported sleep problems (*r*s ranging .31 to .40), neurological problems (*r*s ranging .48 to .66), and adaptive behavior problems (*r*s ranging .44 to .50). Additionally, drug use disorder status was correlated with the Executive Dysfunction scale of the FrSBe (*r* = .25).

Table 4.29

*Correlations: Sample Characteristics and FrSBe Results*

| | FrSBe Scale[a] | | | |
|---|---|---|---|---|
| Variable | Apathy | Dis-inhibition | Executive Dysfunction | Total |
| Age[a] | .16 | .15 | .12 | .16 |
| Ethnicity[b] | .08 | .03 | .02 | .03 |
| Education (yrs)[a] | -.09 | -.18 | -.20 | -.19 |
| Cumulative Days Homeless[a] | .27 | .27 | .24 | .30 |
| Last Meal (hrs)[a] | .05 | .03 | -.02 | .02 |
| No. Head Injuries[c] | -.17 | .04 | -.17 | -.12 |
| No. Mental Health Dx[a] | .33 | .47 | .34 | .41 |
| TAAD Alcohol Dx[d] | -.10 | -.01 | -.11 | -.08 |
| TAAD Drug Dx[d] | .19 | .19 | .25 | .23 |
| No. Medical Problems[a] | .03 | .10 | -.11 | -.01 |
| No. CNS Medications[a] | .15 | .03 | .09 | .09 |
| No. Services Utilized[a] | .33 | .28 | .37 | .36 |
| No. Sleep Problems[a] | .37 | .40 | .31 | .40 |
| No. Neurological Problems[a] | .63 | .48 | .64 | .66 |
| No. Adaptive Behavior Problems[a] | .45 | .45 | .44 | .50 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

As both the DKEFS and the FrSBe aim to measure executive functioning, relationships between the DKEFS tests and FrSBe subscales were examined. Most correlation coefficients were negligible to very small, including those reflecting relationships between the DKEFS switching tasks (trails and fluency versions) and the Executive Dysfunction subscale. Similar results were found for the Tower Test. A full listing of these results can be found in Table 4.30.

Table 4.30

*Correlations: DKEFS Test Performance and Self-Rated Executive Functioning*

| | FrSBe Scale | | |
|---|---|---|---|
| Variable | AP | DI | ED |
| Trail 1, Visual Scanning | -.05 | -.19 | -.15 |
| Trail 2, Number Sequencing | .08 | -.10 | .07 |
| Trail 3, Letter Sequencing | .12 | -.17 | -.06 |
| Trail 4, Number-Letter Switching | .15 | -.10 | .05 |
| Trail 5, Motor Speed | .30 | .13 | .20 |
| Fluency 1, Letter Fluency | .02 | -.08 | -.07 |
| Fluency 2, Category Fluency | .08 | -.03 | -.04 |
| Fluency 3, Switching No. Correct | .07 | .02 | -.04 |
| Fluency 4, Switching Accuracy | .06 | -.01 | -.05 |
| Tower, Achievement Score | .11 | -.07 | -.01 |

*Note.* All variables are continuous; Pearson's *r* used for correlations. AP=Apathy subscale; DI=Disinhibition subscale; ED=Executive Dysfunction subscale

*Group Comparisons*

*Ethnicity.* African American and non-African American participants were compared in terms of performance on Trail 4, the Number-Letter Switching task. A Mann-Whitney *U* test was performed, and the result was statistically significant, $z = -2.78$, $p = .01$. African American participants obtained lower scores ($M = 74.58$, $SD = 19.94$) than did non-African American participants ($M = 90.00$, $SD = 16.47$).

*Drug use*. The Mann-Whitney *U* test was used to compare verbal fluency performance for participants who met criteria for a drug use disorder and those who did not. For all of the verbal fluency tasks, individuals who met criteria for a drug use disorder scored statistically significantly higher than did individuals who did not meet criteria. However, individuals with a drug use disorder obtained significantly higher scores on the Executive Dysfunction subscale of the FrSBe, compared to those who did not have a drug use disorder, $z = -2.50$, $p = .01$. Table 4.31 illustrates these results.

Table 4.31

*Drug Use Disorder Comparisons: Verbal Fluency Tests and Executive Dysfunction Scale*

| Variable | *M* | *SD* | *Mdn* | Range | *z* | *p* |
|---|---|---|---|---|---|---|
| Letter Fluency | | | | | -2.41 | .02 |
| No diagnosis (*n* = 23) | 89.13 | 15.57 | 90.0 | 55 – 115 | | |
| Drug Use Disorder (*n* = 28) | 101.79 | 17.33 | 105.0 | 70 – 130 | | |
| Category Fluency | | | | | -2.81 | .01 |
| No diagnosis (*n* = 23) | 88.70 | 16.67 | 90.0 | 55 – 115 | | |
| Drug Use Disorder (*n* = 28) | 104.46 | 17.45 | 102.5 | 75 – 140 | | |
| Switching, No. Correct | | | | | -2.22 | .03 |
| No diagnosis (*n* = 23) | 90.00 | 18.59 | 90.0 | 60 – 125 | | |
| Drug Use Disorder (*n* = 28) | 100.18 | 13.16 | 100.0 | 80 – 130 | | |
| Switching, Accuracy | | | | | -2.31 | .02 |
| No diagnosis (*n* = 23) | 98.91 | 17.84 | 100.0 | 65 – 135 | | |
| Drug Use Disorder (*n* = 28) | 110.00 | 13.68 | 110.0 | 85 – 140 | | |
| Executive Dysfunction | | | | | -2.50 | .01 |
| No diagnosis (*n* = 23) | 62.91 | 20.90 | 61.0 | 28 – 125 | | |
| Drug Use Disorder (*n* = 28) | 77.68 | 25.28 | 78.0 | 34 – 140 | | |

*Note.* Mann-Whitney *U* test used to compare groups.

*Construction Ability*

Construction abilities were assessed with the RCFT Copy task and the previously discussed Digit Symbol-Coding task (see Table 4.4). Results of the RCFT Copy task can be found in Table 4.32. In terms of time to complete the task, the majority of participants scored in the normal range (i.e., above the 16th percentile). Raw scores for accuracy in copying the figure were also classified into percentile categories, based on test manual procedures (Meyers & Meyers, 1995). The majority of participants (62.7%) were classified as impaired in copy accuracy (i.e., less than or equal to 16th percentile).

Table 4.32

*RCFT Copy Trial Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Copy, Time (sec) | | | 237.75 | 168.27 | 194.0 | 82 – 1145 |
| >16th percentile | 40 | 78.4 | | | | |
| 11-16th percentile | 2 | 3.9 | | | | |
| 2nd-5th percentile | 2 | 3.9 | | | | |
| < 2nd percentile | 7 | 13.7 | | | | |
| Copy, Raw Score | | | 29.19 | 5.97 | 30.0 | 10.5 – 36 |
| >16th percentile | 19 | 37.3 | | | | |
| 11-16th percentile | 6 | 11.8 | | | | |
| 2nd-5th percentile | 4 | 7.8 | | | | |
| < 2nd percentile | 22 | 43.1 | | | | |

*Correlations*

Comparisons between RCFT Copy and Digit Symbol-Coding performance were examined, as both tap graphomotor skills. A medium-size correlation between the two tests was found, $r = .32$. Coding scores were generally better than Copy accuracy scores.

Relationships between sample characteristics and Copy accuracy were also examined; these data can be found in Table 4.33. A medium-sized, positive correlation was found between ethnicity and Copy accuracy ($r = .30$), suggesting better performance for non-African American participants. Additionally, age ($r = -.26$) and cumulative days spent homeless ($r = -.27$) were both inversely related to Copy accuracy.

Table 4.33

*Correlations: Sample Characteristics and RCFT Copy Task Performance*

| Variable | Copy Time[a] | Copy Score[a] |
|---|---|---|
| Age[a] | -.21 | -.26 |
| Ethnicity[b] | -.16 | .30 |
| Education (yrs)[a] | -.09 | .21 |
| Cumulative Days Homeless[a] | -.04 | -.27 |
| Last Meal (hrs)[a] | -.07 | -.09 |
| No. Head Injuries[c] | .07 | -.06 |
| No. Mental Health Dx[a] | -.11 | .02 |
| TAAD Alcohol Dx[d] | .16 | -.05 |
| TAAD Drug Dx[d] | .02 | .18 |
| No. Medical Problems[a] | -.08 | -.09 |
| No. CNS Medications[a] | -.10 | .16 |
| No. Services Utilized[a] | -.21 | .05 |
| No. Sleep Problems[a] | -.17 | -.13 |
| No. Neurological Problems[a] | -.18 | -.16 |
| No. Adaptive Behavior Problems[a] | -.14 | -.20 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

*Group Comparisons*

Results of a Mann-Whitney *U* test found a significant difference between African American and non-African American participants on Copy accuracy, $z = -2.07$, $p = .04$. African American participants obtained scores in the moderately to severely impaired range ($M = 1.33$, $SD = 1.63$), while non-African American participants obtained scores in the mildly to moderately impaired range ($M = 2.44$, $SD = 1.93$).

## *Sensory and Motor Functioning*

Based on the Dean-Woodcock, most participants (62.7%, $n = 32$) were in the normal range in terms of overall motor-sensory functioning. However, motor task scores tended to be relatively lower than sensory task scores.

*Sensory Functioning*

Sensory functioning was assessed via the Object Identification and Finger Identification subtests of the Dean-Woodcock. The results of these tests are outlined in Table 4.34. Most participants performed in the normal range; however, performance on Object Identification-Left Hand was more variable, and over half of the sample obtained scores classified as impaired. An item analysis of this test found that one item, the candle, was correctly identified by 59% ($n = 30$) of the sample, which stood out in comparison to the other items (100% identified fork; 98% - key; 96% - scissors; 88% - nail; and 75% - nickel). Typical incorrect responses for the candle included “screw” and “crayon.”

Table 4.34

*D-WSMB Sensory Tests Results: W-Diff Scores and Impairment Categories*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Object Identification, Right Hand, W-Diff | | | -1.37 | 5.22 | 1.0 | -12 – 2 |
| Mildly Impaired to Within Normal Limits | 10 | 19.6 | | | | |
| Within Normal Limits | 41 | 80.4 | | | | |
| Object Identification, Left Hand, W-Diff | | | -6.24 | 9.77 | -7.0 | -38 – 4 |
| Moderately Impaired | 1 | 2.0 | | | | |
| Mildly Impaired | 10 | 19.6 | | | | |
| Mildly Impaired to Within Normal Limits | 17 | 33.3 | | | | |
| Within Normal Limits | 23 | 45.1 | | | | |
| Finger Identification, Right Hand, W-Diff | | | -3.27 | 8.33 | 1.0 | -38 – 1 |
| Moderately Impaired | 1 | 2.0 | | | | |
| Mildly Impaired | 6 | 11.8 | | | | |
| Mildly Impaired to Within Normal Limits | 6 | 11.8 | | | | |
| Within Normal Limits | 38 | 74.5 | | | | |
| Finger Identification, Left Hand, W-Diff | | | -1.59 | 8.99 | 1.0 | -59 – 1 |
| Severely Impaired | 1 | 2.0 | | | | |
| Mildly Impaired | 2 | 3.9 | | | | |
| Mildly Impaired to Within Normal Limits | 2 | 3.9 | | | | |
| Within Normal Limits | 46 | 90.2 | | | | |
| Overall Sensory Functioning, W-Diff | | | -3.12 | 5.88 | -1.5 | -34 – 2 |
| Severely Impaired | 1 | 2.0 | | | | |
| Moderately Impaired | 1 | 2.0 | | | | |
| Mildly Impaired to Within Normal Limits | 7 | 13.7 | | | | |
| Within Normal Limits | 42 | 82.4 | | | | |

*Note.* W-Diff scores are used for classification purposes. WNL = -6 and above; Mild to WNL = -7 to -13; Mild Impairment = -14 to -30; Moderate Impairment = -31 to -50; Severe Impairment = below -50.

*Motor Functioning*

Motor functioning results based on the Dean-Woodcock can be found in Table 4.35, and Grooved Pegboard results are outlined in Table 4.36. Performance on the motor tasks was generally within normal limits, with the exception of the Romberg task and Finger Tapping. Over half of the participants (51.0%) were classified as mildly impaired on Romberg. On Finger Tapping, over half of the sample performed in the impaired range for both the dominant and non-dominant hand trials. Similarly, on a more complex motor task, the Grooved Pegboard, over half of the sample scored below average, with over one-third performing in the extremely low range for both trials. Grip Strength, however, was largely within normal limits for most participants.

Table 4.35

*D-WSMB Motor Tests Results: W-Diff Scores and Impairment Categories*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Gait and Station, W-Diff | | | -10.33 | 12.37 | -9.0 | -45 – 3 |
| Moderately Impaired | 6 | 11.8 | | | | |
| Mildly Impaired | 12 | 23.5 | | | | |
| Mildly Impaired to Within Normal Limits | 11 | 21.6 | | | | |
| Within Normal Limits | 22 | 43.1 | | | | |
| Romberg, W-Diff | | | -12.45 | 14.67 | -16.0 | -38 – 26 |
| Moderately Impaired | 2 | 3.9 | | | | |
| Mildly Impaired | 26 | 51.0 | | | | |
| Mildly Impaired to Within Normal Limits | 7 | 13.7 | | | | |
| Within Normal Limits | 16 | 31.4 | | | | |
| Finger Tapping, Dominant Hand, W-Diff | | | -7.14 | 5.99 | -7.0 | -23 – 7 |
| Mildly Impaired | 7 | 13.7 | | | | |
| Mildly Impaired to Within Normal Limits | 20 | 39.2 | | | | |
| Within Normal Limits | 24 | 47.1 | | | | |
| Finger Tapping, Non-Dominant Hand, W-Diff | | | -9.67 | 6.08 | -9.0 | -28 – 1 |
| Mildly Impaired | 11 | 21.6 | | | | |
| Mildly Impaired to Within Normal Limits | 24 | 47.1 | | | | |
| Within Normal Limits | 16 | 31.4 | | | | |
| Grip Strength, Dominant Hand, W-Diff | | | -2.33 | 6.28 | -3.0 | -19 – 9 |
| Mildly Impaired | 2 | 3.9 | | | | |
| Mildly Impaired to Within Normal Limits | 9 | 17.6 | | | | |
| Within Normal Limits | 40 | 78.4 | | | | |
| Grip Strength, Non-Dominant Hand, W-Diff | | | -0.43 | 5.35 | 0 | -13 – 10 |
| Mildly Impaired to Within Normal Limits | 6 | 11.8 | | | | |
| Within Normal Limits | 45 | 88.2 | | | | |

Table 4.35, continued

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Overall Motor Functioning, W-Diff | | | -7.06 | 4.63 | -6.5 | -18 – 0 |
| Severely Impaired | 3 | 5.9 | | | | |
| Mildly Impaired | 6 | 11.8 | | | | |
| Mildly Impaired to WNL | 18 | 35.3 | | | | |
| Within Normal Limits | 24 | 47.1 | | | | |

*Note.* W-Diff scores are used for classification purposes. WNL = -6 and above; Mild to WNL = -7 to -13; Mild Impairment = -14 to -30; Moderate Impairment = -31 to -50; Severe Impairment = below -50.

Table 4.36

*Grooved Pegboard Test Results*

| Variable | *n* | % | *M* | *SD* | *Mdn* | Range |
|---|---|---|---|---|---|---|
| Dominant Hand Trial | | | | | | |
| Raw Score (sec) | | | 100.14 | 41.74 | 92.0 | 62 – 300 |
| Standard Score | | | 65.61 | 55.48 | 77.5 | < 0 – 111.6 |
| Extremely Low | 10 | 37.3 | | | | |
| Borderline | 8 | 15.7 | | | | |
| Low Average | 8 | 15.7 | | | | |
| Average | 15 | 29.4 | | | | |
| High Average | 1 | 2.0 | | | | |
| Non-Dominant Hand Trial | | | | | | |
| Raw Score (sec) | | | 114.82 | 50.42 | 96.0 | 65 – 300 |
| Standard Score | | | 57.82 | 60.82 | 76.0 | < 0 – 113.2 |
| Extremely Low | 22 | 43.1 | | | | |
| Borderline | 6 | 11.8 | | | | |
| Low Average | 4 | 7.8 | | | | |
| Average | 17 | 33.3 | | | | |
| High Average | 2 | 3.9 | | | | |

*Correlations*

Table 4.37 outlines correlations between various sample characteristics and performance on sensory and motor tasks. A medium-sized, positive correlation was found between years of education and sensory functioning ($r$ = .41). An examination of correlations between education and specific sensory tasks found that the strongest correlations were between education and finger identification-right hand ($r$ = .34) and finger identification-left hand ($r$ = .49). Correlations with object identification were smaller in comparison (object-right hand: $r$ = .19; object-left hand: $r$ = .15). In addition to sensory functioning, education was correlated with dominant hand Grooved Pegboard performance ($r$ = .25).

In addition to years of education, a moderate correlation was found between drug use diagnosis and sensory task performance ($r$ = .36). Similarly, the number of services a participant was utilizing was also correlated with sensory functioning ($r$ = .27). In terms of performance on the motor functioning tasks, inverse relationships were found between length of homelessness and various motor tasks ($r$s ranging from -.21 to -.26), as well as between number of mental health disorders and motor functioning ($r$ = -.26).

Table 4.37

*Correlations: Sample Characteristics and Sensory-Motor Test Performance*

| | Dean-Woodcock[a] | | Grooved Pegboard[a] | |
|---|---|---|---|---|
| Variable | Sensory | Motor | Dom | Non-Dom |
| Age[a] | -.19 | -.02 | -.15 | .06 |
| Ethnicity[b] | -.04 | 0 | -.04 | 0 |
| Education (yrs)[a] | .41 | -.17 | .25 | .06 |
| Cumulative Days Homeless[a] | .12 | -.22 | -.21 | -.26 |
| Last Meal (hrs)[a] | .01 | .09 | .10 | .04 |
| No. Head Injuries[c] | .10 | -.07 | .01 | -.01 |
| No. Mental Health Dx[a] | -.01 | -.26 | -.12 | -.03 |
| TAAD Alcohol Dx[d] | -.11 | .09 | 0 | .03 |
| TAAD Drug Dx[d] | .36 | 0 | .17 | .13 |
| No. Medical Problems[a] | -.01 | -.10 | -.03 | .07 |
| No. CNS Medications[a] | -.04 | -.14 | -.03 | 0 |
| No. Services Utilized[a] | .27 | -.12 | .17 | .10 |
| No. Sleep Problems[a] | .08 | -.06 | .03 | .11 |
| No. Neurological Problems[a] | -.01 | -.16 | .00 | .09 |
| No. Adaptive Behavior Problems[a] | .16 | -.09 | .01 | .04 |

*Note.* Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships. Point-biserial correlation used for dichotomous – continuous relationships. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

*Group Comparisons*

A Mann-Whitney *U* test found that participants who did not meet criteria for a drug use disorder (*M* = -5.41, *SD* = 7.48) evidenced more sensory impairment relative to those who did meet criteria (*M* = -1.23, *SD* = 3.19). This was a statistically significant difference, *z* = -2.58, *p* = .01.

## Post-Hoc Comparisons

Two grouping variables, ethnicity and drug use status, were found to be moderately to highly correlated with performance on several tests. Comparisons between African American and non-African American participants were presented in Chapter 3 (Table 3.3), with the only differences being number of self-reported medical problems and number of CNS medication currently prescribed. Specifically, non-African American participants reported more medical problems and more CNS medications than did African American participants.

Similar comparisons were performed to determine if differences existed between those participants who met criteria for a Drug Use Disorder (based on the TAAD) and those who did not. Mann-Whitney *U* tests were used to make these comparisons, and the results are provided in Table 4.38. The participants who did not meet criteria for a Drug Use Disorder were significantly older than those participants who did meet criteria for either Drug Abuse or Dependence (*z* = -2.68, *p* = .01). Further, those not diagnosed with a drug use disorder were taking more CNS medications (*z* = -2.08, *p* = .04) and reported fewer adaptive behavior problems (*z* = -2.25, *p* = .03) than participants who had met diagnostic criteria.

Table 4.38

*Comparisons Between Participants With and Without Drug Use Disorders (DUD)*

| | No DUD | | DUD | | | |
|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | *M* | *SD* | *z* | *p* |
| Age[a] | 50.22 | 6.64 | 43.21 | 9.25 | -2.68 | .01 |
| Ethnicity[b] | .61 | .50 | .46 | .51 | -1.02 | .31 |
| Education (yrs)[a] | 11.78 | 2.86 | 11.43 | 2.01 | -0.74 | .46 |
| Cumulative Days Homeless[a] | 506.22 | 721.69 | 616.14 | 867.15 | -0.73 | .47 |
| Last Meal (hrs)[a] | 15.02 | 27.50 | 14.25 | 11.30 | -1.03 | .30 |
| No. Head Injuries[c] | 2.00 | 1.31 | 1.75 | 1.24 | -0.62 | .53 |
| No. Mental Health Dx[a] | 1.65 | 1.95 | 2.61 | 2.25 | -1.84 | .07 |
| TAAD Alcohol Dx[d] | .70 | .47 | .61 | .50 | -0.65 | .52 |
| No. Medical Problems[a] | 1.52 | 1.47 | 0.96 | 1.17 | -1.26 | .21 |
| No. CNS Medications[a] | 1.39 | 1.56 | 0.54 | 0.96 | -2.08 | .04 |
| No. Services Utilized[a] | 3.43 | 1.90 | 3.82 | 1.68 | -0.72 | .47 |
| No. Sleep Problems[a] | 1.83 | 1.47 | 2.04 | 1.64 | -0.38 | .71 |
| No. Neurological Problems[a] | 2.48 | 2.33 | 3.32 | 2.58 | -1.29 | .20 |
| No. Adaptive Behavior Problems[a] | 2.35 | 2.23 | 4.21 | 3.08 | -2.25 | .03 |

*Note.* Mann-Whitney *U* test used to compare groups. [a]Continuous variable [b]Dichotomous variable: 0=African American, 1=Other [c]Ordinal variable: 0=none, 1=1, 2=2-3, 3=4-5, 4=more than 5 head injuries [d]Dichotomous variable: 0=no diagnosis, 1=abuse or dependence diagnosis

## Relationships Among Test Variables

Relationships among the cognitive tests, neuropsychological tests, and self-report symptom measures were examined, and the results can be found in Tables 4.39, 4.40, and 4.41.

Estimated IQ and reading ability (Table 4.39) were moderately to strongly related to performance on most of the neuropsychological tests, with the exception of motor functioning (IQ: $r$ = .12, WTAR: $r$ = .14) and non-dominant hand Grooved Pegboard performance ($r$ = .11). Test day symptomatology (Table 4.40) had negligible relationships with test performance; however, a few relationships did stand out. In particular, motor functioning was negatively correlated with both BAI ($r$ = -.47) and BDI ($r$ = -.35) scores.

Many moderate correlations were found among the neuropsychological tests (see Table 4.41). Tests measuring similar abilities (e.g., subtests of the DKEFS; WRAML2 and RCFT tests) were moderately correlated; for example, Letter-Number Sequencing and Digit Span were correlated at $r$ = .58. Other strong correlations were found between dominant hand Pegboard performance and sensory functioning ($r$ = .66), between the CPT-II Confidence Index and performance on Trail 1 (visual scanning; $r$ = -.51), and between the Verbal Memory Index and the letter fluency task (Fluency 1; $r$ = .53).

Table 4.39

*Correlations: Cognitive Ability and Performance on Select Neuropsychological Tests*

| | Cognitive Test | |
|---|---|---|
| Neuropsychological Test | WASI IQ | WTAR |
| Digit Symbol-Coding | .37 | .19 |
| Digit Span | .46 | .59 |
| Letter-Number Sequencing | .53 | .63 |
| CPT-II Confidence Index | -.49 | -.36 |
| WRAML2-Verbal Memory | .60 | .50 |
| WRAML2-Visual Memory | .31 | .31 |
| WRAML2-Screening Memory | .53 | .47 |
| RCFT-Immediate Recall | .23 | .33 |
| RCFT-Delayed Recall | .20 | .28 |
| Boston Naming Test | .45 | .61 |
| Trail 4-Switching | .33 | .30 |
| Fluency 4-Switch Accuracy | .33 | .22 |
| Tower Test | .19 | .30 |
| RCFT-Copy Score | .55 | .42 |
| Sensory Functioning Index | .37 | .39 |
| Motor Functioning Index | .12 | .14 |
| Grooved Pegboard, Dominant Hand | .26 | .27 |
| Grooved Pegboard, Non-Dominant Hand | .11 | .20 |

*Note.* All variables are continuous. Pearson's *r* used for correlations.

Table 4.40

*Correlations: Symptomatology and Performance on Select Neuropsychological Tests*

| | Measure | |
|---|---|---|
| Variable | BAI | BDI |
| Digit Symbol-Coding | -.22 | -.22 |
| Digit Span | .10 | -.05 |
| Letter-Number Sequencing | .04 | -.12 |
| CPT-II Confidence Index | .15 | .24 |
| WRAML2-Verbal Memory | .03 | -.08 |
| WRAML2-Visual Memory | .01 | -.20 |
| WRAML2-Screening Memory | .02 | -.17 |
| RCFT-Immediate Recall | .02 | -.02 |
| RCFT-Delayed Recall | .11 | .10 |
| Boston Naming Test | -.03 | -.15 |
| Trail 4-Switching | .10 | .10 |
| Fluency 4-Switch Accuracy | .01 | .05 |
| Tower Test | -.01 | -.05 |
| RCFT-Copy Score | -.16 | -.15 |
| Sensory Impairment Index | .02 | -.09 |
| Motor Impairment Index | -.47 | -.35 |
| Grooved Pegboard, Dominant | -.05 | -.09 |
| Grooved Pegboard, Non-Dominant | -.11 | -.08 |

*Note.* All variables are continuous. Pearson's *r* used for correlations.

Table 4.41

*Intercorrelations Among Neuropsychological Tests*

| Test | DS | LN | T1 | T2 | T3 | T4 | T5 | V1 | V2 | V3 | V4 | TW | SC | VR | VS | BN | CI | CP | IR | DR | SN | MT | PD | PN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CD | .28 | .40 | .42 | .40 | .41 | .33 | .40 | .47 | .27 | .16 | .26 | .18 | .39 | .41 | .31 | .09 | -.48 | .39 | .20 | .12 | .37 | .17 | .44 | .33 |
| DS | | .58 | .23 | .08 | .32 | .30 | .22 | .49 | .32 | .30 | .29 | .17 | .24 | .25 | .15 | .28 | -.33 | .36 | .09 | .07 | .22 | .08 | .11 | .04 |
| LN | | | .20 | .11 | .44 | .21 | .15 | .47 | .43 | .39 | .37 | .31 | .52 | .52 | .39 | .43 | -.38 | .33 | .28 | .26 | .38 | .09 | .24 | .13 |
| T1 | | | | .45 | .36 | .36 | .33 | .48 | .40 | .29 | .48 | -.09 | .26 | .31 | .22 | .15 | -.51 | .48 | .14 | .16 | .29 | .19 | .51 | .38 |
| T2 | | | | | .64 | .49 | .60 | .47 | .43 | .39 | .44 | .16 | .41 | .38 | .40 | .17 | -.26 | .47 | .39 | .39 | .33 | .29 | .48 | .52 |
| T3 | | | | | | .62 | .50 | .44 | .49 | .43 | .47 | .38 | .44 | .39 | .39 | .31 | -.35 | .50 | .56 | .55 | .25 | .25 | .34 | .33 |
| T4 | | | | | | | .55 | .48 | .33 | .38 | .44 | .25 | .34 | .28 | .34 | .08 | -.36 | .46 | .45 | .48 | .27 | .03 | .33 | .23 |
| T5 | | | | | | | | .45 | .37 | .32 | .35 | .21 | .34 | .26 | .37 | -.08 | -.26 | .42 | .36 | .41 | .19 | .23 | .40 | .28 |
| V1 | | | | | | | | | .71 | .45 | .52 | .12 | .50 | .53 | .38 | .28 | -.40 | .59 | .30 | .21 | .42 | .23 | .53 | .40 |
| V2 | | | | | | | | | | .64 | .73 | .07 | .44 | .46 | .33 | .27 | -.30 | .32 | .30 | .28 | .19 | .16 | .23 | .13 |
| V3 | | | | | | | | | | | .87 | .21 | .47 | .51 | .31 | .31 | -.28 | .34 | .44 | .50 | .34 | .22 | .27 | .26 |
| V4 | | | | | | | | | | | | .11 | .41 | .47 | .27 | .16 | -.26 | .37 | .36 | .40 | .27 | .18 | .29 | .22 |
| TW | | | | | | | | | | | | | .18 | .12 | .23 | -.03 | .00 | .05 | .15 | .21 | .38 | .13 | .25 | .18 |
| SC | | | | | | | | | | | | | | .84 | .87 | .45 | -.38 | .49 | .45 | .48 | .38 | .26 | .38 | .35 |
| VR | | | | | | | | | | | | | | | .48 | .52 | -.45 | .49 | .31 | .34 | .41 | .12 | .43 | .29 |
| VS | | | | | | | | | | | | | | | | .24 | -.24 | .40 | .47 | .50 | .35 | .30 | .37 | .40 |

Table 4.41, continued

| Test | DS | LN | T1 | T2 | T3 | T4 | T5 | V1 | V2 | V3 | V4 | TW | SC | VR | VS | BN | CI | CP | IR | DR | SN | MT | PD | PN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BN | | | | | | | | | | | | | | | | | -.32 | .21 | .29 | .26 | .05 | .25 | .18 | .22 |
| CI | | | | | | | | | | | | | | | | | | -.44 | -.23 | -.17 | -.29 | -.17 | -.33 | -.24 |
| CP | | | | | | | | | | | | | | | | | | | .51 | .48 | .27 | .16 | .53 | .39 |
| IR | | | | | | | | | | | | | | | | | | | | .91 | .26 | .18 | .35 | .40 |
| DR | | | | | | | | | | | | | | | | | | | | | .28 | .18 | .34 | .37 |
| SN | | | | | | | | | | | | | | | | | | | | | | .08 | .66 | .48 |
| MT | | | | | | | | | | | | | | | | | | | | | | | .25 | .47 |
| PD | | | | | | | | | | | | | | | | | | | | | | | | .82 |

*Note.* CD=Digit Symbol-Coding, DS=Digit Span, LN=Letter-Number Sequencing, T1=Trails Scanning, T2=Trails Number, T3=Trails Letter, T4=Trails Switching, T5=Trails Motor Speed, V1=Verbal Fluency Letter, V2=Verbal Fluency Category, V3=Verbal Fluency Switching Correct, V4=Verbal Fluency Switching Accuracy, TW=Tower Test, SC=WRML2 Screening, VR=WRML2 Verbal Index, VS=WRML2 Visual Index, BN=Boston Naming Test, CI=CPT-II Confidence Index, CP=RCFT Copy Raw Score, IR=RCFT Immediate Recall, DR=RCFT Delayed Recall, SN=Sensory Impairment, MT=Motor Impairment, PD=Grooved Pegboard Dominant Hand, PN=Grooved Pegboard Non-Dominant Hand. All variables are continuous, with the exception of ordinal variables IR and DR. Pearson's *r* used for relationships between continuous variables. $r_{RI}$, a special case of Pearson's *r*, used for ordinal – continuous relationships.

## Cluster Analysis

The technique of cluster analysis was employed in the final phase of data analysis. Cluster analysis, an exploratory tool, is used to group participants on the basis of shared characteristics; it differs from discriminant analysis, in which participants are assigned to pre-established groups (Kaufman & Rousseeuw, 1990). In this study, cluster analysis was used to explore whether adequate clusters, based on neuropsychological test performance, would emerge, or if one cluster, representing the entire sample, would be the best solution. No hypotheses were made regarding the number of clusters that would represent the best solution.

### *Clustering Procedures*

Cluster analysis was used to identify subgroups ("clusters") in the sample based on cognitive and neuropsychological test performance. Several analyses were run, using different combinations of variables, until the best solution was identified. This strategy is advised for cluster analysis, as it is an exploratory technique and non-inferential in nature (Hair et al., 2006). Decisions regarding the best solution are based on the size and meaningfulness of the clusters (Hair et al.). In the case of size, it is recommended that a cluster have enough cases to be meaningful, such as more than one or two members (Hair et al.). Further, each cluster should demonstrate high within-group similarity and high between-group dissimilarity (Hair et al., p. 559).

The data were first screened for outliers, as these can adversely affect the results of cluster analysis (Hair et al., 2006). Each variable to be included in the cluster analysis was screened using empirical methods for small sample sizes (Hair et al.). Any case with a standard score of 2.5 or greater was labeled as an outlier for the variable being

examined. Thirteen cases met outlier criteria for at least one test variable, and two cases were classified as outliers on several variables. However, given the descriptive nature of the study, the use of a non-random sample, and the small sample size, it was decided that all cases would be included in the cluster analysis. Further, it is important to retain outliers when they might represent actual groups that are underrepresented in the sample (Hair et al.).

Nearly all of the cognitive and neuropsychological test variables were included in the cluster analysis. Some variables were excluded because preliminary cluster analyses had resulted in poor solutions based on these data; for example, no adequate clusters were formed on the basis of WRAML2 Verbal or Visual Index scores. In this case, only the WRAML Screening Index was retained for cluster analysis. The final set of variables included the following continuous variables: (1) WASI IQ, (2) WTAR, (3) Digit Symbol Coding, (4) Digit Span, (5) Letter-Number Sequencing, (6) CPT-II Confidence Index, (7) Trail Making Test – conditions 1 through 5, (8) Verbal Fluency Test – conditions 1 through 4, (9) Tower Test, (10) WRAML2 Screening Index, (11) Boston Naming Test, (12) D-WSMB Sensory Functioning Index, (13) D-WSMB Motor Functioning Index, and (14) Grooved Pegboard – dominant and non-dominant hands. Several ordinal variables were also included: (1) RCFT Copy percentile category, (2) RCFT Immediate Recall percentile category, and (3) RCFT Delayed Recall percentile category. Most of the test variables used in the cluster analysis had previously been standardized for interpretive purposes. However, several variables used different types of scoring procedures (e.g., W-Diff scores for Dean-Woodcock subtests; CPT-II Confidence Index). These variables were standardized prior to being entered into the cluster analysis.

Several methods for conducting cluster analysis are available in SPSS (e.g., K-means, hierarchical). However, only the two-step clustering procedure is capable of handling both continuous and categorical variables. As both continuous and ordinal variables were included in the cluster analysis for this study, the two-step procedure was selected. In this procedure, cases are pre-clustered into many small sub-clusters (i.e., step one) and the resulting sub-clusters are then automatically clustered into several possible solutions, using the agglomerative hierarchical method (i.e., step two; Hair et al., 2006). An optimal cluster solution is also determined, based on Schwarz's Bayesian Information Criterion (BIC; Hair et al.; Kaufman & Rousseeuw, 1990), where smaller BIC values indicate better solutions. It is also possible to request a specified number of clusters in SPSS when using this method. However, given the exploratory nature of this study, the automatic method was used. Log-likelihood was used to measure similarity; this approach must be used when conducting two-step clustering with both categorical and continuous variables (Hair et al., 2006; Kaufman & Rousseeuw, 1990).

### *Cluster Analysis Results*

The results of the two-step cluster analysis included data for up to fifteen clusters. Analysis of the BIC values found that the smallest BIC value was associated with the two cluster solution (BIC = 7497.05). The one-cluster solution had the next smallest BIC value (7531.07), followed by the three-cluster solution (7602.05). Although the smallest BIC value represents the best model for the data, the two-cluster and three-cluster solutions were both examined in order to make a decision regarding the final cluster solution. Emphasis was placed on establishing between-cluster dissimilarity.

The two groups of the two-cluster solution (cluster 1: $n = 38$; cluster 2: $n = 13$) were first compared in terms of test performance. Mann-Whitney *U* tests were conducted to determine if the groups were statistically significantly different in terms of test performance. All comparisons were statistically significant, with the exception of Digit Span ($z = -1.92$, $p = .06$), the Tower Test ($z = -1.49$, $p = .14$), and the Boston Naming Test ($z = -1.57$, $p = .12$). The Kruskal-Wallis test was then used to compare the three groups of the three-cluster solution (cluster 1: $n = 22$; cluster 2: $n = 17$; cluster 3: $n = 12$) in terms of test performance. All of the omnibus tests were statistically significant, with the exception of Digit Span ($\chi^2$ (2, $n = 51$) = 3.09, $p = .21$), Trail Making Test – Condition 1 ($\chi^2$ (2, $n = 51$) = 4.84, $p = .09$), Tower Test ($\chi^2$ (2, $n = 51$) = 2.16, $p = .34$), and the Boston Naming Test ($\chi^2$ (2, $n = 51$) = 5.25, $p = .07$).

As the two-cluster solution had both the smallest BIC value and a greater number of statistically significant differences between clusters, it was selected as the final solution for the data. Results of the between-cluster comparisons for the two-cluster solution can be found in Table 4.42. A visual comparison of the two clusters, in terms of performance on the cognitive and neuropsychological tests, can be found in Figure 4.1. Based on these results, cluster one was labeled the “average group” and cluster two the “low average/impaired group.”

Table 4.42

*Comparison of Clusters on Cognitive and Neuropsychological Tests*

| | Cluster 1 ($n$ = 38) | | | Cluster 2 ($n$ = 13) | | | | |
|---|---|---|---|---|---|---|---|---|
| Test | *M* | *SD* | *Mdn* | *M* | *SD* | *Mdn* | *z* | *p* |
| WASI IQ | 97.55 | 16.54 | 97.0 | 84.38 | 11.51 | 83.0 | -2.53 | .01 |
| WTAR | 93.53 | 17.31 | 92.0 | 80.62 | 16.23 | 80.0 | -2.16 | .03 |
| Digit Symbol Coding | 86.32 | 8.60 | 85.0 | 74.62 | 4.31 | 75.0 | -4.66 | .00 |
| Digit Span | 95.26 | 13.35 | 95.0 | 86.92 | 8.30 | 90.0 | -1.92 | .06 |
| Letter-Number Sequencing | 96.32 | 15.45 | 95.0 | 84.23 | 9.09 | 90.0 | -2.47 | .01 |
| CPT-II Confidence Index[a] | 62.23 | 17.04 | 60.9 | 86.49 | 17.16 | 97.8 | -3.64 | .00 |
| WRAML Verbal Index | 91.95 | 10.40 | 91.0 | 76.54 | 9.82 | 77.0 | -3.80 | .00 |
| WRAML Visual Index | 85.55 | 12.04 | 86.5 | 70.00 | 8.59 | 73.0 | -3.74 | .00 |
| WRAML Screening Index | 86.61 | 10.26 | 87.0 | 70.00 | 7.90 | 72.0 | -4.28 | .00 |
| RCFT-Immediate Recall[b] | 2.58 | 1.59 | 3.0 | 0.23 | 0.83 | 0.0 | -4.38 | .00 |
| RCFT-Delayed Recall[b] | 2.50 | 1.57 | 3.0 | 0.23 | 0.83 | 0.0 | -4.61 | .00 |
| Trail 1 | 99.61 | 12.86 | 100.0 | 86.92 | 17.51 | 95.0 | -2.41 | .02 |
| Trail 2 | 100.13 | 11.83 | 100.0 | 72.31 | 13.33 | 75.0 | -4.71 | .00 |
| Trail 3 | 98.03 | 14.36 | 100.0 | 66.92 | 11.46 | 70.0 | -4.75 | .00 |
| Trail 4 | 90.13 | 16.21 | 95.0 | 61.15 | 10.64 | 55.0 | -4.52 | .00 |
| Trail 5 | 103.82 | 8.34 | 105.0 | 85.38 | 16.64 | 90.0 | -3.94 | .00 |
| Fluency 1 | 101.58 | 15.30 | 105.0 | 80.00 | 13.84 | 80.0 | -3.69 | .00 |
| Fluency 2 | 103.03 | 16.09 | 100.0 | 80.77 | 16.05 | 80.0 | -3.62 | .00 |
| Fluency 3 | 100.92 | 13.80 | 100.0 | 80.00 | 13.84 | 80.0 | -3.80 | .00 |
| Fluency 4 | 110.66 | 12.42 | 110.0 | 88.46 | 16.12 | 90.0 | -3.92 | .00 |
| Tower Test | 98.55 | 11.91 | 97.5 | 91.54 | 14.20 | 90.0 | -1.49 | .14 |

Table 4.42, continued

| | Cluster 1 ($n$ = 38) | | | Cluster 2 ($n$ = 13) | | | | |
|---|---|---|---|---|---|---|---|---|
| Test | *M* | *SD* | *Mdn* | *M* | *SD* | *Mdn* | *z* | *p* |
| Boston Naming Test | 81.58 | 28.53 | 91.1 | 66.12 | 36.17 | 70.3 | -1.57 | .12 |
| RCFT-Copy[b] | 2.45 | 1.78 | 3.0 | 0.38 | 1.12 | 0.0 | -3.37 | .00 |
| Sensory-Motor Index[c] | -4.06 | 2.78 | -3.5 | -8.09 | 5.10 | -8.6 | -2.90 | .00 |
| Pegboard, Dom Hand | 80.89 | 20.41 | 81.1 | 20.94 | 92.95 | 62.8 | -2.85 | .00 |
| Pegboard, Non-Dom Hand | 73.89 | 35.99 | 83.1 | 10.85 | 90.61 | 38.7 | -2.64 | .01 |

*Note.* All scores are presented as standard scores ($M$ = 100, $SD$ = 15), with the exception of CPT Confidence Index, RCFT-Immediate Recall, RCFT-Delayed Recall, RCFT-Copy, and Sensory-Motor Index. [a]The Confidence Index is a percentage, indicating likelihood of attention-related problems; lower scores are better. [b]RCFT data represent means of ordinal variables, where 0 = <2nd percentile, 1 = 2nd – 5th percentile, 2 = 6 – 10th percentile, 3 = 11 – 16th percentile, and 4 = >16th percentile. [c]The Sensory-Motor Index score is interpreted as follows: -6 and above = within normal limits; -7 to -13 = mildly impaired to within normal limits; -14 to -30 = mildly impaired; -31 to -50 = moderately impaired; and below -50 = severely impaired. Mann-Whitney $U$ test used to compare groups.

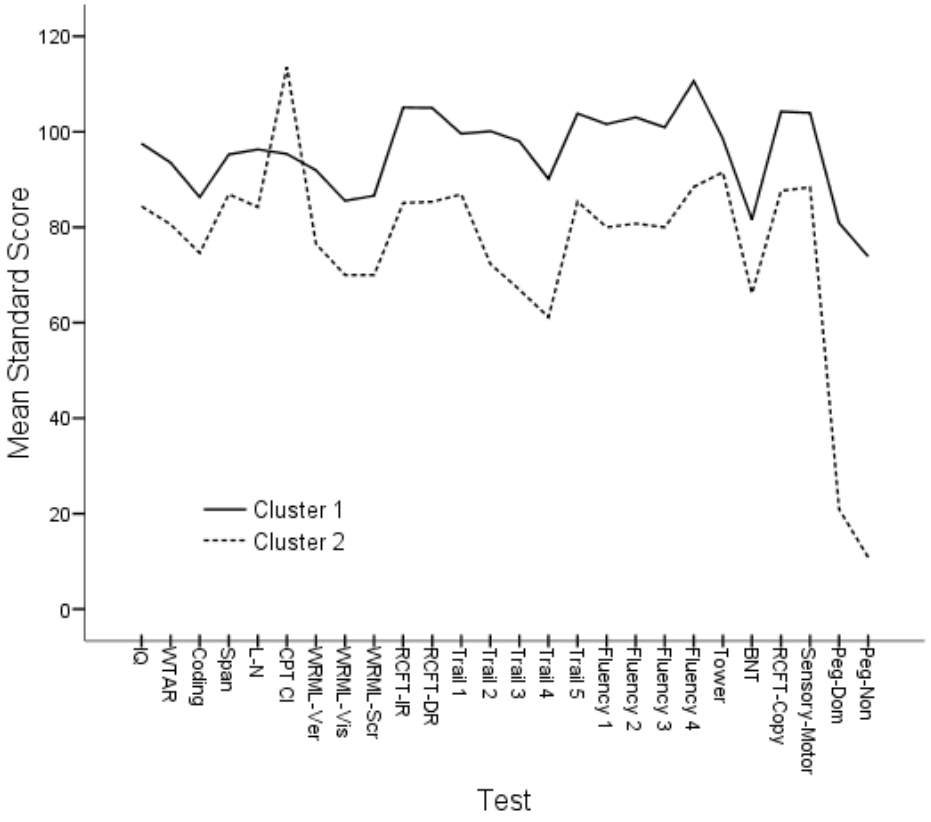


*Figure 4.1.* Comparison of Cluster 1 (*n* = 38) and Cluster 2 (*n* = 13), in terms of performance on cognitive and neuropsychological tests. Higher CPT Confidence Index (CI) scores indicate poorer performance. L-N = Letter-Number Sequencing; Ver = Verbal Index; Vis = Visual Index; Scr = Screening Index; BNT = Boston Naming Test; Dom = dominant hand; Non = non-dominant hand.

## *Quantitative Description of Clusters*

### *Importance of Variables*

Variablewise importance plots for the two clusters were examined, to determine which variables, if any, were statistically significantly important in differentiating each cluster. A 95% confidence level was selected to determine statistical significance. For cluster one ("average" group), scores for dominant-hand Grooved Pegboard, Trail Making Test – Condition 2 (number sequencing), Trail Making Test – Condition 5 (motor speed), Trail Making Test – Condition 3 (letter sequencing), and Trail Making Test – Condition 4 (number-letter switching) were all significantly important in differentiating the cluster. For all variables, scores were in the positive direction (i.e., higher scores). Dominant-hand Grooved Pegboard performance made the largest contribution to differentiating cluster one.

For cluster two, scores for Trail Making Test – Condition 4 (number-letter switching), Digit Symbol-Coding, Trail Making Test – Condition 3 (letter sequencing), WRAML2 Screening Index, Trail Making Test – Condition 2 (number sequencing), Verbal Fluency – Condition 1 (letter fluency), and Verbal Fluency – Condition 3 (category switching) were all statistically significant contributors to differentiating the cluster. The first three variables (Trails 4, Coding, and Trail 3) were of equal importance and had the largest contribution. All of the contributing variables were in the negative direction (i.e., lower scores). Additionally, RCFT – Immediate Recall and Delayed Recall made significant contributions to differentiating cluster two.

### *Demographic and Background Characteristics*

Tables 4.43 and 4.44 provide comparisons of the two groups on a variety of demographic and background characteristics. For continuous variables (Table 4.43), Mann-Whitney *U* tests were conducted to evaluate whether the groups were statistically significantly different on the various variables. Chi-square tests, using the continuity correction, were conducted to compare the clusters on categorical variables (Table 4.44).

The only statistically significant difference found between the groups was in regards to ethnicity. The low average/impaired cluster had a greater proportion of African American participants than did the average cluster ($z = 4.74$, $p = .03$).

Table 4.43

*Comparison of Clusters on Demographics, Background Characteristics, and Symptoms (Continuous Variables)*

| | Cluster 1 ($n$ = 38) | | | Cluster 2 ($n$ = 13) | | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | *Mdn* | *M* | *SD* | *Mdn* | *z* | *p* |
| Age | 45.29 | 9.17 | 46.0 | 49.54 | 7.14 | 48.0 | -1.33 | .18 |
| Education (yrs) | 11.70 | 2.25 | 11.0 | 11.27 | 2.89 | 12.0 | -0.29 | .78 |
| Days Homeless | 516.68 | 614.97 | 281.0 | 712.38 | 1,209.32 | 125.0 | -0.45 | .65 |
| Last Meal (hrs) | 15.00 | 22.68 | 13.5 | 13.42 | 9.27 | 16.0 | -0.76 | .45 |
| No. MH Dx | 2.13 | 2.07 | 1.5 | 2.31 | 2.46 | 1.0 | -0.08 | .94 |
| No. Med Problems | 1.26 | 1.35 | 1.0 | 1.08 | 1.32 | 0.0 | -0.56 | .58 |
| No. CNS Meds | 1.11 | 1.39 | 0.0 | 0.38 | 0.96 | 0.0 | -1.90 | .06 |
| No. Services Used | 3.68 | 1.58 | 4.0 | 3.54 | 2.33 | 2.0 | 0.62 | .54 |
| No. Sleep Problems | 1.97 | 1.50 | 2.0 | 1.85 | 1.77 | 1.0 | -0.41 | .68 |
| No. Neuro. Problems | 2.79 | 2.21 | 2.0 | 3.38 | 3.23 | 2.0 | -0.23 | .82 |
| No. Adapt. Beh. Prob. | 3.50 | 2.65 | 3.0 | 3.00 | 3.51 | 2.0 | -0.97 | .33 |
| BAI | 12.42 | 10.19 | 9.5 | 14.23 | 13.98 | 12.0 | -0.14 | .89 |
| BDI | 18.24 | 12.68 | 18.0 | 19.46 | 16.03 | 12.0 | -0.07 | .95 |
| Apathy | 65.95 | 17.86 | 66.0 | 64.85 | 28.02 | 60.0 | -1.08 | .28 |
| Disinhibition | 57.29 | 16.00 | 56.0 | 60.62 | 34.55 | 50.0 | -0.89 | .38 |
| Exec. Dysfunction | 70.16 | 20.91 | 65.5 | 73.54 | 33.33 | 71.0 | -0.10 | .92 |

*Note.* Mann-Whitney *U* test used to compare groups. Apathy, Disinhibition, and Executive Dysfunction are subscales of the FrSBe.

Table 4.44

*Comparison of Clusters: Demographics, Background Characteristics, and Symptoms (Categorical Variables)*

| | Cluster 1 (*n* = 38) | | Cluster 2 (*n* = 13) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | *n* | % | *n* | % | $z^1$ | *df* | *p* | Cramér's *V* |
| Ethnicity | | | | | 4.74 | 1 | .03 | .35 |
| African American | 14 | 36.8 | 10 | 76.9 | | | | |
| Non-African Amer. | 24 | 63.2 | 3 | 23.1 | | | | |
| Alcohol Use Status | | | | | 0.54 | 1 | .46 | .15 |
| No Diagnosis | 15 | 39.5 | 3 | 23.1 | | | | |
| Abuse/Dependence | 23 | 60.5 | 10 | 76.9 | | | | |
| Drug Use Diagnosis | | | | | 2.90 | 1 | .09 | .28 |
| No Diagnosis | 14 | 36.8 | 9 | 69.2 | | | | |
| Abuse/Dependence | 24 | 63.2 | 4 | 30.8 | | | | |
| Head Injuries | | | | | 0.23 | 1 | .63 | .13 |
| None | 7 | 18.4 | 1 | 7.7 | | | | |
| ≥ 1 | 31 | 81.6 | 12 | 92.3 | | | | |
| Shelter Episodes | | | | | 0.23 | 1 | .63 | .12 |
| Current Only | 10 | 26.3 | 5 | 38.5 | | | | |
| Multiple | 28 | 73.7 | 8 | 61.5 | | | | |
| Outdoor Episodes | | | | | 0.00 | 1 | 1.00 | .01 |
| None | 12 | 31.6 | 4 | 30.8 | | | | |
| ≥ 1 | 26 | 68.4 | 9 | 69.2 | | | | |

[1]Chi-square test with continuity correction

### *Qualitative Description of Impaired Group*

The "low average/impaired" group was small, relative to the size of the "average" group. The thirteen participants in the former group had some similarities, in terms of presentation and back-story, yet there were also some unique cases. In the following section, qualitative descriptions of selected participants in the low average/impaired group will be provided. All names are fictional.

#### *Statistical Outliers*

Within the impaired group, there were three statistical outliers in the negative direction on at least one test. One of these cases, "Roger," was an outlier on five tests, specifically Digit Symbol-Coding, Letter-Number Sequencing, Tower Test, overall sensory-motor impairment, and dominant hand Grooved Pegboard. Another individual, "Stan," obtained BNT and non-dominant hand Grooved Pegboard scores that were significantly below the impaired group average. These cases will be described in turn.

"Roger" was different from the other participants in several ways. He was the oldest participant in the study at 61 years old and had the fewest years of education (3 years). He identified himself as being White. Although Roger's reported history of 2-3 head injuries was not outside the norm for this study, his description of the injuries and their timing stood out from the other participants' experiences. He reported three serious head injuries between the ages of 7 and 9 years, and he did not recall receiving medical attention for any of them. Based on Roger's report, his injuries led to the discontinuation of his schooling. He had used marijuana in the 1960s and 70s and currently met criteria for Alcohol Dependence. Roger's history of homelessness was not extensive. He had stayed in a shelter once before and had spent a few nights outside. At the time of testing,

Roger stated that he had recently suffered an injury to his left (dominant) hand. It was difficult to understand him; his voice was soft and he often mumbled. He tended to make comments that were off-topic during testing and answered many questions by saying "it could be anything." Roger's test session lasted over four hours, the longest of any participant.

"Stan" had a different back-story than Roger, and presented differently as well. Stan was one of the younger participants in the study (age 38) and had completed a few semesters at a community college. He identified himself as Black. He also reported 2-3 head injuries in his lifetime; they occurred during his adult years and involved minor incidences of falling down. Stan had used alcohol and marijuana in the past, but did not meet criteria for a substance use disorder. He did, however, meet criteria for a psychotic disorder but was not taking any medication at the time of the study. Stan had a long history of homelessness; he described himself as being somewhat of a drifter for the past decade. He appeared disheveled and wore two winter coats at all times, including during his October test session. His speech was also soft and difficult to understand, and he often gave vague answers about his background. However, many of his test answers were very clear.

*Other Cases*

Although not statistically different from the remainder of the group, there were some participants who stood out in their presentation or history. For example, "Aaron," a 48-year-old African American man, was very tired throughout the session and needed several breaks in order to stay alert. In addition, he was extremely obese and had difficulty walking. Aaron reported that he was a "slow learner" as a child and had been

involved in special education programming. Further, he had one of the more extensive homelessness histories of all participants. “Earl,” a 44-year-old African American man, was similar to Aaron in that he reported being tired throughout the test session. He said he experienced dizziness when he became tired. In addition, Earl reported a kidney disorder and a history of 4-5 head injuries. He had completed 9 years of school and possessed a GED, and reported receiving some “tutoring” in school.

“Caleb” was another participant in the impaired group. He was a 58-year-old African American man who reported that he had been a boxer as a teenager. Caleb said that he suffered several head injuries that included loss of consciousness during his boxing years. He also said he had been born premature, had been involved in special education programming, and left school after the 10$^{th}$ grade.

Another individual, “Gary,” a 45-year-old Caucasian man, had serious difficulty with his balance and scored extremely low on object identification, gait and station, and Romberg tests. These difficulties were reportedly new and had caused Gary to lose his job. Weeks after his test session, Gary reported that was able to see a neurologist, and that his test results suggested problems with his cerebellum or possibly multiple sclerosis.

Finally, “Frank” had a different type of presentation than other participants. Frank was a 58-year-old African American man. His speech was observed to be slurred, as if he were intoxicated. He reported that many people had told him that his speech had changed, and he was unsure of why this was happening. He denied being under the influence of drugs or alcohol, and the shelter staff would not have allowed him to stay if he had been. Frank also reported feeling “unbalanced.” He was impulsive during the test session,

jumping in to start a test before the directions had been given. Frank also reported two head injuries, one 10 years ago and another as a child.

# CHAPTER V
# DISCUSSION

Understanding the causes of homelessness is a complex endeavor. It involves examining the interaction of external factors, such as high unemployment rates and limited availability of low-cost housing (Milwaukee Continuum of Care, 2007; Koegel, Burnam, & Baumohl, 1996; The United States Conference of Mayors – Sodexho, Inc., 2006) and internal factors such as substance misuse and mental illness (Koegel et al., 1996; Koegel, Sullivan, Burnam, Morton, & Wenzel, 1999; Reardon, Burns, Preist, Sachs-Ericsson, & Lang, 2003; Silver & Felix, 1999; Toro et al., 1995). Regardless of how an individual becomes homeless, he or she is vulnerable to neuropsychological impairment for a variety of reasons. For example, the risk of physical assault and traumatic brain injury is high (Silver & Felix, 1999), and the likelihood of receiving adequate medical attention for injuries and medical conditions with neuropsychological sequelae (e.g., diabetes, HIV/AIDS) is low (Falk, 2006; Silver & Felix, 1999). There are several implications for service delivery when considering the possibility of neuropsychological impairment in this population. However, before recommendations can be proposed, it is necessary to understand the extent of the problem.

Despite the importance of understanding the issue of neuropsychological functioning of homeless individuals, only a handful of studies in this area exists (Cotman & Sandman, 1997; Douyon et al., 1998; Duerksen, 1995; Foulks et al., 1990; Gonzalez et al., 2001; Lo, 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004; Zlotnick et al., 1995). Further, the past five years have seen no new information added to our understanding of this issue. Results of these studies have been mixed, due to variations in

the domains under investigation, the particular tests that were used, and sample characteristics. Tentative conclusions from this small body of literature suggest that at least some homeless individuals evidence impairments in attention/concentration and memory. However, some domains of functioning have received scant attention, such as language and sensory-motor functioning.

The purpose of the current study was to describe the neuropsychological functioning of a sample of men who were residing at the Guest House of Milwaukee (GHOM), a homeless shelter and comprehensive social services agency. In the sections that follow, the results of this study will be summarized, interpreted, and examined in light of prior research. Limitations of the study will also be discussed, and clinical implications and recommendations for future research will be explored.

## Summary of Results

When looking at the performance of the sample on the various cognitive and neuropsychological tests, the picture that emerges includes average intellectual abilities, low average reading abilities, mild difficulties with sustained attention and concentration, visual memory, and cognitive flexibility, as well as major difficulties in language ability, fine motor control, balance, and coordination. However, results of a cluster analysis found two distinct subgroups within the sample based on neuropsychological test performance. Therefore, the neuropsychological functioning of each group will be discussed separately.

### *Average Group*

The majority of participants were classified into the “average” cluster; mean test scores for this group were generally in the average range, including in the domains of

intellectual ability, reading ability, short-term attention span, working memory, verbal memory, and certain aspects of executive functioning. Areas of low average performance for this group included visual memory (based on the WRAML2), sustained and selective attention, language, and fine motor control (dominant hand). In terms of difficulties, participants in this group demonstrated impairment in construction ability, visual memory based on the RCFT, and non-dominant hand fine motor control. The primary factor that differentiated this group from the low average/impaired group was participants' relatively good performance in fine motor control (i.e., Grooved Pegboard – dominant hand). Participants in the average group were also distinguished from those in the other group by their good performance on tasks involve complex visual scanning, attention, motor speed, and cognitive flexibility (i.e., Trail Making Test).

The average group appears to represent those shelter residents whose neuropsychological functioning is generally intact, but with some important caveats. It is notable that the lowest scores for this group were on tests that are sensitive to general cognitive slowing, diffuse brain dysfunction, and mild brain damage (i.e., RCFT, Digit Symbol-Coding, Grooved Pegboard). For example, although performance on the Grooved Pegboard test was better for this group compared to the low average/impaired group, it was nevertheless in the low average range. Further, scores on Digit Symbol-Coding were in the low average range; this test is sensitive to brain damage of varying causes, even when the damage is minimal (Lezak et al., 2004). The recall trials of the RCFT are similarly sensitive to mild neuropsychological impairment (Lezak et al.).

Therefore, despite their adequate performance on several tests, the individuals in the average group evidenced subtle impairment in neuropsychological functioning. Their

difficulties appear to be largely related to mild deficits in prefrontal cortex functioning. Possible explanations for this pattern of results include chronic substance abuse, mild traumatic brain injury, or the early stages of a disease process such as dementia (Lezak et al., 2004). The fact that verbal abilities for this group were in the average range and higher-order aspects of attention were diminished suggests a decline in functioning associated with an acquired condition.

*Low Average/Impaired Group*

A much smaller second group, labeled "low average/impaired," exhibited a pattern of test results that bore some resemblance to the average group. However, scores were essentially shifted downward across the board, with few exceptions (e.g., Tower Test). Participants in this group scored in the low average range in several domains, including intelligence, reading, attention/concentration (based on Digit Span and Letter-Number Sequencing), and verbal fluency. Borderline functioning was found in visual and verbal memory (based on the WRAML2) and attention/concentration (based on Coding). Areas of extremely low functioning included cognitive flexibility based on the Trail Making Test, sustained and selective attention, language, and fine motor control. In addition, visual memory (measured by the RCFT) and construction ability were severely impaired. Performance on tests of cognitive flexibility, psychomotor speed, and sustained attention differentiated the low average/impaired group, with individuals in this group evidencing impairment in all of these areas.

This small group of individuals appears to represent shelter residents who are experiencing serious deficits in cognitive and neuropsychological functioning. It does not appear that these deficits are due to age-related decline, as the clusters did not differ

significantly in terms of mean age. Participants' poor performance across all tests (to varying degrees) suggests diffuse brain damage; however, prefrontal cortex damage is specifically implied by the difficulties with executive functioning and higher-order attentional abilities. This could be explained by moderate traumatic brain injury, a series of mild brain injuries, severe and chronic alcohol abuse, or a combination of injury and substance use. Alternatively, some individuals in this group might have had premorbid conditions such as mental retardation, which would have affected their performance on a range of tests. The pattern of results also bears resemblance to the decline seen in individuals with dementia (e.g., Alzheimer's), such as deficits in visual and verbal memory, verbal fluency, selective attention, cognitive flexibility, and construction ability (Lezak et al., 2004).

The lack of significant differences between the two clusters in terms of self-reported head injuries and medical conditions, substance use disorders, and psychological disorders makes it difficult to suggest reasons for the poor performance of individuals in the low average/impaired group. It is possible that individuals in this group were unable to provide accurate historical information, or that factors other than those asked about in the interview are involved. Regardless of etiology, there are important implications and recommendations for service delivery with both groups; these will be discussed later in the chapter.

### *Other Group Differences*

In addition to the two groups identified through cluster analysis, significant differences between other subgroups were found. The primary example of this was the difference in performance between African American and non-African American (mostly

Caucasian) participants. Statistically significant differences on several tests were found, and in all instances, non-African American participants obtained better scores, suggesting fewer neuropsychological difficulties and less impairment in functioning. In addition to ethnicity, differences between individuals diagnosed with a Drug Use Disorder and those not diagnosed were found, with diagnosed individuals generally obtaining better test scores. These differences will be examined later in this chapter.

## Interpretation of Results

The results of the present study were largely consistent with previous research into the neuropsychological functioning of homeless individuals. However, differences were found in a few specific domains, namely language and executive functioning. In the following sections, comparisons with prior research will be made and explanations for specific findings will be discussed.

### *Neuropsychological Domains*

#### *Cognitive Functioning*

In the current study, intellectual ability for the sample was estimated to be in the average range, similar to prior research with a sample of men from the Guest House of Milwaukee (Solliday-McRoy et al., 2004). Other studies have reported low average IQs among homeless participants (e.g., Seidman et al., 1997), a finding that coincides with the performance of the low average/impaired group in the present study. However, participants in the Seidman et al. study generally had severe mental health problems and limited educational backgrounds compared to participants in the present study, as well as compared to participants in the impaired group.

Findings regarding the reading abilities of homeless men in this study also coincided with previous research (O'Neil-Pirozzi, 2003; Seidman et al., 1997; Solliday-McRoy et al., 2004), lending weight to the idea that reading difficulties – ranging from mild problems to illiteracy – seem to be common in this population. Further, reading ability was directly related to performance on several neuropsychological tests in this study. This had not been reported in previous research.

*Attention and Concentration*

Performance in the area of immediate attention span was similar to previous studies (Cotman & Sandman, 1997; Foulks et al., 1990; Gonzalez et al., 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004), in that it varied with the nature of the task. The pattern of higher scores on an auditory attentional task (Digit Span) relative to scores on a visual-motor attentional task (Digit Symbol-Coding) found in this study coincides with prior research (Seidman et al., 1997). As in the present study, others have reported average-range scores on Digit Span (Cotman & Sandman, 1997; Foulks et al., 1990; Seidman et al., 1997; Solliday-McRoy et al., 2004) and borderline to low average scores on Digit Symbol-Coding (Gonzalez et al., 2001; Seidman et al., 2004) among homeless individuals.

Together, these studies suggest that short-term attention span may be normal among shelter residents, and that lower scores on certain attention tests may be due to task demands (e.g., adequate visual-motor ability). Alternatively, the relatively higher scores on auditory attention span tasks may be explained in part by the demands of shelter life. Shelter residents typically have limited access to materials (e.g., pens, calendars, cell phones) used for keeping notes, lists, and reminders; therefore, they must

find ways to remember orally presented information without relying on such materials. Therefore, performance on a test such as Digit Span might reflect the honing of this skill set.

However, complex attentional abilities may be impaired in this population. Results of previous studies have been mixed in regards to sustained and selective attention (Cotman & Sandman, 1997; Duerksen, 1995; Foulks et al., 1990; Gonzalez et al., 2001; Lo, 2001; Seidman et al., 1997). The present study found that over half of participants had significant difficulties with sustaining and shifting attention; participants in the low average/impaired group were particularly likely to evidence impairment in these skills. This coincides with prior research using similar tests (Cotman & Sandman, 1997; Seidman et al., 1997). Other studies have reported good performance on selective attention tasks (Duerksen, 1995; Foulks et al., 1990), which may be explained by sample characteristics, such as higher levels of education and intellectual ability (Foulks et al., 1990).

In general, data from this study supplement previous findings regarding impairment in aspects of attention that rely on the functioning of the prefrontal cortex and its connections with other brain regions (e.g., posterior parietal cortex for visuospatial selective attention). As previously mentioned, there are several possible causes of prefrontal cortex damage, such as traumatic brain injury, chronic substance abuse, or progressive brain disease. Age was also related to performance on attention tests; however, age-related cognitive decline alone cannot explain the findings of this study, as individuals in the low average/impaired cluster evidenced more attentional impairment

than those in the average group, yet they were not significantly older. It seems likely that the deficits in attention among participants are due to a confluence of factors.

*Memory*

The existing literature on memory ability among homeless individuals generally points to low average to average performance in verbal memory and below average to impaired performance in visual memory (Cotman & Sandman, 1997; Duerksen, 1995; Lo, 2001; Seidman et al., 1997; Solliday-McRoy et al., 2004). A similar pattern of results was found in the present study. For example, results of the RCFT for this study were very similar to those reported by Solliday-McRoy and colleagues, with both indicating impairment in immediate and delayed visual memory. This may be explained by the nature of the visual memory tasks.

The visual memory tasks of the RCFT and WRAML2 – in comparison to verbal memory tasks – are challenging and novel, tapping into executive and attentional abilities as well as memory ability. Research suggests that performance on RCFT recall tasks is partially dependent on strategies employed during the copy trial (e.g., Newman & Krikorian, 2001), and good performance on the copy task requires sustained concentration, attention to detail, and conceptual thinking skills. Individuals who fail to first conceptualize the complex figure as a whole and then fill in the details have difficulty with recalling the figure (Newman & Krikorian). As previously discussed, participants tended to have deficits in complex attention skills, which would negatively affect encoding during the copy trial and subsequently lead to recall difficulties. Therefore, the visuospatial memory impairments found among participants may actually be a manifestation of attention deficits, again suggesting damage to the prefrontal cortex.

In comparison, verbal memory tasks, such as remembering a story or list of words read aloud, are similar to situations encountered in daily life and performance tends to be linked to general verbal ability (Lezak et al., 2004). These tasks may have been "easier" for some participants, compared to the visual tasks.

It is also possible that performance on visual memory tasks was negatively affected by the graphomotor element of such tasks. This would be particularly true for the RCFT, which requires adequate visual-motor/graphomotor skills, in addition to memory capabilities. Visual difficulties, such as would be the case for participants who did not have access to corrective lenses, could also have compromised performance on these tasks. Therefore, it is possible that the visual memory deficits found in this study were due to attention deficits, task demands, or a combination of these.

*Language*

Prior to the present study, very little research had been done on the language functioning of homeless individuals, and the existing data suggested functioning was generally within normal limits (Gonzalez et al., 2001; Lo, 2001). This differs greatly from the results of the BNT in the present study. However, due to potential confounding influences – namely reading ability and educational background – the impairments found in the current study are likely misleading. Others have acknowledged the potential for misdiagnosing dysnomia when using available norms to interpret scores obtained by participants with below average vocabulary and/or educational achievements (e.g., Hawkins & Bender, 2002). This, it is possible that language functioning among homeless men in this study was in the normal range, although further research is needed before

making this conclusion. The influence of race/ethnicity on BNT performance found in this study is also of concern and will be discussed later.

*Sensory-Motor Functioning*

As with language, the availability of information regarding the sensory and motor functioning of homeless individuals was limited prior to the present study. Deficits had been found in manual dexterity (Lo, 2001) and motor speed (Seidman et al., 1997), as well as cerebellar functioning (Douyon et al., 1998). Similar results were found in this study, although results of the Grooved Pegboard test indicated more severe impairment than had been reported in previous studies.

The finding of poor fine motor control across the entire sample stood out when compared to performance in other domains of neuropsychological functioning. Possible explanations include the presence of injuries, the effects of long-term substance abuse, or signs of diffuse brain damage. For those participants who had physical injuries (e.g., missing fingertips, nerve damage) low scores on the manual dexterity tasks would not necessarily be interpreted as signs of neuropsychological impairment. However, such injuries were infrequently observed among participants and do not fully explain the findings. Chronic alcohol use may provide a better explanation, as alcohol affects the cerebellum, and thus fine motor control and coordination (Lezak et al., 2004; Rains, 2002). Further, research has established a relationship among long-term alcohol use, structural brain changes, and diminished fine motor control (Sullivan, Rosenbloom, Lim, & Pfefferbaum, 2000). Alcohol abuse was common among participants in this study, although relationships between alcohol use and performance on motor functioning tasks were rather small. This may be due to the manner in which substance use was assessed,

which will be explored in further detail later. Finally, in addition to providing information about fine motor control, tasks such as the Grooved Pegboard are sensitive to general cognitive slowing. This slowing could be due to diffuse brain dysfunction, such as that seen following head injury, or disease progression. These factors might also explain participants' performance on motor tasks.

This study also added to the literature by exploring sensory functioning; no prior research had been done in this area. Sensory functioning appeared to be intact for nearly all participants; however, the results indicate a need for further research, as low scores on some sensory tasks may have been due to lack of familiarity with test materials (e.g. birthday candle on Object Identification) or poor number ability (i.e. for Finger Identification).

*Executive Functioning*

Findings regarding executive functioning are somewhat difficult to compare with previous research, as different tests were used to assess abilities in this domain. The results of prior studies had indicated difficulties in cognitive flexibility, abstract reasoning, and planning (Duerksen, 1995; Lo, 2001; Seidman et al., 1997). Low scores in these areas were particularly evident among participants in the Seidman et al. study; as mentioned previously, participants in this study had serious mental health concerns and low educational attainments. Although somewhat higher functioning and more educated than participants in the Seidman study, the low average/impaired group in the present study also scored extremely low on cognitive flexibility tasks. Participants in this group also had difficulty with verbal fluency tasks, particularly when the task was relatively unstructured. In comparison, participants in the average group performed adequately on

executive functioning tasks. It is possible that the graphomotor element of one of the tasks could explain the low scores obtained by the low average/impaired group, as they obtained extremely low scores in fine motor control. However, these results could also be explained by frontal cortex damage, especially when considering the pattern of deficits found across several domains.

*Overall Functioning*

The pattern of results obtained in this study strongly points to dysfunction the attentional system, and in particular the "top-down" component of this system, involving the frontal lobes and their role in selective attention, response inhibition, cognitive flexibility, and divided attention. Deficient functioning of this system can manifest as impairment in memory and executive functioning, also found in this study. This explanation may best fit for the low average/impaired group, as the average group evidenced fewer difficulties with memory and executive functioning. There are several possible causes of frontal deficits, including traumatic brain injury, disease processes, and the effects of chronic substance abuse. Other than these acquired conditions, it is possible that some participants had long-standing cognitive disabilities, such as mental retardation.

There also appear to be indicators of diffuse brain damage among some participants in this study, perhaps as a result of prior head injuries, disease processes, chronic substance abuse, or a combination thereof. It is also possible that some participants are evidencing early signs of cognitive decline associated with dementia or other neurological disorders. Additionally, the motor deficits observed in this study suggest that damage to the cerebellum has occurred for some participants, perhaps due to severe, chronic alcohol abuse.

## *Relationships with Test Performance*

The neuropsychological findings of this study were generally in line with previous research, but data analyses revealed relationships that had not been obtained or discussed in prior studies. These will be discussed in turn.

### *Demographic/Background Factors*

In this study, very few demographic or background factors were related to test performance. Notable exceptions were race/ethnicity, drug abuse/dependence, number of CNS medications, and length of homelessness. Prior research had suggested that neuropsychological test performance might be negatively affected by substance abuse (e.g., Brust, 2004; Knight & Longmore, 1994), certain forms of psychopathology (e.g., Basso & Bornstein, 1999; Marenco & Weinberger, 2001; Martin et al., 1991; Silverstein et al., 2002), malnutrition (Silver & Felix, 1999), untreated medical conditions (Silver & Felix, 1999), and traumatic brain injury (e.g., Lezak et al., 2004). Although substance abuse, mental health problems, head injuries, and medical illnesses were prevalent among participants, these factors were minimally linked to test performance. A departure from this conclusion includes the finding that alcohol use was linked to poorer delayed visual memory. In addition, poorer performance in mental processing was correlated with having more head injuries, and having more mental health disorders was linked to lower scores in certain attention tasks and confrontational naming. However, in all cases these correlations were small to moderate. Further, the presence of *more* alcohol problems, head injuries, or mental health disorders was sometimes related to *better* test performance.

There are several possible explanations for why factors such as alcohol abuse and psychopathology were not strongly related to poorer test performance. Foremost among these is the fact that most background variables in this study relied on self-report. For various reasons this information might be inaccurate. One of the concerns with self-report is the possibility of underreporting, due to embarrassment, denial, lack of insight, or misunderstanding the question (e.g., Babor, Steinberg, Anton, & Del Boca, 2000). Thus, the extent of substance misuse and mental health symptoms among participants may be greater than what is reflected in the data presented here. This may explain the low correlations between such factors and test performance.

An alternate explanation for this finding is the extent to which substance use was assessed. Drug and alcohol use disorder diagnoses (for both the eMINI and TAAD) were based on participants' use of substances over the past year, as opposed to lifetime use. Therefore, it is possible that a participant with a history of heavy alcohol abuse would not have met criteria for Alcohol Dependence if he had maintained abstinence for longer than one year. The relationship between diagnostic status and test performance, as a result, does not fully capture the possible effects of long-standing substance abuse on neuropsychological functioning. A similar issue applies to mental health diagnoses, as the questions on the diagnostic interview were geared primarily toward current symptoms. A participant might not have met criteria for a mental health diagnosis if his symptoms were being successfully treated with psychotropic medications, or if he had a prior history of mental illness that had since resolved. However, the influence of these past or currently managed conditions on neuropsychological functioning may still be relevant.

Another hypothesis regarding these findings deserves mention. The capacity to accurately report on one's past and current symptoms or behaviors requires a certain degree of self-awareness, as well as adequate memory ability. Those participants who were capable of accurately responding to questions regarding substance use (e.g., amount, frequency, reasons, and consequences) or mental health symptoms are perhaps also those with average to above average mental capacities. This could potentially explain the findings regarding head injuries as well; participants who could provide details about previous injuries (e.g., when they occurred, length of loss of consciousness, etc.) may have had good cognitive and neuropsychological functioning pre-injury and thus would have retained certain abilities post-injury. It is interesting to note that more head injuries was related to better scores in the domains of reading and language functioning – which are verbal in nature and more likely to be preserved post-head injury – and poorer scores in mental processing speed, a domain of functioning commonly affected after a closed-head injury (Lezak et al., 2004).

In sum, limitations related to self-report and the nature of substance use assessment may explain the lack of meaningful correlations between certain background factors and test performance. Additionally, some relationships were negligible due to the small number of participants who endorsed certain symptoms or problems. The primary example of this was medical conditions. Few participants reported having diabetes, liver disease, or Hepatitis C, making it difficult to examine the degree to which these conditions affected neuropsychological functioning across the sample. In the case of malnutrition, most participants were getting free meals at local churches or social service agencies, and although the nutrition value of these meals is unknown, it was clear that

participants were not severely malnourished. Although relationships between these variables and neuropsychological functioning did not emerge in this study, other interesting and unexpected relationships did, and they merit further discussion.

*CNS Medications*

The relationship between CNS medications and test performance requires some examination. In several cases, taking a greater number of CNS medications was linked to better test scores. One possible explanation for this involves the level of functioning or self-advocacy abilities of participants who reported taking one or more CNS medication (typically an antidepressant). The ability to obtain medical benefits, make medical appointments, and fill prescriptions requires adequate planning, organization, and memory skills, as well as basic literacy. In fact, participants taking one or more CNS medication were involved in more professional and community services than were participants taking no such medications. Further, reading ability was moderately related to quantity of CNS medications. Thus, individuals capable of navigating the social service system and obtaining needed services would perhaps be expected to perform well on cognitive and neuropsychological tests, and the CNS medication variable may actually be a marker for level of functioning, general cognitive ability, and "system savviness."

A second explanation is also possible. Those participants who were taking several CNS medications may have been better able to focus during the test session due to the positive effects of the medications (e.g., fewer symptoms of anxiety or depression). Research by Borkowska, Araszkiewicz, Rajewski and Rybakowski (2002) supports this idea; in their study, individuals with schizophrenia evidenced improved performance on tests of executive functioning following short-term risperidone treatment. However, it

remains to be seen how participants in the present study would have performed had they not taken their prescribed CNS medications, as they were only requested to refrain from taking drugs for attention and concentration problems, such as Ritalin. However, the idea that CNS medications could help improve neuropsychological functioning among homeless men with psychiatric diagnoses is an interesting one that merits further consideration.

*Drug Use Disorders*

The difference in test performance between participants diagnosed with a drug use disorder and those not diagnosed – with diagnosed participants performing better in the domains of attention and verbal fluency – needs further explanation. In looking at the two groups, it appears that age could explain the differential performance on selected neuropsychological tests. Specifically, participants who met criteria for a drug use disorder were significantly younger than those who did not. Age-related decline in cognitive processing, psychomotor speed, and other aspects of fluid intelligence, thus, may explain the differences found between these groups. Further, current drug use was moderately related to better sensory functioning, which could also be a reflection of the age difference between these groups.

*Race/Ethnicity*

Another unexpected group difference found in this study was between African American and non-African American participants. Significant differences were found specifically in estimated intellectual ability, reading, attention/working memory, verbal and visual memory, and language functioning. In all of these domains, non-African American participants outperformed African American participants. The reason for these

differences is somewhat unclear, as both groups were similar in terms of age and years of education, as well as a number of other background factors. The only ways in which African American and non-African American participants differed was in current CNS medications and medical problems, with African Americans taking fewer CNS medications and reporting fewer medical concerns. It was previously suggested that the CNS medications variable could serve as a marker of high functioning or ability to traverse the social service system, as well as general cognitive/reading ability. If African American and non-African American participants actually differ in this particular way – in addition to differences in neuropsychological test performance – then potential reasons for such a difference must be explored.

First, it is important to note that performance in the domains of attention, working memory, verbal memory, visual memory, and language functioning was moderately to strongly related to IQ and reading ability. This was particularly true for language functioning, assessed via the BNT. In all cases, having and adequate or above average IQ and/or reading ability was linked to better test scores. In the present study, non-African American participants attained significantly higher IQ and reading scores compared to African Americans. Thus, differences in intellectual and verbal ability – as opposed to attention, memory, and other aspects of neuropsychological functioning – may explain the pattern of results for these two groups.

However, it remains to be seen *why* African American participants obtained lower IQ and reading scores than non-African American participants. There were no differences in the years of education completed between the two groups, although African American participants' educational achievements tended to cap out around high school. None of the

African American participants had completed a post-high school degree; in comparison, non-African American participants' achievements were more variable, and few reported not achieving at least a GED. Therefore, variations in educational experiences could explain the differential performance on IQ and reading tests. However, these differences in educational achievement were not statistically significant, and the fact remains that both groups completed, on average, approximately 11-12 years of education.

Other explanations, such as the influence of socioeconomic status on educational achievement, different life experiences, and culture bias in testing, may explain the difference in test scores between African Americans and non-African Americans. Inadequate learning environments at home and in school, neighborhood poverty, and negative peer attitudes toward school achievement have all been linked to poor school performance and low IQ scores (e.g., see discussions in McLoyd, 1998 and Sattler, 2001). Unfortunately, race and culture intersect with these issues (for discussion of this, see Wilson, 2009). Research suggests that African American children are disproportionately exposed to severe economic disadvantage, compared to white and Latino children, and that these experiences result in diminished verbal abilities approximately equivalent to missing a year or more of school (Sampson, Sharkey, & Raudenbush, 2008). Although this research focuses on children, these factors can be assumed to have an ongoing influence on cognitive development and would presumably affect adults' cognitive and neuropsychological functioning.

It is possible that the African American participants in this study were differentially exposed to impoverished conditions in their formative years. The experiences available to an individual in a poverty-stricken, urban neighborhood can be

assumed to differ from those available to persons living in suburban or rural settings. For example, hammocks and trellises are perhaps infrequently found in poor, inner city neighborhoods, and therefore individuals from such an environment would have difficulty naming these items – as was seemingly the case with the Boston Naming Test in this study. Ethnic group differences in Boston Naming Test performance have been previously documented (e.g., Boone, Victor, Wen, Razani & Ponton, 2007; Whitfield, Fillenbaum, Pieper, Albert, Berkman, Blazer, et al., 2000), with Whites outperforming non-Whites. Although the Boston Naming Test appears to be a particular concern in terms of possible culture bias, ethnic group differences have been found with other neuropsychological tests (e.g., Digit Span, complex figure copy, Trails A; Boone et al., 2007). The influence of environmental, socioeconomic, and/or cultural factors on test performance has important implications for how the neuropsychological test scores obtained by ethnic minority participants are to be interpreted. Therefore, there are questions about the neuropsychological functioning of African American participants in this study, including whether they were actually more neuropsychologically impaired than were the non-African American participants.

*Length of Homelessness*

Finally, relationships between neuropsychological deficits and length of homelessness also emerged in this study. Specifically, more days spent homeless was related to poorer attention/concentration, reasoning ability, verbal memory, processing speed, cognitive flexibility, and motor functioning. Self-reported sleep problems, neurological symptoms, and adaptive behavior problems were all moderately correlated with duration of homelessness, as was incidence of head injuries. However, it is

impossible to know whether these symptoms are causes or consequences of homelessness. It is plausible that individuals with pre-existing neuropsychological deficits would be more likely to experience homelessness, perhaps due to difficulties with maintaining employment and housing. It is also possible that the longer one spends homeless, the more likely they are to experience head injuries and subsequent neuropsychological impairment. Further, being homeless is a stressful experience. Acute stressors, such as physical assault and muggings, are often superimposed on a baseline of chronic stress, due to the grinding effects of poverty and residential instability (e.g., Littrell & Beck, 2001; Silver & Felix, 1999). It is interesting to note that homelessness was not related to intellectual or reading ability; these abilities may be preserved in the face of stress, whereas other areas, such as attention and mental processing speed, would perhaps be more vulnerable to the effects of stress.

On the other hand, more days of homelessness was also linked to better performance on the Tower Test, a task that requires planful thinking. This could be explained by participants' prior experiences with hands-on activities (e.g., piecework in factory jobs; mechanical expertise) or the game-like nature of the task. However, it is also possible that participants with long histories of homelessness who volunteer to stay at a shelter – which involves following a list of rules and adhering to a schedule of activities – are among the higher functioning homeless individuals. Men at this particular shelter have frequently talked about the difficulties of being homeless (e.g., knowing who to trust, where to sleep, places to avoid, etc.), and it takes a certain amount of wit and wisdom to navigate life on the streets. Perhaps these skills showed themselves in the Tower Test.

## Limitations

Descriptive studies must address two key issues: detailing characteristics of the participants and accurately measuring the phenomenon or construct of interest (Grimes & Schulz, 2002; Heppner et al., 1999). Limitations can arise from either area. In this section, the particular limitations of the present study will be discussed.

### *Sample Issues*

One of the most important issues to be addressed in any descriptive study is the characteristics of the participants studied (Heppner et al., 1999). Related to this is the manner in which a sample is obtained. All participants in the present study were either self-referred or volunteered to participate after being referred by a Guest House staff member. It is likely that the individuals who volunteered were among the higher functioning of the shelter residents; they were perhaps better equipped to understand what would be expected of them, remember appointment times, and follow through on the commitment to participate. Certainly, random selection of participants could have improved the representativeness of the sample.

This concern seems evident in the finding that the “average” cluster consisted of over two-thirds of the sample. It is possible that shelter residents matching this type of profile were overrepresented in the sample. It is unknown if individuals matching the “impaired” profile actually comprise a minority of the shelter’s total population, or if, in fact, they represent a larger group that simply did not participate. Their lack of involvement could have occurred for various reasons, including unfamiliarity with research studies, inability to read posted signs or consent forms, and embarrassment about reading difficulties. Further, prior research at this shelter had found that some

residents are wary of service professionals due to past negative experiences (Hegerty et al., 2007). Although efforts were made to reach out to all shelter residents in order to obtain a diverse group of participants, the issue of representativeness remains. Consequently, the results of this study may not generalize to all men residing at the Guest House of Milwaukee.

Additionally, the findings of this study are not necessarily generalizable to homeless men in other settings (e.g., outdoor-dwelling; other types of shelters) or geographical locations. For example, homeless men in rural locations may have unique issues that could influence test performance. Further, the sample in the present study was comprised of primarily African American and Caucasian men, and thus the results do not necessarily generalize to homeless men of other racial, ethnic, or cultural backgrounds. Therefore, these results must be viewed cautiously and with attention to the context in which they were obtained. Finally, these results cannot be assumed to provide insight into the neuropsychological functioning of women or older adults (e.g., 65+) who are homeless.

### *Measurement Issues*

Although this study used a test battery designed to describe functioning in a wide variety of neuropsychological domains, some areas were screened as opposed to being extensively assessed. This was particularly the case for executive functioning. It would have been ideal to incorporate additional measures that would tap into subtle areas of executive functioning, or those with high ecological validity. However, the addition of such measures would have lengthened the test session, possibly limiting the number of residents who would have been able to participate. Residents typically had daily

schedules that included meetings with case managers, therapy sessions, medical appointments, job interviews, and so forth; this made it difficult for them to find "free time" for a 3-4 hour test session. Nonetheless, the information gleaned from additional measures would have proved useful for this study.

An additional concern regarding the measurement of neuropsychological functioning relates to alternative explanations for test scores. Poor performance on a neuropsychological test is generally interpreted as an indicator of impairment in the particular domain under examination. However, factors such as visual difficulties and physical injuries among participants, as well as the possibility of malingering or "faking bad," can complicate the interpretation of test scores.

Several participants in this study who reported needing corrective lenses did not have access to them. Typically, this was due to financial reasons (i.e., unable to afford an eye exam to obtain new glasses), but participants also reported that their glasses had been stolen. This was particularly the case for reading glasses. Although most of the tests used in this study did not involve reading small print – the reading test was in large print and rarely presented concerns for participants – it is possible that performance on some tests was negatively affected by unclear vision. Particular examples are the RCFT, the Picture Memory subtest of the WRAML2, and the Grooved Pegboard test. Some participants may have had difficulty with Gait and Station due to vision difficulties as well.

A similar concern involves the prevalence of physical injuries among participants. Commonly reported problems included arthritis, nerve damage, back problems (e.g., degenerated discs), and amputated fingers. Participants often reported that these injuries were work-related. Such injuries had a definite impact on motor test performance. In one

case, a participant struggled to complete the Grooved Pegboard test with his non-dominant hand because of a partially missing finger on that hand. His low score pointed to difficulties with manual dexterity, but this is perhaps better explained by physical impairments than by neuropsychological deficits. Hand injuries or arthritis may have also artificially lowered scores on tasks with a graphomotor element, such as Digit Symbol-Coding and the RCFT. The issues of visual difficulties and physical impairments raise the question of whether "true" neuropsychological impairment was being measured by some of the tests in this study.

Another factor influencing the validity of test results in this study is the possibility of malingering or "faking bad." This may have been done for various reasons, including a desire to qualify for entitlements or obtain shelter privileges (e.g. being able to stay indoors during the day due to a disability). Participants often elected to have a summary report sent to a shelter-based case manager, a counselor, or a psychiatrist; requests for contact with a disability case manager were rare, occurring only twice. Thus, it appears that few participants were motivated to perform poorly in order to obtain benefits. However, this does not minimize the possibility of "faking bad" for other purposes, such as garnering attention from the examiner or other shelter personnel. As no measure of malingering or faking bad was employed in this study, it is difficult to assess to what degree such behaviors affected participants' tests scores.

In all, there are several factors that may explain why participants obtained the test scores they did, and some of these factors may call into question the validity of the test scores. Of course, other explanations are also possible. Although an extensive background interview was conducted with each participant, there is always more

information that could be obtained. Examples are parents' educational background, specific information about medical history/head injuries, and more extensive information about substance use history (e.g., amount of use, blood alcohol levels). In addition, there is the issue of premorbid functioning. Without knowing more about this, no conclusion can be drawn regarding whether neuropsychological impairment preceded one's homelessness, or if homelessness itself contributed to difficulties with attention, memory, and so forth.

Despite these limitations, the results of this study are meaningful, in that they provide information about how participants performed on a series of cognitive and neuropsychological tests under the test administration conditions (Sattler, 2001). Further, these findings provide clues to why some homeless men evidence impairment in certain areas of neuropsychological functioning. Such information has value for clinicians and other service providers, as will be discussed in the following section.

## Implications and Recommendations

The present study was motivated by the belief that the more that is known about the unique needs, concerns, strengths, and limitations of people who are homeless, the more potent our interventions with this population can be. For example, psychotherapy and other types of psychosocial interventions – essentially learning situations that require attention, memory, problem solving, and abstract thinking (Fals-Stewart et al., 1994) – are likely to be ineffective if clinicians fail to consider the possibility of at least mild neuropsychological and cognitive deficits among homeless shelter residents. Further, homeless shelters could be designed to better meet the needs of people who require their services, and perhaps break the cycle of homelessness more effectively. In the sections

that follow, implications and recommendations for shelters and service providers working with the homeless will be discussed.

## *Recommendations for Homeless Shelters*

The results of this study have implications for how homeless shelters provide services to those needing them. These relate to services provided onsite (e.g., shelter programming) and shelter policies and procedures.

### *Menu of Services*

*Literacy services.* Shelters often provide onsite services, and the results of this study point to a variety of recommendations for services to include. For example, literacy classes and/or reading improvement courses would be a useful addition to the menu of services, as it appears that many shelter residents have below average reading skills. In addition, shelter staff should consider modifying the reading level of documents presented to residents, perhaps to a fifth-grade level. Assistance with reading documents, such as medical forms, consent forms, job applications, and rental agreements, is also recommended. Brief meetings to review important documents could be arranged; all residents would be invited to minimize any embarrassment they may have about their reading difficulties. The impact of these efforts could go a long way, as was evidenced during the course of this study. A participant, previously found to be functionally illiterate, approached the principal investigator with a stack of documents, stating that he did not understand what they meant or what he needed to do. He was urged to talk with his case manager and likely would have lost his Social Security benefits had it not been for the case manager's efforts. These situations can be avoided with the addition of a few minor changes in shelter practices.

*Vocational services.* It is also apparent from this study that fine motor control, balance, and coordination are areas of difficulty for some shelter residents. This has implications for employment opportunities, particularly because shelter residents typically apply for jobs in the labor or service sectors, as opposed to "white collar" jobs. In addition to making referrals to the Department of Vocational Rehabilitation, shelters could provide onsite vocational services, such as skills training, career counseling, and GED classes. Further, the psychological impact of residents' employment difficulties also needs to be recognized. Being unable to return to one's occupation can be a stressful experience for some; counseling referrals may be helpful in these situations.

*Stress management.* Shelter administrators might also consider adding stress management classes to the menu of services. Although this study cannot conclusively state that the stress of being homeless contributes to difficulties with attention, concentration, and mental processing, it would nevertheless be useful for service providers to address stress management in their work with this population. Shelter residents may not realize how harmful chronic stress is to their functioning, and thus they may not bring it up during therapy or case management sessions. Teaching residents how to monitor and manage stress could help in both the short term (e.g., better able to focus on goals) and long term (e.g., stress management as a relapse prevention tool).

*Neuropsychological assessment.* Homeless shelters often gather information on residents in order to identify the need for referrals, such as for drug counseling, psychiatric treatment, or medical care, but it is unknown how many offer neuropsychological screening or assessment to residents, whether onsite or via referrals to community agencies. The findings of this study suggest that there is a need for these

services. However, investing both the time and money required to complete a full neuropsychological evaluation may not seem worthwhile, considering that some shelter residents stay for only a short duration before moving on. The use of brief neuropsychological tests or screening batteries is one approach that shelters could take. This would provide shelter staff with information that could be pursued more extensively as needed.

However, brief screening instruments may not be designed to identify subtle deficits, making them less useful in terms of treatment planning and targeted case management than a full evaluation. Further, shelter staff would likely administer these brief tests, and they may not have the appropriate level of training to identify the need for further testing. Additionally, a full evaluation would come with specific recommendations for intervention or rehabilitation. Providing shelter residents with access to full neuropsychological evaluations would therefore be ideal. This could be done by creating partnerships with local psychology graduate programs or by identifying licensed clinicians in the community willing to provide pro bono services. The results of these evaluations could be used to develop highly individualized treatment plans, perhaps leading to better outcomes.

### *Shelter Practices*

*Sleeping accommodations.* Many participants in this study reported difficulties with falling and staying asleep, perhaps due to the nature of sleeping arrangements at the shelter (e.g., a large room full of small cots). Although sleep problems were not strongly linked to test performance, it is likely that other areas of functioning would be affected by such problems. Ideally, shelters should provide residents with a quiet, comfortable place

to get adequate sleep; however, the reality is that space is typically limited and the emphasis is placed on providing beds for as many persons as possible. Creative solutions may be needed to address this issue. Examples could include providing earplugs to block out noise from within the shelter or allowing residents to take naps during the day in a designated quiet room. While it would be appropriate for short-term emergency shelters to continue providing basic sleep accommodations for many people, those agencies aimed at ending the cycle of homelessness may want to consider providing quality sleep accommodations for a small group of individuals.

*Meals.* Participants in this study reportedly ate often, although the quality of their meals is questionable. These "meals" seemed primarily to consist of snacks available in the shelter (e.g., chips, cookies) or sandwiches and soup available at local churches. While participants' neuropsychological functioning did not appear to be related to meal regularity, it is possible that nutritional deficits affected their overall well-being and functioning. Although budget constraints would likely make it difficult to do so, shelters should provide residents with access to nutritious foods, perhaps through partnerships with local supermarkets or food banks.

*Shelter staff training.* Many people have misconceptions about the homeless. Neuroimaging research suggests that homeless people are perceived as less than human, and that they elicit feelings of disgust in others (Harris & Fiske, 2006). This stereotypical response may block empathic responses to homeless persons, as well as distort the conceptualization of how and why a person becomes homeless or continues to be homeless. While shelter staff may be less likely to have such preconceived ideas, they may not associate residents' behavioral problems with neuropsychological impairment.

Training staff on the basics of neuropsychology may help them frame missed appointments, underresponse to treatment, occupational problems, and other difficulties with activities of daily living as being related to deficits in attention, memory, motor skills, planning and goal-setting, and so forth. Taking such an approach may help residents feel better understood, which could improve their willingness to engage with the service system in general.

### *Other Homeless Subgroups*

Although this study focused on shelter residents, and generalizability is limited, it is likely that individuals who are in other homeless situations, such as living outdoors, also exhibit neuropsychological impairment. Perhaps such individuals are lower functioning and less capable of advocating for themselves or navigating the world of shelters and social service agencies. Perhaps they have more severe mental health and/or substance use problems. Outreach efforts with this subset of the homeless population also need to be tailored. For example, fliers and appointment cards are useless to individuals who cannot read. Similarly, outreach interventions may need to be brief and to the point, so as not to lose the audience's attention. Once such individuals enter a shelter or seek services at an agency, it would be important to keep in mind the possibility of memory difficulties and limitations in planning, organization, and goal setting. A slow, one-step-at-a-time approach may be best in some cases.

### *Group-Specific Recommendations*

The finding of two distinct subgroups in this study suggests the need for specific recommendations for each group. In the following section, specific recommendations for each of these groups will be discussed.

*Average Group*

The average group identified in this study via cluster analysis appears to represent male homeless shelter residents who are functioning adequately. There are a few areas of subtle impairment, such as in aspects of attention that rely on the functioning of the prefrontal cortex, but these individuals would not, on the surface, present as "impaired" – particularly in contrast to those in the low average/impaired group. Thus, they would seem to need little in the way of rehabilitation or specially tailored services.

However, homeless men with this particular profile could be in the early stages of cognitive decline. This implies that preventive efforts to stop or slow any additional damage from occurring would be beneficial, such as drug treatment and appropriate medical care. Lifestyle changes, such as establishing a regular sleep schedule and eating nutritious meals would also be of benefit. Further, rehabilitative interventions to address areas of difficulty would likely be more successful at this stage as opposed to waiting until the degree of impairment is more severe. An individualized approach to care with these men should also involve building upon existing strengths and providing access to learning opportunities, in order to build up cognitive resources for protective purposes. This approach could reduce the length and number of shelter stays, as well as minimize the likelihood of these men becoming chronically homeless.

This prevention-early intervention approach would also be useful for those men with mild deficits due to previous injuries or premorbid conditions, as opposed to progressive decline related to drug abuse or medical disease. By teaching these men skills to improve their neuropsychological functioning, they would be better equipped to manage the tasks of everyday life. For those involved in substance use and/or mental

health treatment, improvements in focus and concentration might translate into better medication compliance and fewer relapses. Addressing their difficulties now, rather than ignoring them, would perhaps make the path out of homelessness a more efficient one.

In order to identify whether a shelter resident would benefit from these efforts, shelters and other agencies working with homeless men would need to incorporate neuropsychological assessment as part of the intake process. This would provide a baseline against which future assessment results could be compared, allowing service providers to adjust the care plan as needed. This would be especially important for those men who are experiencing progressive decline. Interventions efforts could be increased as needs changed, perhaps reducing the number of homeless men who fall through the cracks of the service system.

The preventive approach not only benefits the client, but the service system as well. Investing resources and targeted care up front could help move these men out of the service system faster. Even if ties to the service system are maintained (e.g., continuing treatment after obtaining housing), the amount and intensity of services required would potentially be reduced. This translates into lower per-client expenditures, more time for service providers to manage complex cases (see next section), and a more efficient system overall. Further, it would be cost-effective to deal with minor problems now that could become major problems – and expensive ones – later.

*Low Average/Impaired Group*

The individuals in the low average/impaired group in this study represent a different male homeless shelter resident than just described. These men are evidencing significant neuropsychological impairment in a number of areas, which has implications

for daily functioning, such as the ability to obtain and maintain competitive employment and stable housing. An intensive, comprehensive system of care is recommended for men who exhibit this degree of impairment.

This system of care would involve multiple service providers and agencies working together to meet the needs of these men. A shelter-base case manager could serve as a central point of contact for the individual, coordinating communication with other providers and advocating for the client within the service system. Having this primary contact person located within the shelter would be ideal, as men could access the case manager without having to leave the building. Due to the difficulties in attention, memory, and executive functioning, case manager would ideally provide a "hand holding" approach with these clients, such as attending off-site appointments with the client, scheduling brief daily meetings, and reviewing all documents to ensure understanding. Further, case managers working with these men should be able to identify signs of neurological impairment, such as motor and sensory deficits, and make appropriate referrals for further examination.

Homeless men with this profile of neuropsychological impairment would likely be at risk of prematurely leaving the shelter or being asked to leave due to difficulties with following rules (e.g., keeping appointments, being on time for nightly check-in). Shelter staff should be aware of the possible reasons for a resident's forgetfulness or difficulty following rules and advocate for him when it comes to making the decision to discharge. Returning these men to the streets is not likely to solve the problem. This suggests that a Housing First approach (Tsemberis, Gulcur & Nakae, 2004) may be most beneficial for these men.

In the Housing First approach, homeless individuals with a dual diagnosis obtain stable housing prior to satisfying any particular treatment criteria. Tsemberis and colleagues (2004) cite an 80% housing retention rate when using this approach. A similar philosophy may benefit homeless men with neuropsychological impairment, whether or not they have existing substance use and/or mental health disorders. An individual with serious difficulties in planning, organization, and attention is likely to have a hard time independently directing his own path out of homelessness for any significant length of time. Further, expecting such an individual to exhibit behaviors that are consistent with a high-functioning person, and making housing dependent upon this expectation, would be unreasonable. Secure, supportive housing as the first step in the overall care plan would allow the individual to work with service providers on other goals aimed at improving quality of life.

## Recommendations for Shelter-Based Research

Conducting research within a homeless shelter can be a challenging, yet rewarding experience. Various concerns were encountered over the six months that were spent at GHOM, with one of the most important being residents' schedules. Perhaps surprisingly to some, shelter residents are often quite busy; their days are filled with various mandatory meetings within the shelter, off-site appointments, on- and off-site work obligations, and so forth. Further, nearly all residents get from one place to the next by public transportation or walking. Thus, finding an uninterrupted block of time to complete testing was often challenging.

In addition, residents at GHOM are not allowed to stay in the shelter during the day unless they are attending meetings or counseling sessions. This made recruitment a

challenge. To circumvent this, researchers made a habit of being onsite in the morning before residents left for the day, and in the evening after the mandatory check-in time. It was also important to have open communication with shelter staff, so that participants would not be reprimanded for being in the shelter on the day of testing. Further, examiners had to be mindful of shelter routines, such as the timing of morning chores, smoke breaks, and the distribution of sack lunches. These issues, however small, were essential for entering and becoming part of the shelter environment.

Entering the shelter environment not only involved establishing relationships with staff members and being mindful of shelter routines, but also having a regular presence within the shelter. Residents do not read all signs posted within the shelter, so it was not enough to provide the information and await responses. In fact, many residents had misconceptions about this research study based on their reading of the posters (e.g., believing that gift cards were simply being given out). The tactic used in this study was to be in the shelter on a regular basis, so that residents could ask questions about the study and sign up in person, as opposed to waiting for the shelter telephone to become available. Further, being in shelter on an almost daily basis meant that participants could easily be followed up with, which perhaps explains the high retention rate for this study.

Researchers interested in conducting a shelter-based study may want to consider these factors early in the project development process. Recommended actions to take include the following: (1) communicating with shelter administrators/staff about shelter rules and schedules and resident requirements; (2) determining whether adequate space is available for study activities, including storage of equipment, files, etc.; (3) locating a centralized area where information about the study can be posted; (4) establishing a

mailbox and/or office where residents can leave notes for researchers; (5) partner with at least one staff member who can help communicate information about the study to residents; (6) spend several hours per week at the shelter to talk with residents, answer questions, and do recruitment; and (7) vary the timing of on-site visits to coordinate with residents' schedules (e.g., some morning visits, some evening visits).

## Future Research

Although the present study adds to the literature on the neuropsychological functioning of homeless individuals, additional research in this area is still needed. In particular, data in the domains of language, motor-sensory, and executive functioning – domains that have received little attention thus far – are needed. In the case of language, further assessment may help clarify whether impairment in this area actually exists to the degree found in this study, or if poor scores on a test like the BNT reflect poor reading ability and/or lack of cultural knowledge. With executive functioning, further examination is needed to determine if subtle impairments exist in different facets of this domain, such as goal-directedness, planning, purposive action, and self-regulation. Participants' relatively good performance on the Tower Test suggests that planning and organizational skills may be a strength for some men in shelters, but additional research is needed to see if this holds true in other samples.

One of the difficulties encountered in this study was the occasional inadequacy of neuropsychological test norms for interpreting the sample's performance. Specifically, available norms often were based on standardization samples with relatively high education levels, reading ability, and/or IQ. This was particularly true for the RCFT, the BNT, and the Grooved Pegboard test. Participants' standardized scores were sometimes

in the negative when using even the best available norms. The development of additional norms for these and other neuropsychological tests would be of benefit to researchers and clinicians working with homeless individuals. Norms for different racial/ethnic or childhood SES groups would also be useful, as it appears that sociocultural factors are related to performance on some cognitive and neuropsychological tests.

Cognitive rehabilitation strategies to improve attention, problem solving, and other aspects of neuropsychological functioning might also be developed and empirically examined, to see if these could be useful additions to shelter programs. Similarly, tailored psychological interventions could be developed for systematic research. For example, a shelter-based treatment group might be designed to include a short psychoeducational segment, followed by a summary and application segment that "tests" clients' understanding of the information presented. This could be followed by a short break and a second review segment to consolidate clients' memories of the information. Such a program could be manualized and studied to determine its feasibility and utility for shelter residents.

Finally, the results of this study do not speak to the neuropsychological functioning of street-dwelling individuals, homeless women, and the elderly homeless. Further research with these subgroups of the homeless population is sorely needed.

## Conclusion

In conclusion, the purpose of this study was to describe the neuropsychological functioning of men residing in a homeless shelter. Research in this area has been limited, despite the likelihood of impairment in the shelter population. In the present study, a comprehensive battery of tests was administered to a group of men residing at The Guest

House of Milwaukee, a social service agency providing emergency shelter, case management services, and substance abuse treatment. The results suggest that many men residing in the shelter exhibit at least mild difficulties with reading, sustained and selective attention, fine motor control, balance/coordination, and cognitive flexibility. In addition, there appears to be a subset of shelter residents who evidence moderate to severe impairment across most domains of neuropsychological functioning. Further, the influence of reading ability, educational experiences, and cultural background on test performance was evident in this study, pointing to the need for appropriate test norms for this population. This study also identified implications of the findings for psychologists, counselors, social workers, and medical professionals who work with shelter residents, as well as for shelter administrators, shelter staff members, and homeless outreach programs. The generalizability of these findings, however, is limited, due to the nature of the sample. Thus, research regarding the neuropsychological functioning of other homeless subgroups is needed. The development of cognitive rehabilitation interventions and tailored psychosocial/outreach interventions is also recommended.

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Appendix A

Participant Questionnaire

## Background/History

Date: _____ ID: _____

Birth date: _____ Age: _____

Ethnicity: __African American __Latino/a / Hispanic __Asian American
__Native American __Caucasian / European American
__Biracial / Multiracial
__Other:_____

Highest level of education completed: __High School __GED __Technical Training
__Associates __Bachelors __Masters __PhD

How many years of education have you completed? _____

When you were in school, did you take special classes for a learning disability or learning problems? __Yes __No __Don't know

If yes, please explain: _____
_____
_____

What is your employment situation?

__Unemployed If yes, check one:
__Can't work because of health problems
__Lost my job
__Can't work because of personal reasons
__Don't want to work right now

What was your last job? _____

__Employed If yes, check one:
__Temporary Job
__Part-Time
__Full-Time

What is your job? _____

Do you have a disability? __Yes __No

If yes, please check one:
__I get Social Security Disability
__I don't get Social Security Disability
__I applied for Disability but I don't get it yet

Were you ever in the military? __Yes __No

If yes, please answer the following:
What branch? _____
For how long? _____
Did you see combat? Please explain. _____
_____
Were you exposed to toxic materials? Please explain. _____
_____
Discharge status? _____
Reason for discharge: _____
_____

Marital Status: __Single __Married __Separated __Divorced __Widowed
__Non-Married Partner

Do you have children? __Yes __No __Don't know

If yes, do you pay child support or owe child support? __Yes __No __Don't know

Are you left-handed or right-handed? __Left __Right __No preference

What is your first (native) language? _____

Do you have any of these medical concerns? Check all that apply.
__Diabetes __Heart Disease __High Blood Pressure
__HIV/AIDS __Epilepsy/Seizure disorder __Parkinson's disease
__Kidney disease __Liver disease/cirrhosis
__Cancer – type(s): _____
__Other: _____
__None

What prescribed medications do you take? (include dosage if known) _____
_____
_____

What non-prescribed (over-the-counter) medications do you take? (include amount/ how often taken) _____
_____
_____

How tall are you? _____ Your current weight? _____

Do you have any trouble with your sleep? Check all that apply.

__Difficulty falling asleep __Difficulty staying asleep
__Difficulty waking up/ feel unable to move
__Daytime sleepiness/ fall asleep often during the day
__Sleep apnea/ breathing problems while sleeping (including snoring)
__Insomnia that lasts several days or more
__Other (explain): _____
_____

How many complete meals do you eat on a normal day?

__0 __1 __2 __3 __more than 3

When was your last meal? _____

Have you ever injured your head or brain? __Yes __No __Don't know

If yes, how many times? __Once __2-3 times __4-5 times
__more than 5 times

If yes, explain what happened and when: _____
_____
_____

When was the last time you had a head/brain injury? _____
_____

Were you ever hospitalized for a head/brain injury?
__Yes __No __Don't know If yes, when? _____
_____

Did you ever lose consciousness or become dazed, confused, or "see stars" because of your injury? __Yes __No __Don't know

For how long were you unconscious?
__Seconds __under 5 minutes __6-10 min __11-20 min
__21-60 min __more than 1 hr

Were there any problems/complications with your birth? __Yes __No __Don't know

If yes, please explain: _____
_____

Did you have any health problems as a child or teenager? __Yes __No __Don't know

If yes, please explain: _____
_____

Do you have any of these symptoms or problems? (Check all that apply)

__Frequent headaches __Dizziness __Forgetfulness/Memory problems
__Difficulty concentrating/staying focused __Vision problems
__Hearing problems __Coordination problems __Confusion
__Lack of motivation __Speech problems
__Other: _____

What services are you currently using or receiving? (Check all that apply)

__AODA treatment __Mental health treatment __Medical treatment
__Meal program (e.g., soup kitchen) __Social Security Disability
__Case management services __Educational or vocational services
__Other:_____

If you checked "AODA treatment" what are you getting treatment for? (Check all that apply)

__Alcohol __Crack/Cocaine __Heroin __Marijuana
__Other drugs (list): _____

How long has it been since you last used

Alcohol? _____
Crack/Cocaine? _____
Heroin? _____
Marijuana? _____
Other drugs (give names): _____
_____

If you checked "Mental health treatment" what are you getting treatment for? (Check all that apply)

__Depression __PTSD __Anxiety __Schizophrenia
__Bipolar Disorder __Family/Relationship Issues
__Other: _____
__I don't know what I'm getting treatment for

Have you ever been diagnosed with a mental health or substance use disorder?
__Yes __No __Don't know

If yes, please list diagnoses here: _____
_____
_____

Have you ever had a psychological assessment? __Yes __No __Don't know

If yes, please explain when and why: _____
_____
_____

In the past year, have you had problems with any of these things? (Check all that apply)

__Speaking / communicating with other people __Reading and/or writing
__Handling money __Making decisions for yourself

__Getting along with other people __Following rules/laws
__Feeling good about yourself / self-esteem
__Being tricked or fooled by others __Being taken advantage of

__Taking care of your personal hygiene __Using transportation [continued]
__Attending scheduled appointments __Keeping yourself safe from harm

Any other problems or concerns, please list here: _____
_____
_____

How long have you been staying at the Guest House of Milwaukee? _____

What programs are you involved in at the Guest House? Check all that apply.
__Case management services __Counseling services (individual or group)
__Educational programming/ classes __Work program (e.g. Resident Manager)
__Other (explain): _____

----------Continued on next page----------

## Homelessness History

| LOCATION | HOW MANY TIMES AND FOR HOW LONG? (Each time must be separated by at least 30 days, otherwise count as one time) |
|---|---|
| Homeless Shelter | |
| Outdoors (streets/ sidewalk, parks, in a vehicle, or in an abandoned building, etc.) | |
| Other (e.g., transitional housing, temporary housing, etc.) | |

What is the longest length of time you have stayed in a homeless shelter or similar place?

__Less than one week __1-3 weeks __1-2 months __3-4 mo __5-6 mo
__7-8 mo __9-10 mo __11-12 mo __more than one year (how long: _____)
__Never stayed in a shelter

What is the longest length of time you have slept / lived outdoors, in an abandoned building, in an automobile, or a similar place?

__Less than one week __1-3 weeks __1-2 months __3-4 mo __5-6 mo
__7-8 mo __9-10 mo __11-12 mo __more than one year (how long: _____)
__Never lived/slept outdoors

How many times have you stayed in a homeless shelter in the last year? _____

How many times have you slept outdoors in the last year? _____

What is the reason that you are homeless right now? (Check all that apply)

__Lost my job
__Lost my house/apartment
__Staying with friends/family and couldn't stay there any more
__Just moved here from another city/state
__Just got release from jail/prison
__Prefer to be homeless
__Not sure why I am homeless
__Other reason: _____

Appendix B

Sensory-Motor Screening

*Directions for the Recruiter:* Please read the following questions to the potential participant during your initial meeting.

**Visual Impairment** – Do you have any of the following?

Near-sighted __Yes __No
Far-sighted __Yes __No
Cataracts __Yes __No
Partial blindness __Yes __No
Legally blind __Yes __No

If you answered "yes" to any of the above, please also answer these questions:

My vision can be compensated for with glasses __Yes __No

Do you have these glasses? __Yes __No

How do you feel about reading or performing visual activities **without** your glasses?

__I can do just fine without my glasses/ feel confident
__I might be able to do it, but I'm not 100% sure
__I probably wouldn't do very well
__I know I wouldn't be able to do it

**Hearing Impairment** – Do you have any of the following?

Total deafness in right ear __Yes __No
left ear __Yes __No
both ears __Yes __No

Partial deafness in right ear __Yes __No
left ear __Yes __No
both ears __Yes __No

If you answered "yes" to any of the above, please also answer these questions:

My hearing can be corrected with a hearing aid __Yes __No

Do you have this hearing aid? __Yes __No

How do you feel about listening to questions, understanding instructions, providing verbal answers, etc. **without** your hearing aid?

__I can do just fine without it/ feel confident
__I might be able to do it, but I'm not 100% sure
__I probably wouldn't do very well
__I know I wouldn't be able to do it

**Limitations of Movement**

Are you limited in the ability to move your hands? __Yes __No

Are you able to sit for long periods of time? __Yes __No

Do you have any other limitations of movement? __Yes __No
Explain:

**Speech Behavior**

Do you have any difficulties with your speech? __Yes __No
Explain:

[Recruiter, please document if either of the following are present]

__Speech is unintelligible
__Problems with speech comprehension

**Other Observations:**

Appendix C

Screening for Aggressive/Violent Behavior

*Directions for the Recruiter:* Please complete this checklist either during or immediately after your initial meeting with the potential participant.

**Verbal Aggression**

□ Shouting, yelling loudly, making loud noises □ Yelling personal insults
□ Swearing/cursing in anger □ Moderate threats to self/others
□ Clear threats of violence to self/others

Please explain/provide context for any items checked above:

**Physical Aggression/Violence toward Self**

□ Engages in behavior that causes no injury/minor injury – Check all that apply:
□ Hitting self □ Biting, picking, scratching □ Pulling hair □ Banging head
□ Punching objects, e.g. wall, table □ Throwing self onto floor or against wall
□ Other: _____

□ Evidence of minor cuts, bruises, or burns

□ Evidence of deep cuts, severe mutilation, or other major self-harm

□ Engages in behavior that leads to bleeding, fractures, internal injury, loss of consciousness, or other major/serious injury

Please explain/provide context for any items checked above:

**Physical Aggression/Violence toward Others**

□ Threatening gestures toward people (no physical contact)
□ Aggressive behavior toward others without injury (e.g., pushing, kicking, pulling hair, hitting)
□ Aggressive behavior toward others with mild/moderate injury
□ Aggressive behavior toward others with serious injury

Please explain/provide context for any items checked above:

**Other Aggressive, Assaultive, or Violent Behaviors**

□ Slamming doors □ Throwing down objects, kicking objects (with no damage)
□ Ripping up papers □ Intentionally breaking objects
□ Throwing objects in a dangerous way □ Other: _____

Please explain/provide context for any items checked above:

Appendix D

Checklist for Examiner Competencies

**Examiner:** **Date:**

___Y ___N Makes an effort to develop rapport with the examinee

___Y ___N Maintains control of the test materials

___Y ___N Makes sure that the examinee is comfortable

___Y ___N Arranges materials such that the examinee can see them clearly

___Y ___N Keeps the testing area clear of all extraneous materials

___Y ___N Uses exact wording in reading instructions and test questions

___Y ___N Maintains accurate timing

___Y ___N Presents the materials as indicated in the test manual

___Y ___N Uses exact wording in the test manual for probing questions

___Y ___N Follows the scoring instructions precisely

___Y ___N Does not tell examinee whether his answers are correct, and does not give the correct answer (except during practice trials or as indicated in the test manual)

___Y ___N Accurately records responses, times, or other scores on the test forms

___Y ___N Encourages hesitant or frustrated examinee to respond or guess

___Y ___N Does not cue the examinee to indicate approval or disapproval of his responses (unless indicated in the test manual)

___Y ___N Records responses in an efficient manner (e.g., using abbreviations, writing without looking at the paper, etc.)

___Y ___N Scores responses immediately after they are given (where appropriate)

___Y ___N Administers tests in the correct order

**Comments/ Recommendations:**