THE MMPI-2 RESTRUCTURED CLINICAL (RC) SCALES AND PERSONALITY ASSESSMENT IN MULTIPLE SCLEROSIS

APPROVED BY SUPERVISORY COMMITTEE

Laura Lacritz, Ph.D.

Carroll Hughes, Ph.D.

Noelle McDonald, Ph.D.

Wendy Ringe, Ph.D.

Cheryl Silver, Ph.D.

Dedicated in loving memory to my great grandmother, Annie.

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by

TRACI ROSVALL

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TRACI ROSVALL, Ph.D.

The University of Texas Southwestern Medical Center at Dallas, 2010

Supervising Professor: Laura Lacritz, Ph.D., ABPP

ABSTRACT

Multiple sclerosis (MS) is a demyelinating central nervous system disease commonly accompanied by mood changes and cognitive deficits. The Minnesota Multiphasic Personality Inventory-2 (MMPI-2) is frequently used in MS but has been criticized for its inclusion of items referring to neurologic content. MS patients may accurately endorse physical symptoms, which may lead to multiple scale elevations due to the extensive item overlap across the MMPI-2 Clinical Scales. Many published studies have documented elevations on Scales 1, 2, 3, 7, and 8 in MS. In 2003, Tellegen et al. used factor analysis

and a construct validity-guided approach to adapt the MMPI-2 and create a set of Restructured Clinical (RC) Scales that included 388 items. The RC scales have attracted significant attention, with evidence of improved psychometric properties, but also criticism about their conceptual foundations and applications. This study had three broad goals. The first was to compare psychometric properties in the RC and Clinical Scales in an MS sample. Secondly, profiles were examined to compare the association between somatic symptoms and the RC and Clinical Scales. Third, the relationship between cognitive dysfunction and the RC and Clinical Scales was investigated. Scores from the RC and Clinical Scales and several cognitive measures were examined from 84 patients in an outpatient neuropsychology clinic. Results showed higher item-total correlations and lower inter-scale correlations for the RC Scales compared to the Clinical Scales, although internal consistency coefficients were comparable or better for the Clinical Scales. Thus, internal consistency findings were mixed with regard to improvement for the RC Scales, while some evidence of higher discriminant validity was found. Somatic and cognitive symptoms were associated with higher Clinical Scale elevations compared to their RC counterparts, particularly on Scales 1, 2, 3, 7, and 8, which were clinically significant in this sample. Mean RC Scale scores were within normal limits with the exception of RC1 (Somatic Complaints), indicating less psychopathology in the sample than the Clinical Scales would suggest. Findings support the need for cautious interpretation of Clinical Scale profiles in MS and suggest that the RC Scales may be a useful measure with this population.

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PRIOR PUBLICATIONS

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CHAPTER ONE

Introduction

Statement of the Problem

Multiple sclerosis (MS) is an inflammatory, demyelinating disease of the central nervous system that affects approximately 400,000 Americans and at least 2.1 million individuals worldwide (National Multiple Sclerosis Society, 2010b). Individuals with MS may experience a wide array of physical and neuropsychiatric problems, including extreme fatigue, difficulty with walking and balance, weakness, dizziness and vertigo, pain, numbness or other abnormal sensations, visual disturbance, impaired coordination, muscle spasticity, bladder and bowel dysfunction, sexual difficulties, mood changes, and cognitive deficits. Less common problems include headache, hearing loss, itching, seizures, tremor, insomnia, and speech or swallowing disorders (Acheson, 1985; Goldstein, Siroky, Sax, & Krane, 1982; National Multiple Sclerosis Society, 2010a). Additionally, up to 25% of persons with MS endorse significant sleep difficulties (Clark et al., 1992).

It is not surprising that symptoms of depression and anxiety are commonly associated with MS, given its unpredictable exacerbations, symptomatology, and prognosis. Lifetime prevalence estimates for major depressive disorder, obtained using standardized rating scales and structured interviews, have ranged from 25.7% to 54% (Joffe, Lippert, Gray, Sawa, & Horvath, 1987; Minden, Orav, & Reich, 1987; Patten, Beck, Williams, Barbui, & Metz, 2003; Sadovnick et al., 1996), and anxiety has reportedly been observed in 24% to 37% of the MS population (Diaz-Olavarrieta,

Cummings, Velazquez, & Garcia de al Cadena, 1999; Feinstein, O'Connor, Gray, & Feinstein, 1999; Minden, et al., 1987). Discrepant prevalence levels among studies may reflect methodological differences or factors related to the disease. Regardless, even the minimum of these ranges reflects a substantial impact in the lives of many MS patients. Psychiatric symptoms can produce substantial disability, and detecting them among MS patients may result in improved management of their condition.

To date, most of the research involving emotional functioning in MS has used three types of measures. The first are scales representing relatively circumscribed constructs, such as the Hamilton Rating Scale for Depression (1960) or the Pathological Laughter and Crying Scale (Robinson, Parikh, Lipsey, Starkstein, & Price, 1993). While potentially useful, these questionnaires do not provide a broad picture of individuals' psychological adjustment and may fail to detect critical symptoms of psychopathology in MS patients. Another type of measure is a standardized interview, such as the Structured Clinical Interview for the DSM-IV (First, Spitzer, Gibbon, & Williams, 2002). This approach requires significantly more face-to-face time be spent with the examinee and may be impractical for everyday clinical use. The third type of assessment uses a multidimensional personality measure, such as the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1943) and its revision, the (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989). These inventories offer a comprehensive characterization of emotional functioning, but their inclusion of test items reflecting common physical symptoms associated with MS has been criticized. Several investigators have highlighted the neurologic content of the MMPI/MMPI-2 (Baldwin, 1952; Elder, 1999; Marsh, Hirch, and Leung, 1982; Meuller & Girace, 1988; Nelson,

2003), including symptoms associated with motor weakness, paresis, paresthesia, difficulty with balance and coordination, dysarthria, numbness, visual problems, tinnitus, and impairments in concentration and memory. Individuals with and without MS may endorse these symptoms for very different reasons. For example, Scale 2 (Depression) elevations may reflect accurate endorsement of physical symptoms (e.g., fatigue, psychomotor retardation, weakness), psychiatric problems, such as depressed mood, social withdrawal, agitation and fearfulness, or a lack of self-confidence, among other characteristics.

In addition to the problem of somatic content, extensive item overlap across the MMPI/MMPI-2 Clinical Scales can cause the endorsement of a single item to elevate scores on several scales. There are many more overlapping items than nonoverlapping items on each scale. The average number of overlapping items per pair on the 10 Clinical Scales of the MMPI-2 is 6.4 (Greene, 2000; Helmes & Reddon, 1993), with considerably higher overlap between certain scale pairs. For example, Scales 1 and 3 share 20 items, and Scales 7 and 8 share 17 items (Simms, 2006). Scale 2 has only 10 items unique to it, whereas the other 47 items are evenly shared with the other Clinical Scales (Greene, 1991). Many published studies have documented elevations on Scales 1, 2, 3, 7, and 8 in neurological populations (Alfano, Paniak, & Finlayson, 1993; Gass, 1992; Gass & Wald, 1997; Glassmire et al., 2003; Mack, 1979; Moehle & Fizhugh-Bell, 1988), likely reflecting the problems of item overlap and/or the inclusion of items associated with physical symptomatology.

Various approaches have been taken to improve the understanding of MMPI/MMPI-2 profiles in MS. For example, some researchers have identified disease-

associated symptoms and removed their inclusion from profile analyses (Baldwin, 1952; Marsh, Hirsch, & Leung, 1982; Meyerink, Reitan, & Selz, 1988; Muller & Girace, 1988). However, selectively removing items from a measure violates the test's standardization and may render profiles less valid and total scores more difficult to interpret.

In 2003, Tellegen et al. adapted the MMPI-2 items to create a set of Restructured Clinical (RC) Scales (the larger measure being known as the MMPI-2 Restructured Form, or MMPI-2-RF), largely to address concerns about item overlap and heterogeneity among the standard Clinical Scales. Using factor analyses and a modified Jacksonian (1970) approach to test construction, new scales were devised: Demoralization (RCd), Somatic Complaints (RC1), Low Positive Emotions (RC2), Cynicism (RC3), Antisocial Behavior (RC4), Ideas of Persecution (RC6), Dysfunctional Negative Emotions (RC7), Aberrant Experiences (RC8), and Hypomanic Activation (RC9). The RC Scales have attracted significant attention, with evidence of improved psychometric properties (Rogers, Sewell, Harrison, & Jordan, 2006), but also criticism about their conceptual foundations (Nichols, 2006).

Given the confounding variables of somatic content and item overlap among the Clinical Scales, the RC Scales may prove useful as an adjunct (or eventual replacement) of the Clinical Scales for assessment in MS. Preliminary evidence suggests that they may be useful with other medical populations, such as bariatric surgery candidates (Wygant et al., 2007) and epilepsy patients (Locke et al., 2010; Schaffer, Barr, Brand, Alper, & Devinsky, 2007). However, research on this measure is in its infancy and further examination is necessary in order for clinicians and researchers to better understand MMPI-2-RF findings in MS.

CHAPTER TWO

Literature Review

Overview of Multiple Sclerosis

As previously noted, approximately 400,000 Americans are living with MS, and 200 new cases are diagnosed each week (National Multiple Sclerosis Society, 2010b). Women are twice as likely as men to acquire MS, although men may have a poorer prognosis (Kantarci & Wingerchuck, 2006). While the disease is often characterized by relapses and remissions early on, MS is considered to be a degenerative disease because its long-term course reflects a progressive accumulation of neurological deficits, with persistent cognitive and behavioral sequelae. The average age of symptom onset is between 20 and 40 years (Reingold, 1995), which is during prime wage-earning years. MS frequently leads to loss of gainful employment, with 40 to 80 percent of patients becoming unemployed (Beatty, Blanco, Wilbanks, Paul, & Hames, 1995; Rao, Leo, Bernardin, & Unverzagt, 1991). Disability can occur early, at least episodically, and the patient's lifespan may not be significantly shortened, making MS an extreme financial burden at both the individual and societal level (Whetten-Goldstein, Sloan, Goldstein, & Kulas, 1998).

In MS, the body's immune system attacks the myelin sheath surrounding nerve axons, resulting in demyelinization of nerve fibers and scar tissue, known as lesions or plaques. The lesions, which may appear in the brain, on the spinal cord, or on the optic nerves, become widespread and interfere with the conduction of electrical impulses throughout the central nervous system. Brain lesions are particularly likely to be found in

the white matter of the brainstem, cerebellum, and cerebrum, especially in the area around the ventricles (Pallett & O'Brien, 1985). In addition to the inflammatory demyelinization, axonal damage or loss may occur early in the disease (Trapp & Nave, 2008; Trapp et al., 1998).

As a result of demyelinization and axonal injury, patients diagnosed with MS may suffer from a variety of sensory, motor, cognitive, and neuropsychiatric deficits, and no two individuals have exactly the same symptom profile or disease course. A diagnosis is based upon clinical evidence, laboratory, and neuroimaging findings. The diagnostic criteria for MS have evolved over time from Schumacher et al. (1965) to the Poser Committee (1983) to the McDonald consensus (2001). These criteria are presented in Tables 1, 2, and 3, respectively.

Insert Tables 1, 2, and 3 here

Additionally, Lublin and Reingold (1996) recommended classifying patients with one of 6 types of MS, based on the progression of the disease. Patients may be classified as having relapsing-remitting, primary progressive, secondary progressive, progressive-relapsing, benign, or malignant forms of the disease. Table 4 shows the characteristic pattern of symptom expression for each type. An individual's diagnostic subtype may change over the course of the illness, depending on clinical findings.

Insert Table 4 here

Cognitive Impairment in MS

Cognitive impairment is a common symptom in MS and is estimated to occur in 43% to 65% of patients (Benedict et al., 2006; Peyser, Rao, LaRocca, & Kaplan, 1990; Rao, et al., 1991). Deficits have been observed in nearly every domain and will be discussed more below. Most studies suggest that overall intelligence remains intact (Macniven et al., 2008; Marsh, 1980). Dementia is rarely diagnosed in MS, possibly because the cognitive deficits tend to be less severe than those associated with other neurological conditions in which dementia is more pronounced such as Huntington's disease (Butters, Goldstein, Allen, & Shemansky, 1998; Chiaravalloti & DeLuca, 2008). The relatively spared verbal intellectual abilities in MS patients may mask their degree of impairment, resulting in fewer referrals for neuropsychological testing. When functional problems are observed, individuals with MS or their families may attribute the difficulties solely to physical symptoms rather than cognitive disturbance, thereby missing an opportunity for intervention.

Cognitive deficits may be apparent during early and late stages of MS (Pelosi, Geesken, Holly, Hayward, & Blumhardt, 1997; Piras et al., 2003) and are only mildly associated with the patient's level of physical disability (Beatty, et al., 1995; Lynch, Parmenter, & Denney, 2005). The pattern of cognitive functioning may fluctuate with other disease symptoms and disease course. Most research suggests that progressive MS is associated with greater cognitive dysfunction than the relapsing-remitting type (Beatty, Goodkin, Monson, & Beatty, 1989; Heaton, Nelson, Thompson, Burks, & Franklin, 1985; Huijbregts, Kalkers, de Sonneville, de Groot, & Polman, 2006; Rao, Hammeke, McQuillen, Khatri, & Lloyd, 1984), although not all studies support this conclusion

(Beatty, Goodkin, Hertsgaard, & Monson, 1990; Wishart & Sharpe, 1997). Several researchers have demonstrated significantly greater cognitive deficits in secondary-progressive patients compared to primary progressive groups (Beatty, et al., 1989; Bergendal, Fredrikson, & Almkvist, 2007; Comi et al., 1995; Denney, Sworowski, & Lynch, 2005; Gaudino, Chiaravalloti, DeLuca, & Diamond, 2001; Huijbregts, et al., 2006). Chiaravalloti and DeLuca (2008) expressed concern that some of this study data may have been confounded by other factors, such as the duration of the disease. That is, approximately 50% of relapsing-remitting patients will develop secondary progressive MS within 10 to 15 years of onset (Weinshenker et al., 1989). Therefore, the secondary progressive group is likely to include patients with a longer history of illness and progressive cognitive decline. However, several studies suggest duration of illness is not a significant factor in cognitive impairment (e.g., Beatty, et al., 1990; Denney, et al., 2005; Lynch, et al., 2005; Marsh, 1980; Rao, et al., 1991; Wishart & Sharpe, 1997). An unfortunate complication is that many prior studies relied on the "chronic progressive" classification, which encompassed what are now known as primary- and secondary-progressive types. The changes in classification were initiated because of evidence of differential pathology (Comi, et al., 1995; Revesz, Kidd, Thompson, Barnard, & McDonald, 1994; Thompson et al., 1991), making prior results difficult to interpret.

The types of cognitive deficits shown by MS patients are somewhat variable, which may partially reflect methodological differences, such as the way authors conceptualize and measure domains, or disease-related factors, including the severity and distribution of lesions, fatigue, or medication regimen. Nevertheless, there are several trends apparent in the literature. A number of studies suggest that many MS patients

demonstrate mild to moderate impairments in the areas of attention, information processing speed (Beatty, 1993; Beatty, Goodkin, Monson, Beatty, & Hertsgaard, 1988; Diamond, DeLuca, Kim, & Kelley, 1997; Feinstein, Kartsounis, Miller, Youl, & Ron, 1992; Litvan, Grafman, Vendrell, & Martinez, 1988), problem solving and other executive functions (Beatty, et al., 1989; Denney, et al., 2005; Feinstein, et al., 1992; Foong et al., 1997; Heaton, et al., 1985; Lazeron, Rombouts, Scheltens, Polman, & Barkhof, 2004; Rao, et al., 1991), and long term memory (Brassington & Marsh, 1998; Rao et al., 1993). Regarding the latter domain, some researchers have argued that deficits in processing speed and working memory are likely significant contributors to MS patients' difficulty learning (and therefore, remembering) new information (Chiaravalloti, Balzano, Moore, & DeLuca, 2009; Lezak, Howieson, Loring, Hannay, & Fischer, 2004). Functions that appear relatively intact include language abilities that do not rely on rapidly processing information and academic skills. For example, vocabulary and comprehension are usually spared, while verbal fluency, and to a lesser extent, confrontation naming, show impairment (Beatty, 1988; Beatty, et al., 1989; Beatty & Monson, 1990; Caine, Bamford, Schiffer, Shoulson, & Levy, 1986; Huber et al., 1987; Minden, Moes, Orav, Kaplan, & Reich, 1990; Pozzilli et al., 1991; Wishart & Sharpe, 1997; Zakzanis, 2000).

Wishart and Sharpe (1997) performed a meta-analysis of 36 studies comparing the neuropsychological performance of MS patients with that of healthy control participants. They calculated effect sizes for each measure, which were separated into various neuropsychological domains: general cognitive ability; attention and processing speed; executive functions; conceptual ability; language; visuoperceptual, visuospatial,

and visuo-constructional ability; learning and memory; motor and sensory ability; interhemispheric transfer (auditory, tactile, and motor tests); and mood and psychological status. Results showed that many test performances were significantly impaired in MS patients, with mean effect sizes in the small to moderate range for all domains. The areas of cognition that seemed to be the most affected by impairments included interhemispheric transfer, general cognitive ability, and learning/memory. Among the measures that most strongly differentiated the MS group was the Wisconsin Card Sorting Test (number of categories; WCST; Heaton, Chelune, Talley, Kay, & Curtis, 1993). Moreover, processing speed accounted for a significant amount of the difficulty seen on other tests. They concluded that measures with significant speed demands (e.g., Symbol Digit Modalities Test; Digit Symbol Test) may be more sensitive to detecting impairments in MS than non-timed tasks, such as Digit Span.

Although learning and memory dysfunction have been noted in MS patients, Lezak et al. (2004) argued that deficits in conceptual reasoning, planning, sequencing, temporal ordering, monitoring internal and external stimuli, cognitive estimation, and/or self-regulation may contribute to MS patients' impairments on tests of other cognitive abilities, such as memory. These executive function deficiencies may significantly disrupt the lives of those with MS and lead to difficulties with friends and family, who may express frustration regarding patients' disorganization and problem solving without understanding the neuropathological basis for their problems.

To summarize, cognitive dysfunction has been observed in a significant percentage of individuals with MS. The areas that appear most prone to impairment include attention, information processing speed, and executive functioning. Memory

may be reported as impaired, but deficits in executive functions likely account for a significant portion of learning and recall difficulties. In contrast, most untimed verbal functions and academic abilities tend to remain intact. Cognitive deficits are important to identify in MS because they may directly relate to unemployment, social difficulties, sexual dysfunction, and psychopathology (Rao et al., 1989).

Emotional Functioning in MS

Mood disorders may also play an important role in the daily functioning and quality of life of MS patients. In addition to potentially exacerbating cognitive dysfunction (Forman & Lincoln, 2010), comorbid anxiety and depression have been associated with increased thoughts of self-harm and suicide, more somatic complaints, and greater social difficulties (Feinstein, et al., 1999; Forman & Lincoln, 2010). While the exact directionality of causality is unknown, Minden, Orav, and Reich (1987) and others have observed mood disturbance with MS since the writings of Charcot (1879) were published.

It is possible that the neurobiological mechanisms related to MS contribute to affective disturbance. For example, several investigators (Feinstein et al., 2004; Honer, Hurwitz, Li, Palmer, & Paty, 1987; Pujol, Bello, Deus, Martí-Vilalta, & Capdevila, 1997; Ron & Logsdail, 1989; Zorzon et al., 2001; Zorzon et al., 2002) have found mood disorders in MS to be correlated with lesion load in the frontotemporal and parietal regions of the brain. Additionally, medication used to treat the neurological symptoms of MS may induce and/or exacerbate affective symptomotology (Schiffer, 2002).

Individuals with MS are most likely susceptible to psychiatric disturbance both as a direct result of the disease and as a consequence of attempting to cope with its effects.

Multiple factors may complicate adjustment to MS. First, the constellation of symptoms is highly idiosyncratic, both within and among patients. The disease course is unpredictable (Hayes & Grenello, 2009), with intermittent relapses and remissions and an unknown prognosis. There is no definitive test for MS and it can be difficult to diagnose. Early misdiagnoses are common and often the patient must endure a protracted series of tests while contemplating the possibility of having other major diseases. The etiology of MS is not yet understood, and there is no known cure. Additionally, clinically significant pain has been found in as many as 65% of MS patients. Acute pain conditions may include trigeminal neuralgia, painful optic neuritis, and Lhermitte's syndrome. Chronic pain in MS is frequently manifested as dysesthesias in the limbs, joint pain, and other musculoskeletal or pain problems as a consequence of spasticity and deconditioning. Finally, efforts to alleviate pain may negatively impact the symptoms of MS, such as increasing the incidence of osteoporosis, headache, and fatigue (Kerns, Kassirer, & Otis, 2002).

In an effort to determine the MS community's need for psychiatric care, Eklund and MacDonald (1991) surveyed a group of patients. They reported that 58% of respondents believed they needed professional help with emotional problems during some point in the course of their illness. Nearly a third (31.7%) endorsed a need for help at the time of the study. Yet, 28.8% indicated they were not receiving the psychological services they felt were necessary. More recently, Patten and his colleagues (2003) demonstrated that Canadian MS patients had over 2.6 times the need for mental health

services than the general population. Despite the high incidence of emotional disturbance in this population, they may be undertreated from a psychiatric standpoint.

Major depressive disorder. The most common mood disorder co-occurring with MS is major depressive disorder, with lifetime prevalence rate estimates at specialty clinics ranging from 25.7% to 54% (Joffe, et al., 1987; Minden, et al., 1987; Patten, et al., 2003; Sadovnick, et al., 1996), which may be more than 3 times that of the general population (Blazer, Kessler, McGonagle, & Swartz, 1994; Kessler et al., 2003). These rates far surpass those found with many common medical conditions, such as hypertension, diabetes, coronary artery disease, congestive heart failure (Egede, 2007), and muscular dystrophy (Surridge, 1969). Whether depressive symptoms are more common in MS than other neurological diseases is somewhat uncertain. Most studies have suggested an increased risk (Dalos, Rabins, Brooks, & O'Donnell, 1983; Dalton & Heinrichs, 2005; Rabins et al., 1986; Sadovnick, et al., 1996; Schiffer, Caine, Bamford, & Levy, 1983; Schubert & Foliart, 1993; Surridge, 1969; Whitlock & Siskind, 1980), while a few have found comparable estimates of major depressive disorder in other neurological populations (e.g., Moriarty, 2007; Rabins, et al., 1986). The discrepant findings may be partially explained by methodological differences, such as the use of small sample sizes, variable inclusion and exclusion criteria, or incomparable assessment measures. A significant complication in interpreting the data is that these studies used a variety of screening tools, such as standardized psychiatric rating scales (e.g., Beck Depression Inventory, or BDI; Beck, Ward, Medelson, Mock, & Erbaugh, 1961) or structured interviews, to diagnose major depressive disorder. Many contain mood

symptoms as well as somatic items, such as fatigue or psychomotor retardation. The resulting scores on these types of measures may artificially inflate the estimates of psychopathology in MS patients (Minden & Schiffer, 1990). That is, vegetative and cognitive disturbance are more likely to be indicative of major depressive disorder in a nonmedical sample, while the same symptoms should be interpreted with caution in MS patients, as they are cardinal problems associated with their disease (Nyenhuis et al., 1995).

Nyenhuis and his colleagues (1995) illustrated this point by comparing 84 MS patient scores to two groups, (101 patients diagnosed with major depressive disorder and 87 healthy control participants), on two questionnaires, the Multiscale Depression Inventory (MDI; 1993 Nyenhuis, Rao, Zajecka, & Garron, 1993), and the BDI. The MDI is a 42-item, self-report measure that produces scores in three domains: Mood (e.g., sadness), Vegetative (e.g., fatigue), and Evaluative (e.g., feelings of uselessness) symptoms. The scales can be examined separately, resulting in a more pure estimate of non-somatic depressive symptoms in patients who endorse physical problems. When the MDI and BDI total scores were used for comparison, the MS group endorsed significantly more depressive symptoms. However, when the subscales were examined, the rate of *mood* disturbance in the MS group was not significantly different from that of the controls. Moreover, the prevalence rate of major depressive disorder in the MS group was significantly lower when measured by the MDI mood scale (17.7%) than by the BDI (30.5%) or the MDI total score (26.6%).

Affective instability and sub-threshold syndromes. Although measures like the MDI may help clinicians obtain diagnostic information about major depressive disorder, other forms of psychopathology, as well as sub-threshold syndromes (endorsement of symptoms not meeting the full criteria for a mood disorder), may not be accounted for with such inventories. Feinstein and Feinstein (2001) reported finding sub-syndromal psychiatric symptoms in almost half of their MS outpatient sample (total *N* = 100). Consistent with this, Minden and her colleagues (1987) noted that although a third of their sample of 50 MS patients experienced a major depressive episode during the preceding year, many more participants complained of low mood (64%), anger (64%), and irritability (56%). Another study, undertaken by Diaz-Olavarrieta et al. (1999), indicated the presence of the following psychopathology in their MS sample (*N* = 44): depressive symptoms (79%), agitation (40%), anxiety (37%), irritability (35%), apathy (20%), euphoria (13%), disinhibition (13%), hallucinations (10%), aberrant motor behavior (9%), and delusions (7%).

In an effort to study the sub-threshold presentations of affective disturbance, such as irritability, sadness, and tearfulness, Feinstein and Feinstein (2001) administered multiple measures to 100 MS patients at their yearly neurological examination. They utilized the Structured Clinical Interview for DSM-IV (SCID4; First, Spitzer, Gibbom, & Williams, 1994), Pathological Laughing and Crying Scale (PLACS; Robinson, et al., 1993), the BDI, and a measure of overall psychological distress, the 28-item General Health Questionnaire (GHQ; Goldberg & Hillier, 1979). Results indicated that 17% met a diagnosis for major depressive disorder, 8% experienced pathological laughing and crying (PLC), 48% were symptomatic for emotional dyscontrol without meeting criteria

for a formal psychiatric diagnosis, and only 27% were considered emotionally stable. Discussing their findings, the authors cited evidence that symptoms falling between euthymia and major depressive disorder negatively impinge upon psychosocial outcomes (Judd, Paulus, Wells, & Rapaport, 1996). Additionally, they asserted, "Given that depression and chronic medical conditions have unique and additive effects on patient functioning (Wells et al., 1989) and mortality (Wells, 1995), the importance of detecting and treating subsyndromal depression needs emphasizing."

Pathological laughing and crying. PLC has been observed in 8% to 10% of the MS population (Feinstein & Feinstein, 2001; Feinstein, Feinstein, Gray, & O'Connor, 1997; Minden & Schiffer, 1990). This symptom is characterized by sudden bursts of emotional dyscontrol, wherein patients display laughter or crying that is either exaggerated in intensity or incongruent with the provoking stimulus (Parvizi et al., 2006). Depending on the severity of PLC, patients may encounter significant difficulty with activities of daily living and interpersonal situations (Wortzel, Oster, Anderson, & Arciniegas, 2008).

Bipolar disorder. There is a dearth of research into the prevalence of bipolar disorder in MS, although structured interviews have suggested that patients with MS may be at greater risk. Joffe et al. (1987) reported a lifetime prevalence rate of 13% to 16% (N = 100), which is 10 to 15 times more common than in the general population (as cited in Lezak, Howieson, Loring, et al., 2004, p. 255). Schiffer et al. (1986) performed an epidemiological study in Monroe County, New York and found a greater than expected

statistical association between bipolar disorder and MS. In addition, Minden and her colleagues (1987) found mania in 4% and hypomania in 28% of a sample of 50 MS patients.

Anxiety disorders. Anxiety disorders have been identified in approximately one quarter of MS patients, most of whom are female (Feinstein, et al., 1999), which is slightly less than the estimated lifetime prevalence of anxiety disorders in the general population (28.8% based on structured interviews; Kessler & Wang, 2008). Nonetheless, identifying anxiety disorders in MS patients is extremely important, given that anxiety is associated with high rates of medically unexplained symptoms, increased utilization of healthcare resources (Katon & Walker, 1998; Marciniak et al., 2005; McLaughlin, Khandker, Kruzikas, & Tummala, 2006; Meltzer-Brody, Hidalgo, Connor, Davidson, & Jonathan, 2000; Simon & VonKorff, 1991; Walker et al., 2003), chronic medical illness (Harter, Conway, & Merikangas, 2003; Sareen, Jacobi, Cox, Belik, & Stein, 2006), reduced physical health-related quality of life, and physical disability (Kroenke, Spitzer, Williams, Monahan, & Lowe, 2007; Ludman et al., 2006; Sareen, Cox, Clara, & Asmundson, 2005; Sareen, et al., 2006). Moreover, comorbid anxiety and major depressive disorder in MS have been correlated with increased somatic symptoms, suicidal ideation, interpersonal difficulty (Feinstein & Feinstein, 2001), and decreased treatment adherence (Bruce, Hancock, Arnett, & Lynch, 2010; Patten, et al., 2003).

Psychological Testing and Multiple Sclerosis

Psychiatric disorders have been studied in patients with MS for over 170 years. However, there has been little agreement about the nature and extent of mental health difficulties in this population. Part of the problem is that most studies have involved a variety of measures with a relatively narrow focus, such as depressive or anxious symptoms, rather than a more comprehensive measure of emotional functioning in MS patients. However, even broader inventories have produced controversial results. For example, early reports of personality functioning suggested MS patients had an "overemphasis on dependency needs, a virtually complete absence of body-centered anxiety, a minimum of inner conflict, or an attitude of resignation and unrealistic tendency to see the world as through colored glasses" (Harrower, 1954). Other studies were indicative of irritability, apathy, and in a small percentage of patients, sexual disinhibition. However, these findings were criticized as resulting from biased semi-structured interviews and inaccurate interpretation of objective personality inventories, such as the MMPI (Benedict, Priore, Miller, Munschauer, & Jacobs, 2001). Researchers determined that early investigations of MS patients' emotional functioning were characterized by methodological flaws, such as the use of retrospective research designs, small sample sizes and non-random subject selection, nonstandardized and non-objective measures, inadequate control groups, failure to control for certain demographic, medical, or response-style variables, and failure to test for a priori hypotheses (Devins & Seland, 1987).

The Minnesota Multiphasic Personality Inventory. The MMPI (Hathaway & McKinley, 1943) is the most widely used objective personality measure in the world (Greene, 2000). Starke R. Hathaway and J.C. McKinley sought to create a personality inventory that was more valid and objective than available measures at the time. Prior personality tests were developed using clinical and theoretical judgment to determine which items contained face valid content and measured the construct of interest (i.e., the rational approach to test construction). The resulting questions were criticized for producing profiles potentially influenced by test taker attitudes (e.g., defensiveness, overreporting of symptoms, self-deception, or social desirability factors), as well as demographic variability among examinees, such as reading comprehension and general intellectual ability (Friedman, Lewak, Nichols, & Webb, 2001). To reduce such problems, Hathaway and McKinley used an empirical method (the criterion keying approach) in the construction of the MMPI. Test questions were retained when they successfully distinguished between various diagnostic groups and normal control participants, regardless of whether the items appeared to measure the symptoms of a particular disorder. However, the system was imperfect, as evidenced by the development of the K "correction factor" (Meyerink, Reitan, & Selz, 1988). The K Scale was created to enhance the diagnostic accuracy of Clinical Scales 1, 4, 7, 8, and 9 with adult inpatients (Friedman, et al., 2001) and primarily reflects the test taker's degree of defensiveness and emotional control, although demographic variables such as high socioeconomic status are also associated with elevations. Factor analytic studies suggested that responses to test items were influenced by other external sources of variability, including poor physical health (O'Connor & Stefic, 1959). This is not to say

that psychosomatic pathology does not occur in medical populations, but rather that profile interpretation must proceed with caution, particularly on scales that contain large numbers of questions pertaining to physical symptoms. Many items refer to neurologic content, including symptoms associated with motor weakness, paresis, paresthesia, difficulty with balance and coordination, dysarthria, numbness, visual problems, tinnitus, and impairments in concentration and memory (Nelson, Elder, Tehrani, & Groot, 2003). Individuals with and without MS may endorse these symptoms for very different reasons. Inappropriate interpretation of results could result in misdiagnoses or ineffective treatment planning.

The original MMPI also came to be criticized for its constricted, non-representative normative group (Pancoast & Archer, 1989). To address this and other issues, the instrument was revised in 1989 with the publication of the MMPI-2 (Butcher, et al., 1989; Butcher et al., 2001). A contemporary sample of normal controls was selected, and the language was updated to reflect modern usage and current clinical problems. Importantly, the structure of the Clinical and validity scales was left largely unaltered in an effort to ensure continuity with prior research and application. Fifteen new Content Scales and 12 supplementary scales were added to clarify the meaning of Clinical Scale elevations. Uniform T scores were developed to aid interpretation.

Despite its improvements, the MMPI-2 attracted some of the same criticism as the MMPI. It became clear to many researchers and clinicians that the significant item overlap and heterogeneity of the scales created interpretive challenges (Helmes & Reddon, 1993; Horn, Wanberg, & Appel, 1973). The average number of overlapping items per pair in the MMPI-2 (for the 10 standard Clinical Scales) is 6.4, with particularly

high overlap between scale pairs 1-3 (20 items overlapping), 7-8 (17), 2-7 (13), 2-3 (13), 6-8 (13), 4-0 (11), 8-9 (11), 1-2 (10), 2-8 (10), 3-4 (10), and 4-8 (10) (Greene, 2000; Helmes & Reddon, 1993). Redundancy of items across the inventory can be problematic for several reasons. First, overlap of items erroneously inflates interscale correlations, thereby reducing their distinctiveness and discriminant validity (Helmes & Reddon, 1993; Tellegen et al., 2003). This results in a less clinically effective measure that necessitates additional interpretive steps by the clinician, who must determine whether one or more scales are spuriously elevated by item overlap with other scales, elevated due to unique symptoms, or some combination of both. Item overlap is also problematic because it complicates the understanding of the factor structure of the instrument (Horn, et al., 1973; Reddon, Marceau, & Jackson, 1982; Waller, 1999).

The empirical criterion keying approach has also been criticized for creating excessive heterogeneity within scales (Greene, 2000; Helmes & Reddon, 1993; Tellegen, et al., 2003). Consequently, the T score of a scale, particularly one in the moderate range (60 to 70) may reflect endorsement of an assortment of symptoms. For example, Scale 2 (Depression) elevations may reflect accurate endorsement of physical symptoms (e.g., fatigue, psychomotor retardation, weakness), depressed mood, social withdrawal, agitation, fearfulness, or a lack of self-confidence, among other characteristics. Similar observations related to heterogeneity have been found in most of the other MMPI/MMPI-2 Scales (Helmes & Reddon, 1993; Horn, et al., 1973; Waller, 1999), and the problem is worsened when multiple scale elevations occur. Many published studies have documented elevations on Scales 1, 2, 3, 7, and 8 in neurological populations (see Hayes & Grenello, 2009).

MMPI-2 Restructured Clinical Scales. In an effort to address these concerns, Tellegen et al. (2003) adapted the MMPI-2 items to create a set of Restructured Clinical (RC) Scales. In contrast to the criterion keying approach used by Hathaway and McKinley (1943), Tellegen et al. adopted a test construction strategy that aimed to be more theoretically grounded and construct-validity-guided (2006) than its predecessor. The RC Scales were developed using exploratory factor analyses in combination with select principles of Jackson's (1970) sequential approach to construct validity in personality measures (Rogers, et al., 2006). The Jacksonian method posits four important requirements. First, the foundation for the test should arise from established psychological theory. Secondly, response style variance must be minimized. Third, scales should be homogeneous and generalizable. Finally, the measure must be designed from its conception to demonstrate adequate convergent and discriminant validity (Jackson, 1970).

Tellegen et al. (2003) followed the first and fourth Jacksonian principles in their design of the RC Scales. A primary goal was to increase the discriminant validity of the standard Clinical Scales, thereby clarifying the unique information provided by individual elevations. Additionally, they sought to reduce nonspecific variance associated with a common "first" or "prime" factor (Simms, 2006; Tellegen, et al., 2006), described as a "broad, emotionally colored variable that underlies much of the variance common to the MMPI-2 Clinical Scales" (Tellegen, et al., 2003, p. 11). They labeled this scale, conceptually based on previous research about the structure of affect (Tellegen & Watson, 1999; Watson & Tellegen, 1985), Demoralization (RCd). Based on their prior work, RCd was expected to reduce a nonspecific, shared component with the Clinical

Scales. Demoralization was described as reflecting an examinee's standing on a continuum of positive to negative affect, which was separated into dimensions of "unpleasantness" to "pleasantness." The model links depression to "low positive emotionality" and anxiety to "high negative emotionality." Therefore, RCd was primarily formulated based on factor analyses of Clinical Scales 2 (Depression) and 7 (Psychasthenia). Other items were added to RCd when they correlated highly with the rest of the RCd set. While Tellegen et al. (2003) did not follow Jackson's second principle of personality measure development, response bias has been investigated using archival data (Sellbom, Ben-Porath, Graham, Arbisi, & Bagby, 2005) and found to be commensurate with the Clinical Scales. The final RC Scales are presented in Table 5, along with their standard Clinical Scale counterparts.

Insert Table 5 here

Tellegen et al. (2003) investigated the reliability of the RC Scales and reported internal consistency coefficients equal to or better than the internal consistencies of the Clinical Scales. The significantly higher alpha coefficients were evidenced despite two factors inflating those of the Clinical Scales. First, the saturation of the Clinical Scales with the demoralization factor would tend to raise the internal consistencies compared to the RC Scales, where this shared variance has largely been removed. Second, the Clinical Scales are much longer. For example, RC2 is comprised of 17 items, while Scale 2 has 57. Despite these factors, the RC Scale alpha coefficients ranged from .62 (for RC2) to .79 (for RC3), with a median of .76 for all of the RC Scales, in the

normative sample of women (n = 1,462). In comparison, the alpha coefficients of the Clinical Scales ranged from .39 (for Scale 6) to .87 (for Scale 7), with a median of .63 in the same sample. The authors concluded that the RC Scales appeared to measure emotional functioning with much greater efficiency (substantially reduced scale length) and often higher reliability, relative to the Clinical Scales. The fact that the MMPI-2-RF contains only 338 items, compared to the 567-item MMPI-2, is particularly appealing for use in MS, given the fatigue and concentration difficulties common with the disease.

Internal validity analyses by Tellegen et al. (2003) showed the RC Scales to be significantly correlated with their standard scale counterparts, with the exception of RC3 (Cynicism) and Scale 3 (Hysteria), which was anticipated because RC3 retains only a small portion of the original construct and is actually reversed in direction. Otherwise, the correlations between each RC Scale and its respective parent scale ranged from r = .41 (between RC6 and Scale 6) to r = .92 (between RC1 and Scale 1) in the MMPI-2 normative sample of women (n = 1,462) and were comparable with the normative male sample. This suggests that the RC Scales successfully retained their core constructs.

Tellegen et al. (2003) also computed intercorrelations between the RC Scales to see if they were lower than those between the Clinical Scales. The RC Scale intercorrelations were indeed substantially reduced, providing evidence of enhanced discriminant validity in comparison with the Clinical Scales. For example, the correlation between RC4 and RC6 was r = .26 in the normative sample of men (n = 1,138), while the correlation between Clinical Scales 4 and 6 was r = .41. With few exceptions, this pattern was observed across most of the RC Scale intercorrelations. The

authors concluded that their data demonstrated equivalent or better discriminant validity for the RC Scales compared to the Clinical Scales.

Finally, Tellegen et al. (2003) performed regression analyses to compare the ability of the RC Scales versus Clinical Scales to predict extra-test criterion variables obtained from the Patient Description Form (PDF; Graham, Ben-Porath, & McNulty, 1999) and Record Review Form (RRF; Arbisi, Ben-Porath, & McNulty, 2003). The PDF scales are comprised of symptoms and personality characteristics developed based on the MMPI-2 correlate literature (Tellegen, et al., 2003) and were obtained from therapists' ratings at a community mental health center. The RRF scales were extracted from intake assessments of the same patient groups. By pairing each RC and Clinical Scale with a PDF or RRF scale deemed to correspond to a similar construct (i.e., RC1 and Scale 1 each paired with the PDF Somatic Symptoms scale), they found most of the RC Scales showed substantially improved discriminant validity, and comparable or better convergent validity, compared to the Clinical Scales. (There were no conceptually related variables to examine RC3 and RC9.)

While the psychometric properties of the RC Scales appear promising, Tellegen et al. (2003) cautioned that their interpretative meaning requires further research, and suggested RC Scales be primarily used in the interim to augment the understanding of MMPI-2 profiles. For example, RC Scale elevations could be used to clarify the meaning of Clinical Scale elevations. Because the RC Scales have shown evidence of improved convergent and discriminant validity (Sellbom, Ben-Porath, & Graham, 2006; Tellegen, et al., 2003), elevations may reflect a high level of the core construct (e.g., cynicism reflected by RC3) rather than a myriad of syndromal possibilities (e.g., somatization,

naivete, and extraversion on Clinical Scale 3). Demoralization is reflective of general emotional distress and was comprised of the formerly shared variance of this construct across the Clinical Scales. Therefore, if an examinee's profile code type was 3-1-2/1-3-2 on the Clinical Scales, but scores were only elevated on RCd among the RC Scales, the elevations on the former likely reflect general distress more than they do features unique to Clinical Scales 1-3. Similarly, if RC1 was elevated, while RC2 and RC3 were in the normal range, the clinician could evaluate for the presence of a somatoform disorder. Further research is needed to validate this interpretative strategy.

MMPI/MMPI-2 findings in MS patients. Due to the high incidence of emotional disturbance in patients with MS, clinicians have sought to quantify and characterize these problems with comprehensive psychological instruments. However, because of the physical symptoms included in the MMPI/MMPI-2 questions, the true rate of psychopathology in this population has been difficult to determine. In an effort to address the question, Meyerink, Reitan, and Selz (1988) used the MMPI to assess 83 MS patients (59 males and 24 females) and compared their performance with a gender-matched control group selected from the original MMPI control group. Two neurologists determined which MMPI questions targeted physical and cognitive symptoms associated with MS and called these "symptom items." The authors compared the rate of endorsement of symptom items versus nonsymptom items for the MS patients and for the control group in each of the affected scales. The MS patients endorsed the symptom items significantly more frequently than nonsymptom items, and the controls had the opposite pattern of response. Analyses of individual scale items and elevations showed

that MS patients and controls had differential patterns of responding to the symptom and nonsymptom items on Scales 1, 2, 3, 7, and 8. In fact, there were enough symptom items on Scales 1, 2, 3, and 8 that the T scores of MS patients were elevated 3 to 15 points as a direct result of the accurate endorsement of their disease processes. Meyerink et al. concluded that the MMPI profiles of the MS patients reflected their physical ailments as well as possible personality or emotional problems.

Muller and Girace (1988) also examined MMPI findings in MS patients. They compared the profiles of 26 individuals with MS to 26 T score matched control subjects from the original MMPI normative database, using a modified MMPI from which they removed the 22 physical symptoms determined to be associated with MS. They found that the MS group's T scores on Scales 1, 3, and 8 (Hypochondriasis, Hysteria, and Schizophrenia) dropped an average of 13.81, 8.98, and 9.81 points respectively when the MS-related items were removed. These changes were significantly greater than those of the control group. The MS patients' T scores on Scales 1, 3, and 8 were lowered to the normal range (i.e., below 60), changing the resulting two-point code type of the profile (the two highest scale scores across the 10 Clinical Scales) from an 8/1 to 2/4. The researchers observed that Scale 2 T scores were not significantly lowered on their modified MMPI, likely because very few MS-specific items were located on the Depression Scale. They recommended employing a statistical correction procedure for this potential confounding factor.

Several other researchers have demonstrated that the MMPI and MMPI-2 contain items reflecting MS symptomatology (Baldwin, 1952; Elder, 1999; Marsh, Hirsch, & Leung, 1982; Nelson, et al., 2003), and various deletion strategies have been studied.

While such modifications have been promising, Taylor et al. (1986) cautioned that selectively removing questions from the MMPI violates the test's standardization that is the basis of cut-off scores and severity levels (as cited in Nyenhuis, et al., 1995). Alternatively, MMPI subscales have been developed to examine the separate influence of patients' neurological and psychiatric symptoms. Among these are the Hovey 5-Item Scale (1964) and the Shaw and Matthews Pseudoneurologic Scale (1965). The Hovey 5-Item Scale was criticized for its lack of specificity in differentiating organic conditions from functional psychopathology (Ruff, Ayers, & Templer, 1977). While investigation by Schwartz and Brown (1973) suggested the Pseudoneurologic Scale differentiated between MS and conversion hysteria patients, they found that different cutoff scores were required for the MS patients than those recommended by Shaw and Matthews. Statistical correction procedures have also been applied to the profiles of MS patients and other neurological populations (Carlton, 1996; Gass, 1992; Nelson, et al., 2003).

Summary and Implications

MS patients often require neuropsychological assessment in order to characterize any cognitive or mood disturbances that may reduce their quality of life and treatment adherence. The precise relationship between cognitive and emotional symptoms in the disease is unclear. Some research has suggested that mood problems, such as major depressive disorder, may contribute to cognitive difficulties (Arnett, Higginson, & Randolph, 2001; Arnett, Higginson, Voss, Bender, et al., 1999; Feinstein, 2006), particularly with regard to processing speed, working memory (Arnett, et al., 2001; Arnett, Higginson, Voss, Bender, et al., 1999; Arnett, Higginson, Voss, Wright, et al.,

1999; Thornton & Raz, 1997), and executive dysfunction (Arnett, et al., 2001). Alternatively, mood disturbance may arise when cognitive impairment causes occupational and social problems (Gilchrist & Creed, 1994). Other studies have failed to find an association between major depressive disorder and cognitive functioning in MS (DeLuca, Barbieri-Berger, & Johnson, 1994; Grafman, Rao, Bernadin, & Leo, 1991; Minden, Moes, Orav, Kaplan, & Reich, 1990; Rao, et al., 1993; Rohling, Green, Allen, & Iverson, 2002; Schiffer & Caine, 1991). However, as Hartlage et al. (1993) noted, non-MS research has suggested that there may be a certain threshold of depression required before cognitive dysfunction is evidenced (as cited in Demaree, Gaudino, & DeLuca, 2003). Moreover, studies with negative findings may have failed to demonstrate a relationship between depression and cognitive functioning due to methodological problems, such as the use of small sample sizes, depression rating scales that include vegetative symptoms, or cognitive measures lacking sufficient sensitivity (Feinstein, 2006). Evidence from a meta-analysis of ten studies examining the relationship between depression and performance on the Paced Auditory Serial Addition Test (PASAT; Gronwall, 1977; Gronwall & Sampson, 1974; Gronwall & Wrightson, 1974) suggested that MS patients with clinically significant depression demonstrated poorer performance compared to healthy controls (Thornton & Raz, 1997). However, none of these studies used a comprehensive measure of psychological functioning to compare groups with and without cognitive dysfunction. The measures they employed only evaluated depressive symptoms. A more thorough measure, such as the MMPI-2, may help to clarify the relationship between psychopathology and cognitive dysfunction in MS.

It is important to obtain a thorough understanding of MS patients' emotional strengths and vulnerabilities, and this is more likely to be accomplished through the use of a comprehensive inventory. However, MMPI-2 profiles in this population have been questioned by researchers, who suspect spurious inflation of Clinical Scales 1, 2, 3, 7, and 8 through accurate endorsement of physical symptoms. Because the MMPI-2 RC Scales were constructed in a way that partitioned physical symptoms to the RC1 Scale, they may be more appropriate for use with a neurological population such as MS. Research is needed to determine the nature of MMPI-2 RC Scale profiles in MS and compare findings to the Clinical Scales. Particularly given the conflicting findings about the association between depression and cognitive dysfunction, this relationship in MS patients should be further investigated.

CHAPTER 3

Rationale, Aims, and Hypotheses

Rationale and Aims

Although numerous studies have examined psychological functioning in MS, findings have yielded variable results. Some research has suggested an increased risk for depression and anxiety compared to healthy control participants and even other neurologic populations, while other research (using either deletion strategies with or without statistical correction procedures, or single-construct measures designed specifically for neurologic patients) has shown emotional disturbance in MS to be commensurate with other medical conditions. Estimates of cognitive dysfunction also vary, though in general are suggestive of mild to moderate deficits in attention, processing speed, executive functions such as problem solving, and possibly memory (although it has been argued that deficits in attention and processing speed may account for many "memory" complaints).

Emotional and cognitive dysfunction have each been shown to negatively impact activities of daily living in MS. The presence of mood disturbance has been associated with greater cognitive difficulties, particularly in the domains of attention, processing speed, working memory, and executive dysfunction. An important methodological problem with the assessment of emotional functioning in MS is that many measures, including the MMPI-2, incorporate numerous items reflecting physical symptoms that are common with the disease. Furthermore, extensive item overlap is present across the Clinical Scales, causing endorsement of somatic items to potentially elevate multiple

scales. As a result, the MMPI-2 Clinical Scales, particularly 1, 2, 3, 7, and 8, may be spuriously inflated to varying degrees. A traditional interpretation of such profiles may erroneously suggest that MS patients as a group are neurotic, anxious, depressed, and prone to somatization.

The MMPI-2 RC Scales, which do not have overlapping items, may be more useful for evaluation of a neurologic population such as MS. However, there is no published literature regarding RC Scale profiles in MS. Given the variable findings regarding the incidence of cognitive and emotional dysfunction in MS, and the problematic nature of the MMPI-2 somatic content across scales, as well as the lack of research with this population on the RC Scales, the current study aimed to do the following:

1. Compare the psychometric properties of the RC Scales versus Clinical Scales in an MS sample.
2. Compare the impact of the endorsement of somatic symptoms, such as those seen in MS, on the profiles of the RC Scales versus Clinical Scales.
3. Compare the impact of cognitive dysfunction on the RC Scales versus Clinical Scales.

Hypotheses

Aim I: Compare the psychometric properties of the RC Scales versus Clinical Scales in an MS population.

Hypothesis I-A: The RC Scales were expected to yield higher internal consistency coefficients [Cronbach's (1951) alpha

coefficients ≥. 70] compared to the Clinical Scales. Additional exploratory analyses examined mean item-total correlations for each Clinical and RC Scale.

Hypothesis I-B: RC Scale intercorrelations (Pearson product-moment correlations) were expected to be lower than Clinical Scale intercorrelations.

Aim II: Compare the impact of the endorsement of somatic symptoms, such as those seen in MS, on the profiles of the RC Scales versus Clinical Scales.

Hypothesis II: MS patients with clinically significant RC1 scores were expected to produce significantly higher elevations on the Clinical Scales compared to the RC Scales.

Aim III: Compare the impact of cognitive dysfunction on the RC Scales versus Clinical Scales.

Hypothesis III-A: Performance on select cognitive measures (WAIS-III Arithmetic and/or Digit Symbol Coding, Digit Vigilance Test, PASAT, verbal fluency, WCST) was expected to be more highly associated with scores on Clinical Scales 2 and 7, compared to RC2 and RC7, respectively.

Hypothesis III-B: Impaired performance (i.e., scores falling ≥ 1 SD below the normative mean on at least 2 of the above

cognitive measures) was expected to be associated with significantly higher elevations on Clinical Scales 2 and 7, compared to RC2 and RC7, respectively.

CHAPTER 4

Methodology

Participants

Participants included individuals with a diagnosis of MS who underwent a neuropsychological evaluation at the University of Texas Southwestern Medical Center at Dallas (UTSW) between August 1995 and April 2009.

Inclusion Criteria

1. Male or female
2. Age between 20 and 70 years
3. English speaking
4. Diagnosed with any subtype of MS by the referring clinician, based on clinical history, laboratory, and neuroimaging studies
5. Completed a valid MMPI-2, as indicated by Graham's (2006) guidelines for inpatients: The T score on F must be less than or equal to 100, the VRIN raw score must be less than 13 (T < 80), and the TRIN raw score must be less than 13 (T < 80 in the direction of true) and greater than 5 (T < 80 in the direction of false).

Exclusion Criteria

1. Below normal intellectual functioning (FSIQ < 80)
2. Prorated or incomplete MMPI-2 protocols

Of the original subject pool of 162 patients, 45 (27.8%) did not consent to have their test data used for research purposes, 18 (11.1%) had problematic MMPI-2 protocols (e.g., prorated or missing substantial information), 5 (3.1%) cases were removed because each was a re-evaluation of an included participant, 4 charts (2.5%) were unavailable, 3 patients (1.9%) produced invalid MMPI-2 profiles, 2 (1.2%) patients had an unconfirmed diagnosis of MS, and 1 patient (0.6%) was excluded because she was tested under nonstandard conditions. This resulted in a final sample of 84 participants.

Procedure

As indicated above, the MMPI-2 and cognitive measures were administered to participants as part of a comprehensive neuropsychological assessment for clinical purposes. Due to changes in the test battery over time and/or clinical reasons, not all measures were administered to every patient. Tests were administered and scored by an experienced psychometrician or psychology intern who had no knowledge of the current study's aims or hypotheses. Patients gave informed consent to have the measures administered as part of their clinical evaluation, but none had knowledge of the hypotheses of the current study. All data were de-identified prior to analysis. The MMPI-2 Clinical and validity scales, as well as the cognitive measures, were scored at the time of evaluation. The RC Scales were later scored by hand using scoring templates from Pearson Assessments. This study was approved by the Institutional Review Board of the University of Texas Southwestern Medical Center at Dallas.

Materials and Measures

Minnesota Multiphasic Personality Inventory-2 (MMPI-2; Butcher, et al., 1989). The MMPI-2 is an objective measure routinely used in diagnostic assessments to evaluate emotional and personality functioning. Normative data are available based on profiles of English-speaking individuals aged 18 and older. The MMPI-2 contains 567 self-report, true/false questions. Several validity scales have been derived from these items, as well as 10 Clinical Scales, 9 RC Scales, and numerous Content Scales. Scores on the validity scales (L, F, K, VRIN, TRIN) help the clinician determine whether an examinee answered questions truthfully, as opposed to feigning good or poor psychological health. The validity scales may also indicate inconsistent responding (e.g., due to decreased effort or comprehension problems). Validity scores within an acceptable range suggest that the profile may be interpreted with confidence, while abnormally high or low scores indicate that caution must be exercised when drawing conclusions from the results.

The MMPI-2 manual provides gendered and nongendered uniform T scores to aid in profile interpretation. These T scores have a mean of 50 and standard deviation of 10. Butcher and Williams (1992) recommended that MMPI-2 uniform T scores of 65 or greater be considered to represent clinical significance. Therefore, the present study assessed Clinical Scales 1-4 and 6-9 using this criterion. Clinical Scales 5 (Masculinity-Femininity) and 0 (Social Introversion) are not generally considered to reflect psychopathology (Graham, 2006) and do not have RC Scale counterparts.

MMPI-2-RC Scale profiles were derived from the same MS sample as the MMPI-2 in the current study. Due to differences in composition, Tellegen et al (2003)

provided separate uniform T scores (also gendered and nongendered), based on the MMPI-2 normative data. They recommended the same threshold (T scores > 65) for clinical significance. The retrospective nature of the current study precluded comparison with non-K-corrected T scores on the MMPI-2, as this correction factor was deemed unnecessary and not developed for the RC Scales. Non-K-corrected scores would have been ideal for comparison, although some research suggests that that comparable findings would have resulted regardless of whether the K-correction was applied (Wallace & Liljequist, 2005).

Digit Vigilance Test. The Digit Vigilance Test (DVT; Lewis, 1995; Lewis & Rennick, 1979) is a cancellation task developed as part of a larger assessment, the Repeatable Cognitive-Perceptual-Motor battery (Lewis & Rennick, 1979). The DVT requires vigilance, sustained attention, visual tracking ability, and psychomotor speed (Mitrushina, Boone, Razani, & D'Elia, 2005). The protocol includes two pages, the first printed in red ink and the second in blue ink. Each page consists of 35 single target digits, randomly dispersed across 59 rows, consisting of various other numbers. The examinee is instructed to cross out the number 6 as quickly and accurately as possible. The primary outcome measure that was analyzed was the T score for the time it takes to complete the task. Additionally, the total number of errors (i.e., the sum of the omissions and commissions) were reviewed.

The DVT manual (Lewis, 1995) refers the reader to the comprehensive normative data published by Heaton, Grant, and Matthews (1991), which was collected from several studies conducted over a 15-year period, to obtain T scores. Participants

underwent structured interviews and were excluded for endorsing a history of learning disabilities, neurological illness, “significant” head injury, “serious” psychiatric disorders (e.g., schizophrenia), or substance abuse. The final sample for the DVT included 280 participants with an average age of 44.9 (SD = 20.0) years and 14.0 (SD = 3.2) years of education. Regression-based T scores are provided, with separate scores available based on gender, ten age groups, and six education groups.

Research is lacking on this measure, though a factor analysis performed by Grant et al. (1987) showed the DVT to cluster with tests of attention and psychomotor speed. Analyses of diazepam-taking versus placebo groups have suggested high internal reliability (Rich & Brown, 1992) and discriminant validity (Kelland & Lewis, 1996; Rich & Brown, 1992). Bivariate correlations with the Digit Symbol Coding subtest of the WAIS and the Trail Making Test, Part B, suggest sensitivity to detection of generalized cerebral dysfunction. DVT performance has been shown to distinguish chronic progressive MS patients from Alzheimer’s disease patients, with the MS patients tending to perform worse (Filley, Heaton, Nelson, Burks, & Franklin, 1989). Significant differences have also been detected in groups of patients with chronic obstructive pulmonary disease (COPD; Grant, et al., 1987; Prigatano, Parsons, Wright, Levin, & Hawryluk, 1983), insulin-dependent diabetes (DCCT Research Group, 1994), and various stages of Human Immunodeficiency Virus (HIV; Heaton et al., 1995).

Paced Auditory Serial Addition Test. The Paced Auditory Serial Addition Test (PASAT; Gronwall, 1977; Gronwall & Sampson, 1974; Gronwall & Wrightson, 1974; Sampson, 1956) involves an addition task designed to assess working memory, divided

and sustained attention, and processing speed (Lezak, 1995; Lezak, Howieson, Loring, et al., 2004; Shucard et al., 2004; Strauss, Sherman, & Spreen, 2006). The task also involves basic arithmetic and numeracy skills, and therefore is considered a multifaceted measure (Sherman, Strauss, & Spellacy, 1997; Strauss, et al., 2006). Numbers 1-9 are presented verbally and the examinee is asked to consecutively add paired numbers (versus adding the number to the prior answer). The rate of presentation is increased across 4 trials, thereby incrementally increasing information processing demands under timed conditions. While several scores can be derived, the measure generally analyzed is the total number of correct responses (Strauss, et al., 2006). This study utilized the T score for correct responses, adjusted for age, gender, and education level, based on normative data available from Heaton, Grant, and Matthews (1991).

The PASAT has strong evidence of internal consistency, with split half reliability estimates greater than .90 (Egan, 1988). Construct validity has been demonstrated through corroborative correlations with other measures of attention, such as the Visual Search and Attention Task (r = 0.55) and Trail Making Test, Part B (r = 0.58) and other tests of concentration, processing speed, and working memory (Crawford, Obansawin, & Allan, 1998; Deary, Langan, Hepburn, & Frier, 1991; Gronwall & Wrightson, 1981). The PASAT has been found to be impaired in a number of MS samples (DeLuca, Johnson, Beldowicz, & Natelson, 1995; DeLuca, Johnson, & Natelson, 1993; Gronwall, 1977; Johnson, DeLuca, Diamond, & Natelson, 1996; Parmenter, Shucard, Benedict, & Shucard, 2006; Rosti, Hamalainen, Koivisto, & Hokkanen, 2007), to accurately distinguish MS patients from various control groups (Kujala, Portin, Revonsuo, & Ruutiainen, 1995; Solari & Filippini, 1995), and to correlate with the total area of

sclerotic brain lesions (utilizing an experimental scoring system; Snyder & Cappelleri, 2001) in MS. Furthermore, Rosti et al. (2007) found the PASAT to have a sensitivity and specificity of 74% and 65%, respectively, in MS.

Verbal fluency tests. Verbal fluency tasks require spontaneous production of words under timed and restricted conditions. Successful performance appears to depend on intact auditory attention, short-term memory, initiation and maintenance of word production set, cognitive flexibility, response inhibition, processing speed, and long-term vocabulary storage (see review in Mitrushina, et al., 2005). In the form utilized here, participants were asked to produce as many words as they could, starting with a particular letter (F, A, and S) and then within a category (animals). The primary variables obtained were the total words produced in one minute for all three letters combined and for the total number of animals named. These totals were compared to normative data stratified by age, sex, and education (Heaton, Miller, Taylor, & Grant, 2004), resulting in phonemic and semantic fluency T scores. In addition to total words generated, perseverative errors (repeated words) and losses of set (rule violations) were reviewed.

Verbal fluency has been found to have high internal consistency (phonemic fluency alpha coefficient = .83; Tombaugh, Kozak, & Rees, 1999) and interrater reliability (r = .99; Ross, 2003). A large meta-analysis performed by Henry and Crawford (2004) showed focal frontal lesions to be associated with proportional verbal fluency deficits, suggesting sensitivity to executive dysfunction (Parker & Crawford, 1992; Phillips, 1997; Reitan & Wolfson, 1994). In another study, phonemic fluency was found to be more strongly and specifically related to the presence of frontal lesions than

the Wisconsin Card Sorting Test (Henry & Crawford, 2004). Several investigations have suggested impaired verbal fluency in MS (e.g., Beatty, et al., 1989; Beatty, et al., 1988; Friend et al., 1999; Matotek, Saling, Gates, & Sedal, 2001; Rao, et al., 1991; Rao, Leo, & St. Aubin-Faubert, 1989; Santiago, Guardia, Casado, Carmona, & Arbizu, 2007). A meta-analytic review by Zakzanis (2000) found semantic fluency to be more impaired than phonemic fluency (i.e., *M* effect size = -.99 versus -.78, respectively), in MS. However, a more recent meta-analysis performed by Henry and Beatty (2006), that statistically controlled for the effects of duration of illness, neurological disability, and age, found comparable impairments on phonemic and semantic fluency in MS (r = .42 for each). Comparison with performance on other executive functioning measures led the authors to conclude that cognitive slowing was more likely contributing to the verbal fluency difficulties than executive functioning deficits.

Wechsler Adult Intelligence Scale, Arithmetic subtest (Revised and 3rd Editions; Wechsler, 1981; Wechsler, 1997). The Arithmetic subtest of the Wechsler Adult Intelligence Scale (WAIS-R or WAIS-III, respectively) requires participants to mentally solve math problems that are presented orally under time constraints. The WAIS-III is a revision of the WAIS-R and provides scaled scores (M = 10, SD = 3) derived from a standardization sample of 2,450 examinees, with normative data stratified (i.e., by age, gender, race/ethnicity, education level, and geographic region) to reflect the composition of the 1995 U.S. Census. The WAIS-III Arithmetic subtest added 6 new items to the 14 WAIS-R items to extend the floor and ceiling of the test, and the subtest's discontinue criterion increased from 3 to 4 incorrect responses. This raises the possibility

that combining scores from both versions of the test could diminish estimates of functioning at the extreme lower and upper limits of ability. Therefore, the data were carefully reviewed for outliers, and tests of normality were conducted.

Research is limited regarding the Arithmetic test in MS, although given the working memory difficulties common with the disease, it may be a sensitive task for detecting deficits in this population. Consistent with this, Santiago et al. (2007) reported significantly worse performance in relapse-remitting patients compared to healthy controls, although the scores of the MS group still fell in the average range of functioning.

Wechsler Adult Intelligence Scale, Digit Symbol Coding subtest (Revised and Third Editions; Wechsler, 1981, 1997). The Digit Symbol Coding subtest of the Wechsler Adult Intelligence Scale (WAIS-R or WAIS-III, respectively) requires participants to copy symbols that are paired with numbers under timed conditions. Using a key, the examinee draws each symbol under its corresponding number. The score is the total number of symbols correctly copied within 120 seconds. As with the WAIS-R and WAIS-III Arithmetic subtest, Digit Symbol Coding scores are converted to scaled scores (M = 10, SD = 3) derived from the same sample of 2,450 examinees. Successful performance on Digit Symbol Coding is primarily dependent upon intact psychomotor speed, (Strauss, et al., 2006), with contributions from motor persistence, sustained attention, and visuomotor coordination (Schear & Sato, 1989).

Wisconsin Card Sorting Test. The Wisconsin Card Sorting Test (WCST; Heaton, et al., 1993) is a measure requiring participants to match 128 response cards, one at a time, to four stimulus cards, arranged in front of them. Though the cards can be sorted along three different dimensions (color, form, and number), participants are not given this information upfront. Instead, they must utilize the examiner's feedback indicating "correct" or "incorrect" following each selection and then modify their responses accordingly to successfully sort the cards. The sorting principle changes after ten consecutive correct responses, allowing for assessment of perseverative responding and cognitive flexibility (i.e., the examinee's ability to generate alternative strategies). The primary measure analyzed from the WCST was the T score for total number of perseverative responses. Performances were compared to normative data adjusted for age and education, as these demographic variables strongly correlate with performance.

The WCST is generally considered to be a measure of frontal lobe integrity (Arnett et al., 1994; Heaton, et al., 1993; Rezai et al., 1993; Stuss et al., 2000; Weinberger, Berman, & Zec, 1988), and executive functioning (Heaton, et al., 1993), requiring planning, organized searching, utilization of environmental feedback to modify behavior (i.e., shifting of cognitive set), goal-oriented behavior, and regulation of impulsive responding. Impaired performances have been demonstrated in MS samples (Arnett, et al., 1994; Beatty & Monson, 1996), as well as other populations known to exhibit executive functioning impairments (e.g., Beatty & Monson, 1996; Brokate et al., 2003; Green et al., 2002; Lacerda et al., 2003; Minshew, Meyer, & Goldstein, 2002; Rosselli & Ardila, 1996).

Statistical Analyses

Data were analyzed with the Statistical Package for the Social Sciences for Windows, version 16.0 (SPSS 16.0) and Microsoft Excel 2007. Descriptive statistics are reported for the following demographic and disease variables: age, gender, ethnicity, education, and duration since diagnosis. Additionally, mean scores and standard deviations are reported for the following measures: Full Scale IQ, Verbal IQ, Performance IQ, WAIS-R/WAIS III Arithmetic and Digit Symbol Coding, DVT, PASAT, verbal fluency (letters and animals), WCST, the MMPI-2 Clinical and RC Scales.

Aim I: Compare the psychometric properties of the RC Scales versus Clinical Scales in an MS population.

Hypothesis I-A: The RC Scales were expected to demonstrate higher internal consistency compared to the Clinical Scales.

Cronbach's (1951) alpha coefficients of internal consistency were calculated for the RC and Clinical Scales in a subset of 25 participants, selected using a true random integer generator (Haahr, 2008). It was expected that alphas for the RC Scales in this sample would be equal to or greater than .70, whereas the Clinical Scales would produce lower alpha coefficients. Additional exploratory analyses examined mean item-total correlations for each Clinical and RC scale.

Hypothesis I-B: RC Scale intercorrelations were expected to be lower than Clinical Scale intercorrelations.

Pearson product-moment correlations were computed between each RC Scale and the other RC Scales, and likewise for the Clinical Scales.

Aim II: Compare the impact of the endorsement of somatic symptoms, such as those seen in MS, on the profiles of the RC Scales versus Clinical Scales.

Hypothesis II: MS patients with clinically significant RC1 scores were expected to produce significantly higher elevations on the Clinical Scales compared to the RC Scales.

First, two groups were created, consisting of participants whose RC1 scores were < 65, and another whose scores were ≥ 65 (clinically significant). Paired sample proportions tests with Yates correction (Kirk, 1990, p. 418) were computed between the high and low RC1 Scale groups on each RC and Clinical Scale pair (except for RC1/Scale 1) to determine whether a significant frequency difference in other elevations existed between the groups. Dependent t-tests were also conducted, comparing the mean T scores in the high and low RC1 groups to determine whether a significant difference was present in RC and Clinical Scale profiles between each group.

Aim III: Compare the impact of cognitive dysfunction on the RC Scales versus Clinical Scales.

Hypothesis III-A: Performance on select cognitive measures (WAIS-III Arithmetic and/or Digit Symbol Coding, DVT, PASAT, verbal

fluency, WCST) was expected to be associated with scores on Clinical Scales 2 and 7, as well as RC2 and RC7.

To evaluate this hypothesis, Pearson product-moment correlations were computed between the cognitive test scores, RC Scales, and Clinical Scales.

Hypothesis III-B: Impaired performance (i.e., scores falling ≥ 1 SD below the normative mean on at least 2 of the above cognitive measures) was expected to be associated with significantly higher elevations on Clinical Scales 2 and 7, compared to RC2 and RC7, respectively.

To evaluate Hypothesis III-B, two groups were created, consisting of cognitively impaired (as defined above) and non-cognitively impaired participants (i.e., impairment on not more than one of the measures). Paired sample proportions tests with Yates correction were conducted between the groups on each pair of RC and Clinical Scales to determine whether a significant difference in frequency of elevations (i.e., T scores ≥ 65) was present. Additionally, dependent t-tests were conducted, comparing the RC and Clinical Scales of the cognitively impaired and non-impaired groups to determine whether significant differences existed between the mean scores based on cognitive performance.

CHAPTER 5

Results

Descriptive Data

Table 6 provides descriptive characteristics of the participants. The sample consisted of 15 (17.9%) males and 69 (82.1%) females, ranging in age from 21 to 69 years, with a mean of 43.8 years (SD = 9.4), at the time of assessment. The majority of the sample was Caucasian (*n* = 81; 96.4%) and right handed (*n* = 77; 91.7%). The average length of time since diagnosis of MS was 8.03 years (SD = 6.46). The mean education completed was 15.4 years (SD = 2.4). The Full Scale IQ was 102.7 (SD = 12.7), with similar Verbal and Performance IQ scores.

Insert Table 6 here

Duration of illness was not significantly correlated with cognitive scores or the RC or Clinical Scale scores. These data are presented in Table 7. Descriptive statistics for the RC Scales and Clinical Scales for the total sample are presented in Table 8. Mean scores for the RC Scales were within the normal range, with the exception of RC1 (*M* = 68.45, SD = 12.28). The Clinical Scales were all higher than their respective RC Scales, with significant elevations present on Scales 1, 2, 3, and 8. Scale 7 approached clinical significance at a T score of 63.96 (SD = 12.28).

Insert Tables 7 and 8 here

Neurocognitive scores for the total sample are presented in Table 9. Higher T scores represent better performance. Due to the changes between the WAIS-R and WAIS-III Arithmetic subtests, these scores were reviewed for outliers and found to approximate a normal distribution, with skewness and kurtosis well within the normal range. The mean scores for Arithmetic, PASAT, semantic fluency, and WCST fell in the average range, while Digit Symbol Coding, DVT, and phonemic fluency were low average. Using a 1 SD criterion below the normative mean, the following percent of participants showed impairment on the cognitive measures: Arithmetic = 17.3%, Digit Symbol Coding = 41.5%, DVT = 47.3%, PASAT = 31.9%, FAS = 48.2%, Animals = 28.9%, and WCST = 25.6%. Table 10 presents this information.

Insert Tables 9 and 10 here

Analyses of Hypotheses

Hypothesis I-A. Based on prior research (e.g., Rogers, et al., 2006; Sellbom, et al., 2006), the first hypothesis stated that the RC Scales would demonstrate higher Cronbach's (1951) internal consistency alpha coefficients ($\geq .70$), compared to the Clinical Scales. This hypothesis was tested by computing Cronbach's alpha for 25

randomly chosen participants, for whom MMPI-2 item responses were input. Internal consistency coefficients for each of the RC and Clinical Scales are presented in Table 11.

Insert Table 11 here

The data only partially supported this hypothesis. In general, the coefficients were similar between the RC and Clinical Scales. The mean alpha for the RC Scales was .749, while the mean alpha for the Clinical Scales was .777. The RC Scale coefficients ranged from .619 (for RC9) to .909 (for RC6), with 6 of the 9 scales producing alphas $\geq$ .70 (the exceptions fell slightly below this threshold). The Clinical Scale coefficients ranged from .484 (for RC9) to .914 (for RC8), with 6 of 8 scales producing alphas $\geq .70$. The two RC Scales that appeared to have significantly higher coefficients compared to their respective Clinical Scales were RC6/Clinical Scale 6 (.909 compared to .621) and RC9/Scale 9 (.619 compared to .484). The Clinical Scales in the current study actually produced comparable or greater coefficients for all of the other scale pairs, with particularly high differences noted for scale pairs RC7/Scale 7 (a = .753 compared to .905, respectively) and RC8/Scale 8 (a = .623 compared to .914, respectively).

Further analyses were conducted for the same participants to examine the mean item-total correlations for the RC and Clinical Scales. These correlations are included in Table 11. According to Clark and Watson (1995), optimal item-total correlations fall between r = .15 to .50. The mean item-total correlations were roughly within this range for both the RC and Clinical Scales, with RC6 (r = .072) and Scale 3 (r = .520) falling

slightly outside the guidelines. The mean item-total correlation for all of the RC Scales was *r* = .271, compared with *r* = .399 for the Clinical Scales.

Hypothesis I-B. As the RC Scales were designed to improve upon the discriminant validity of the Clinical Scales, Hypothesis I-B posited that RC Scales' intercorrelations would be lower than those of the Clinical Scales. This hypothesis was evaluated by calculating Pearson product-moment correlations among the RC and Clinical Scales. These intercorrelations are presented in Tables 12 and 13, respectively. Consistent with the hypothesis, the mean intercorrelation among the RC Scales was *r* = .361, compared to *r* = .558 among the Clinical Scales. Intercorrelations for the RC Scales ranged from *r* = .018 (for RC3/RC4) to *r* = .733 (for RCd/RC2), while the Clinical Scales ranged from *r* = .26 (for Scales 2/9) to *r* = .874 (for Scales 1/3). Fifty percent of the RC Scales produced significant intercorrelations, compared to 82% for the Clinical Scales. When all 28 possible pairs were considered, 99% (all but the RC7/RC9 and Scale 7/Scale 9 comparisons) of the RC Scales produced lower intercorrelations compared to the Clinical Scales. Thus, Hypothesis I-B was supported.

Insert Tables 12 and 13 here

Hypothesis II. The second hypothesis stated that endorsement of somatic symptoms would be associated with higher elevations on the Clinical Scales compared to the RC Scales. To evaluate this hypothesis, two groups were compared, one with RC1 T

scores < 65 ("non-elevated somatic symptom endorsers"), and the other with T scores ≥ 65 ("high somatic symptom endorsers"). Similarly, each of the other RC and Clinical Scale scores was assigned to either a non-elevated group (T score < 65) or elevated group (T score ≥ 65). Paired sample proportions tests with Yates correction were computed within the high RC1 group (n = 49) on each pair of RC and Clinical Scales, with the exception of RC1/Scale 1, to examine the frequency of RC and Clinical Scale elevations. As Table 14 illustrates, a significantly greater number of Clinical Scales were clinically elevated for 6 of the 8 scale pairs: RC2/Scale 2 (z = 4.36, p <.0001), RC3/Scale 3 (z = 6.48, p <.0001), RC4/Scale 4 (z = 2.67, p = .008), RC7/Scale 7 (z = 4.90, p <.0001), RC8/Scale 8 (z = 5.57, p <.0001), and RC9/Scale 9 (z = 2.27, p = .023). RC Scale scores in the clinically significant range occurred in 0% (for RC9) to 37% (for RC2) of the patients. Clinical Scale scores were significant for 14% (for Scale 9) to 96% (for Scale 3) of the patients. In several cases, the differences in elevations were striking. For example, 18 participants (37%) had elevations on RC2, while 39 (80%) elevated Scale 2. RC3 was elevated in only 3 (6%) individuals, while 47 (96%) elevated Scale 3. RC7 was elevated in 6 (12%) cases, while Scale 7 was elevated in 32 (65%) cases. RC8 was elevated in 10 (20%) cases, compared to Scale 8 in 43 (88%) cases. Analyses were repeated using performance on Clinical Scale 1 (i.e., T scores ≥ 65) to identify "high somatic endorsers," with similar results.

Insert Table 14 here

Hypothesis II was further evaluated by performing dependent t-tests. Using the same elevated RC1 group, mean T scores for each RC and Clinical Scale pair were compared. When these scores were examined, significantly higher Clinical Scale scores were found for every scale pair. No mean RC Scale score was clinically significant. In contrast, mean T scores of ≥ 65 were found for Clinical Scales 2, 3, 7, and 8. These results are presented in Table 15. These analyses support Hypothesis II, suggesting a stronger relationship between somatic symptoms and Clinical Scale elevations, compared to the RC Scales.

Insert Table 15 here

To examine whether the RC and Clinical Scale elevation differences were a function of somatic symptom endorsement, rather than merely a reflection of overall elevations on each measure (MMPI-2 Clinical Scales and MMPI-2 RC Scales), additional calculations were performed. First, the paired sample proportion tests with Yates correction were calculated for the non-elevated RC1 group (n = 35) to compare elevations between the RC and Clinical Scale pairs. Table 16 presents this data. In contrast with the elevated RC1 group, significantly more Clinical Scale elevations were found between only 2 of 8 scale pairs: RC3/Scale 3 (z = 3.18, p = .002) and RC8/Scale 8 (z = 2.47, p = .013). However, as Table 17 shows, dependent t-tests between scale pairs for the non-elevated RC1 group showed significantly higher mean T Scores on the Clinical Scales between almost every scale pair, with the exception of RC6/Scale 6 (z = -

.756, p = .455). No mean T score in the non-elevated RC1 group reached the level of clinical significance for any of the RC or Standard Clinical Scales.

Insert Tables 16 and 17 here

Paired sample proportion tests and independent t-tests were also computed for the total sample (i.e., high and non-elevated RC1 groups combined; N = 84). As Table 18 indicates, the paired sample proportion tests found significantly more elevations for the Clinical Scales among pairs RC2/Scale 2 (z = 4.51, p < .0001), RC3/Scale 3 (z = 7.35, p < .0001), RC4/Scale 4 (z = 2.77, p = .006), RC7/Scale 7 (z = 5.39, p <.0001), and RC8/Scale 8 (z = 6.25, p < .0001). Despite the greater number of Clinical Scale elevations for 5 of 7 RC/Clinical Scale pairs in the entire sample, every Clinical Scale showed more elevations in the high RC1 group compared to the entire sample. For example, Clinical Scale 2 was elevated in 80% of high somatic symptom endorsers, 54% of the total sample, and 17% of the non-elevated somatic symptom endorsers. This pattern of elevations (i.e., high RC1 group T scores > all participants T scores > non-elevated RC1 group T scores) was consistent across all of the Clinical Scales. The RC Scales showed a similar pattern for all scales except RC9, which was not elevated for any of the high somatic symptom endorsers.

Insert Table 18 here

Table 19 presents the results of the independent t-tests comparing mean scores for the RC and Clinical Scales in the entire sample. Significantly higher Clinical Scale scores were found for every scale pair. Clinically significant elevations were found for RC1 (M = 68.45, SD = 12.28), Scale 1 (M = 71.95, SD = 12.56), Scale 2 (M = 68.17, SD = 15.19), Scale 3 (M = 72.07, SD = 14.61), and Scale 8 (M = 67.01, SD = 12.32). Additionally, Scale 7 showed a trend toward significance (M = 63.96, SD = 12.28). Given the greater number of elevations and higher mean T Scores observed for high somatic symptom endorsers on the Clinical Scales, Hypothesis II was largely supported (i.e., 6 significantly greater elevations present in the elevated RC1 group pairs compared to 2 elevations among the non-elevated RC1 group pairs, with 4 of the mean Clinical Scale scores in the high somatic symptom endorsers falling in the clinically significant range). The finding of significant differences for number of elevations and mean scores in the total sample suggests these differences may have also been related to the Clinical and RC Scale measures themselves, rather than solely to somatic symptom endorsement.

Insert Table 19 here

Figures 1 and 2 show the Clinical and RC Scale profiles for the entire sample in relation to their respective scores for the high and non-elevated RC1 groups. The t-tests for the Clinical Scales showed a similar pattern to that seen in the paired sample proportions tests. That is, the mean T scores were highest for the elevated RC1 group, second highest for the entire sample, and lowest for the non-elevated somatic symptom endorsers. In addition, the high RC1 group produced 4 elevated ($T \geq 65$) Clinical Scales (i.e.,

considering only Scales 2-4 and 6-9), compared to 3 Clinical Scale elevations in the entire sample. When the high somatic symptom endorsers and non-elevated somatic symptom endorsers were compared to the entire sample on the RC Scales, a similar pattern (i.e., high RC1 group T scores > all participants T scores > non-elevated RC1 group T scores) was observed for all scales except RC4, which was comparable in the high RC1 group and entire sample (M = 51.57 and 51.86, respectively).

Insert Figures 1 and 2 here

Hypothesis III-A. Hypothesis III-A predicted that cognitive performances on select measures (i.e., WAIS-III Arithmetic and/or Digit Symbol Coding, DVT, PASAT, verbal fluency, WCST) would be more highly associated with scores on Clinical Scales 2 and 7, compared to RC2 and RC7. To evaluate this hypothesis, Pearson product-moment correlations were calculated to examine the correlations between mean cognitive test scores and the RC and Clinical Scales. These correlations are presented in Tables 20 and 21. Given the large number of comparisons, the alpha level was set at .001. Using this criterion, no significant correlations were found between cognitive performance and either set of Scales. In fact, the correlations between the cognitive scores and the RC Scales were quite low, ranging from of r = -.001 to -.176 (for RC2) and r = .030 to -.299 (for RC7), with an average (across all scales) of r = -.081. Similarly correlations between the cognitive scores and Clinical Scales 2 and 7 were weak, ranging from $r \leq .000$ to -.285 (for Scale 2) and r = -.007 to -.207 (for Scale 7), with an average of r = -.096. As

cognitive performance was predicted to be more highly associated with RC2 and RC7, compared to Clinical Scales 2 and 7, this hypothesis was not supported.

Using a criterion of $p < .05$, the DVT was correlated with RC3 and RC7 (r = -344 and -.299, respectively), as well as Clinical Scales 2 and 8 (r = -.285 and -.296, respectively). Digit Symbol Coding was correlated at this level with RC8 (r = -.240), and with Scales 8 and 9 (r = -.267 and -.273, respectively). In addition, the PASAT correlated with Scale 6 (r = -.381, $p < .01$), and with Scales 1 and 3 (r = -.297 and -.358, respectively, $p < .05$). Thus, using more liberal criteria, the Clinical Scales had 7 significant correlations, while the RC Scales only had 3.

Insert Tables 20 and 21 here

Hypothesis III-B. Hypothesis III-B predicted that impaired cognitive performance (i.e., scores falling ≥ 1 SD below the normative mean on at least 2 of the above cognitive measures) would be associated with significantly higher elevations on Clinical Scales 2 and 7, compared to RC2 and RC7, respectively. To evaluate this hypothesis, two groups were created, consisting of cognitively impaired participants (as defined above) and non-cognitively impaired participants (i.e., impairment on no more than one of the cognitive measures). Paired sample proportions tests with Yates correction were conducted for the cognitively impaired group (n = 50), comparing each pair of RC and Clinical Scales to determine whether a significant difference in frequency of elevations (i.e., T scores ≥ 65) was present. A significantly greater number of

elevations were found for the Clinical Scales between scale pairs RC1/Scale 1 ($z = 2.0$, $p = .046$), RC2/Scale 2 ($z = 3.75$, $p = .0002$), RC3/Scale 3 ($z = 5.57$, $p < .0001$), RC4/Scale 4 ($z = 2.0$, $p = .046$), RC7/Scale 7 ($z = 4.25$, $p < .0001$), and RC8/Scale 8 ($z = 4.90$, $p < .0001$). These data are presented in Table 22.

Insert Table 22 here

Next, dependent t-tests were conducted, comparing the RC and Clinical Scales of the cognitively impaired group to determine whether significant differences existed between the mean scores based on cognitive performance. Significantly higher Clinical Scale scores were found for every scale pair except for RC6/Scale 6 ($t = -1.70$, $p = .095$). As Table 23 shows, clinically significant elevations were found for only one RC Scale (RC1), compared to five Clinical Scales (Scales 1, 2, 3, 7, and 8).

Insert Table 23 here

As with Hypothesis II, paired sample proportion tests were calculated for the non-cognitively impaired group ($n = 34$). These results, presented in Table 24, showed significantly more Clinical Scale elevations for scale pairs RC2/Scale 2 ($z = 2.21$, $p = .027$), RC3/Scale 3 ($z = 4.59$, $p < .0001$), RC7/Scale 7 ($z = 3.02$, $p = .003$), and RC8/Scale 8 ($z = 3.61$, $p = .0003$). Dependent t-tests computed for the non-cognitively impaired group are presented in Table 25. Significantly higher Clinical Scale scores were found for every scale pair. Clinically significant elevations were found for RC1 ($M =$

67.32, SD = 12.86), Scale 1 (*M*= 70.47, SD = 14.69), Scale 2 (*M*= 65.82, SD = 13.57), and Scale 3 (*M* = 71.88, SD = 13.80).

Taken together, these results support the hypothesis that cognitive dysfunction is associated with higher elevations for Clinical Scales 2 and 7 compared to RC2 and RC7. Moreover, the rest of the Clinical Scales, with the exception of Scale 6 (and 9, in the paired sample proportion tests), produced significantly higher elevations compared to the RC Scales, in cognitively impaired participants.

Insert Tables 24 and 25 here

CHAPTER 6

Discussion

Cognitive and emotional difficulties are common in individuals with MS, due to physical as well as psychosocial factors associated with the disease. Discrepancies in the literature regarding emotional and cognitive functioning in MS likely reflect both methodological and sample-related differences across studies. A significant problem in MS research involves the use of measures tapping single constructs, such as depression questionnaires (e.g., BDI), which may fail to provide a complete picture of psychological difficulties and/or be confounded in MS by the inclusion of vegetative symptoms of depression. Comprehensive inventories, such as the MMPI-2, provide a broader examination of emotional functioning, and are therefore more likely to be used in medical settings. However, the MMPI-2 has long been criticized for its less than optimal psychometric properties. Perhaps more importantly, researchers have consistently voiced concern about the potential complications arising when using the MMPI-2 with neurological patients. Due to the overlap of somatic content across scales, Clinical Scales 1, 2, 3, 7, and 8 have been suspected of being spuriously elevated in MS patients through the accurate endorsement of physical symptoms (Baldwin, 1952; Elder, 1999; Marsh, et al., 1982; Meyerink, et al., 1988; Mueller & Girace, 1988; Nelson, et al., 2003).

The MMPI-2 RC Scales were developed largely to address criticisms regarding the psychometric shortcomings of the MMPI-2. Early research has suggested that the RC Scales have improved reliability and discriminant validity (e.g., Tellegen, et al., 2003). A primary reason for the purported improved psychometrics was the removal of item

overlap across scales. This process included a reassignment of "demoralization" items to RCd, as well as partitioning most somatic-related items to a single scale, RC1. The RC1 scale, along with the increased homogeneity in the other RC Scales, may be advantageous for use with neurological populations such as MS patients. Moreover, the item count in the RC Scales was reduced and may be less burdensome for individuals with fatigue and concentration difficulties. However, the MMPI-2 RC Scales have not previously been studied in MS patients or in relation to cognitive functioning.

Given the lack of research regarding RC Scale profiles in MS, this study aimed to do the following: (1) examine the psychometric properties, including internal reliability and discriminant validity, of the RC Scales and compare the findings to the MMPI-2 Clinical Scales in an MS sample; (2) explore the relationship between endorsement of somatic symptoms and elevations on the RC and Clinical Scales; and (3) compare the impact of cognitive dysfunction in MS on the RC and Clinical Scales. To accomplish these goals, data from 84 MS outpatients were compiled, and analyses performed on scores from the Clinical and RC Scales, as well as cognitive measures. The findings, limitations, and implications will be discussed in the following sections.

General Findings

The sample was primarily comprised of females (82.1%) with a mean age of 43.8 years (SD = 9.4). Almost all patients were Caucasian. The average education of participants was 15.4 years (SD = 2.4), though their Full Scale, Verbal, and Performance IQ scores were in the average range. Time since diagnosis, which averaged 8.03 years (SD = 6.46), was not correlated with any of the RC or Clinical Scale scores or the

cognitive measures. This is in accordance with prior research suggesting that duration of illness is not a significant predictor of cognitive impairment in MS (e.g., Beatty, et al., 1990; Denney, et al., 2005; Lynch, et al., 2005; Marsh, 1980; Rao, et al., 1991; Wishart & Sharpe, 1997), and adds evidence that illness duration is minimally associated with psychological symptomatology.

Overall performances on most cognitive measures (i.e., WAIS-III/WAIS-R Arithmetic, PASAT, Animals, and the WCST) fell in the average range of functioning, while Digit Symbol Coding, DVT, and FAS scores were low average. It is possible that the low average scores on Digit Symbol Coding, DVT, and FAS reflected differential cognitive demands among the tasks, such as an increased requirement for processing speed (Boone, Ponton, Gorsuch, Gonzales, & Miller, 1998; Grant, et al., 1987; Mitrushina, et al., 2005; Salthouse, Atkinson, & Berish, 2003; Strauss, et al., 2006) or attentional control (Elias, Elias, D'Agonstino, Silbershatz, & Wolf, 1997; Grant, et al., 1987; Mitrushina, et al., 2005; Schear & Sato, 1989). FAS is known to be a sensitive indicator of brain dysfunction (Lezak, Howieson, & Loring, 2004), and has been found to be impaired in MS patients (e.g., Beatty, et al., 1989; Beatty, et al., 1988; Friend, et al., 1999; Matotek, et al., 2001; Rao, et al., 1991; Rao, Leo, & St. Aubin-Faubert, 1989; Santiago, et al., 2007). Individuals with MS have also shown reduced performance on Digit Symbol Coding compared to healthy controls (Kujala, et al., 1995; Kujala, Portin, & Ruutiainen, 1997; Zakzanis, 2000), and on the DVT compared to Alzheimer's disease patients (Filley, et al., 1989).

Another consideration is that some participants were not given all of the measures. In particular, the DVT (N = 55) and PASAT (N = 47) were administered to

fewer patients than other tests. Due to the retrospective nature of the study, the reason for the participants not completing these measures was unknown, although it was speculated that the clinician may have anticipated certain patients to be unduly frustrated by the tests, particularly the PASAT, known to be a challenging task. Additionally, the mean PASAT score was average (M = 45.13, SD = 13.46), which was inconsistent with numerous prior investigations that found MS patients to be impaired on this measure (e.g., DeLuca, et al., 1995; DeLuca, et al., 1993; Gronwall, 1977; Johnson, et al., 1996; Parmenter, et al., 2006; Rosti, et al., 2007).

To compare the PASAT examinees with non-PASAT examinees, cognitive scores on the other measures were compared for these groups. The only performance significantly different between the groups was Digit Symbol Coding, $t(80) = 3.13$, $p = .002$, with those who were given the PASAT performing in the average range (M = 8.98, SD = 2.96) versus low average (M = 6.94, SD = 2.87) in the non-PASAT examinees. Given the significant processing speed component of Digit Symbol Coding, it is possible that the patients not administered the PASAT were perceived to be more cognitively slowed and therefore less capable of a successful performance on the measure. If so, the PASAT mean score may have been confounded by a selection bias, rendering the average performance less representative of the overall sample.

Alternatively, the current sample may have not been significantly cognitively impaired. As performances ≥ 1 standard deviation below the mean were observed for 17.3% (Arithmetic) to 48.2% (FAS) of participants across the measures, the finding of overall cognitive scores to be in the low average to average range was surprising. Prior reports in the literature have suggested difficulties on these tasks in MS. For example, a

large meta-analysis performed by Zakzanis (2000) found moderate to large effect sizes for the WAIS-R Digit Symbol subtest (*d* = -.1.03, SD = .56), Controlled Oral Word Association Test (*d* = -.78, SD = .32), semantic fluency (*d* = -.99, SD = .30), WCST Perseverative Responses (*d* = .57, SD = .29), and PASAT (*d* = -.48, SD = .18) in distinguishing MS patients from healthy controls. Zakzanis reviewed neurocognitive test results from 34 studies, which included 1,845 patients. However, he did not provide information about the type of patients who were tested. Given the large number of studies, there was almost certainly a more heterogeneous pool of participants compared to the current study. "Clinic attenders" assessed in another meta-analysis of 37 studies were observed to have cognitive dysfunction across a variety of domains. Neither total number of participants, nor detailed information about the type of patients, were reported in this study, although sample sizes for the analyses of domains ranged from 798 to 7,575, which stands to reason that a diverse group of MS patients were included in these analyses. The lack of cognitive impairment in this study likely indicates that patients were examined at times of minimal disease expression or that there was minimal cerebral dysfunction in this sample.

In contrast with the low average to average mean cognitive scores, several MMPI-2 Scales were abnormal. However, the number of elevations on the RC Scales was markedly different from that of the Clinical Scales, with the latter showing significantly more elevations on 6 of 8 scales. The RC Scales were elevated in up to 58.3% (for RC1) of participants, compared to 70.2% (for Scale 2) participants among the Clinical Scales. As Figure 3 illustrates, only one mild elevation (for RC1) was present among the mean RC Scale scores. In contrast, four Clinical Scales had elevated mean

scores, including Scales 1, 2, 3, and 8, with Scale 7 showing a trend toward significance, which are scales more vulnerable to being elevated due report of physical/cognitive symptoms (Alfano, et al., 1993; Gass, 1992; Gass & Wald, 1997; Glassmire, et al., 2003; Mack, 1979; Moehle & Fizhugh-Bell, 1988).

Insert Figure 3 here

The elevated RC1 Scale is consistent with increased somatic symptoms reported in MS patients, and similarly, Scales 1 and 3 were expected to be higher than average. The lack of elevated mean scores on RC2 and RC8, compared to the high Scale 2 and 8 scores, suggests the latter may have been impacted by endorsement of physical symptoms. At the same time, approximately one quarter to one half of MS patients report depressive symptomatology (Joffe, et al., 1987; Minden, et al., 1987; Patten, et al., 2003; Sadovnick, et al., 1996), and the percentages of elevated RC2 and Scale 2 scores are consistent with these figures (25% and 53.6%, respectively). Anxiety disorders, on the other hand, have been estimated to occur in 25% of MS patients, which is higher than suggested by RC7 (7.1% elevated) but lower than the elevations on Scale 7 (44%,). RCd scores, which were elevated in 19% of the participants, may have reflected more worry and maladjustment than RC7. Tellegen et al., (2003) based RCd largely on their model of a pleasantness-unpleasantness dimension and acknowledged that a portion of the scale reflected components of anxiety that were contained in Scale 7. It is therefore possible, that RCd was a better indication of anxious symptoms than RC7.

Discussion of Hypotheses

Hypothesis I-A: The RC Scales were expected to demonstrate higher internal consistency compared to the Clinical Scales.

Tellegen et al., (2003) reported several areas of improved psychometric properties in the RC Scales compared to the Clinical Scales. Using three clinical samples, they found largely comparable or higher internal consistency coefficients for the RC Scales compared to their Clinical Scale counterparts. The greatest improvement was seen on RC6 (which ranged from *a* = .78 to .86) compared to Scale 6 (which ranged from *a* =.59 to .68), despite the fact that the RC Scales have significantly fewer items, (e.g., RC6 is comprised of 17 items compared to 40 on Scale 6), and less saturation of the Demoralization (RCd) variance found across the Clinical Scales.

Reliability analyses of the present study's 25-patient subset supports Tellegen and colleagues' findings regarding RC6/Scale 6, (*a* = .909 and .621, respectively) and RC9/Scale 9 (*a* = .619 and .484, respectively), although the Clinical Scales produced comparable or greater coefficients for the other scale pairs, with particularly high differences noted for RC7/Scale 7 and RC8/Scale 8. The largest difference occurred between the latter pair (Scale 8 *a* = .914 versus RC8 *a* = .623), and may have been influenced by the scales' item counts, which showed the greatest discrepancy at 55 items (i.e., 17 compared to 69, respectively). Additionally, RC8 contains far fewer items reflecting MS symptomatology, raising the possibility that greater endorsement of neurological symptoms increased the consistency of Scale 8. Overall, the internal consistency for the Clinical Scales was largely comparable or slightly better compared to the RC Scales, and this hypothesis was not supported.

One explanation for these findings, which differ from previous reports (Rogers, et al., 2006; Simms, Casillas, Clark, Watson, & Doebbeling, 2005; Tellegen, et al., 2003), is that the other studies utilized significantly larger sample sizes, which would tend to increase internal consistency. Another factor may be that endorsement of somatic symptoms influenced coefficients to a greater degree among the Clinical Scales due to item overlap, while the RC Scales contained a significantly reduced influence of physical symptom saturation across scales. Consistent with this, the Clinical Scales' higher alphas occurred on Scales 1, 2, 3, 4, 7, and 8. All of these except Scale 4 have been shown to be elevated in populations with greater endorsement of physical symptoms on the MMPI-2 (Alfano, et al., 1993; Gass, 1992; Gass & Wald, 1997; Glassmire, et al., 2003; Mack, 1979; Moehle & Fizhugh-Bell, 1988).

Item-total correlations were also conducted in the same subset of patients to examine the homogeneity of the RC and Clinical Scales. Given the method of development for the RC Scales, which involved removal of the shared Demoralization (RCd) variance, more item-total correlations would have been expected to fall within the optimal range (i.e., .15 to .50; Clark & Watson, 1995) for the RC Scales compared to the Clinical Scales. However, this was not found. Although the mean RC Scale item-total correlation was lower than that of the Clinical Scales, both were within the optimal range. Each produced item-total correlations within the optimal range for approximately the same percentage of their scales. The weakest correlation, which was present for RC6 (r = .072), may have been impacted by the scale's low item count, (n = 11), resulting from a lack of variance among certain items.

Hypothesis I-B: RC Scale intercorrelations were expected to be lower than Clinical Scale intercorrelations.

Pearson product-moment correlations computed between each RC Scale and the other RC Scales resulted in a lower mean intercorrelation of (r = .361), compared to the Clinical Scales' mean intercorrelation (r = .558). The RC Scales produced lower intercorrelations for nearly every comparison, suggesting the RC Scales measure more distinctly different constructs than the Clinical Scales. Therefore, although the alpha coefficients were relatively comparable between the measures, the RC Scales proved more distinct from one another, providing evidence of greater discriminant validity than the Clinical Scales.

This finding is consistent with the intercorrelations reported by Tellegen et al., (2003) in 7 large samples, including 5 clinical samples (i.e., 410 male and 610 female community mental health center patients, 722 male and 501 female psychiatric inpatients, and 1,229 male Veteran inpatients). Of note, the high correlations between RCd and some of the other RC Scales, particularly RC2 (r = .733, $p < .01$), suggest that shared variance is still present between some of the RC Scales and RCd. This relationship may reflect the demoralization component present with other psychological symptomatology. For example, the correlation between RCd and RC2 may reflect endorsement of such symptoms as pessimism, low expectations or appraisal of success, or discouragement.

Hypothesis II: MS patients with clinically significant RC1 scores were expected to produce significantly higher elevations on the Clinical Scales compared to the RC Scales.

The premise of Hypothesis II was that, because of less overlap and inclusion of somatic items across the RC Scales, endorsement of physical symptoms would have less of an effect on RC profile elevations compared to the Clinical Scales. To evaluate this hypothesis, the number of clinically significant elevations ($T \geq 65$) and mean T scores were compared between high somatic symptom endorsers (RC1 T score ≥ 65) and non-elevated somatic symptom endorsers (RC1 $T < 65$). Paired sample proportion tests with Yates correction found significantly more Clinical Scale elevations compared to the RC Scales in the group of high somatic symptom endorsers ($n = 49$) for 6 of 8 scale pairs. Particularly large differences ($p < .0001$) were observed between pairs RC2/Scale 2, RC3/Scale 3, RC7/Scale 7, and RC8/Scale 8. In comparison, the non-elevated somatic symptom endorsers only had more Clinical Scale elevations for the pairs RC3/Scale 3 and RC8/Scale 8. Dependent t-tests showed significantly higher means for every Clinical Scale, compared to their respective RC Scales, in the elevated RC1 group, and for all but one pair (RC6/Scale 6) in the non-elevated RC1 group. Interestingly, none of the mean RC Scale scores was clinically elevated in the high RC1 group, while 4 of the 7 Clinical Scales (Scales 2, 3, 7, and 8) were significantly elevated. The dependent t-tests in the non-elevated somatic symptom endorsers produced no clinically elevated mean scores in either the RC or Clinical Scale groups, despite the significant differences between almost every scale pair.

Examination of elevations and mean T scores for the entire participant group (i.e., including both the high and non-elevated RC1 groups; $N = 84$) revealed significantly higher Clinical Scale scores for nearly every scale pair, with exceptions noted for RC6/Scale 6 and RC9/Scale 9 (in the paired sample proportions tests, but not

the independent t-tests), although both of these pairs showed a trend toward significance that may have been statistically significant within a larger sample. Again, clinically significant mean scores were found for Scales 1, 2, 3, and 8. However, despite the Clinical Scale elevations in the entire sample, the high somatic endorsers nevertheless produced greater elevations on every scale. The largest differences between the elevated RC1 group and entire sample, at 8.4 points, were observed for Scales 2 and 3. Therefore, the high somatic symptom endorsers were more likely to show elevations on the Clinical Scales compared to the RC Scales.

Hypothesis II, which predicted that RC1 elevations would be associated with higher Clinical Scale scores, compared to the RC Scales, was largely supported. The Clinical Scale elevations on Scales 1, 2, 3, and 8 (with a trend toward significance on Scale 7; $M = 63.96$, SD = 23.28) are consistent with prior MMPI-2 research in MS (Baldwin, 1952; Elder, 1999; Marsh, et al., 1982; Meyerink, et al., 1988; Mueller & Girace, 1988; Nelson, et al., 2003). In addition, the significantly higher Clinical Scale T scores for the high somatic symptom endorsers suggests that item overlap, likely of somatic symptoms, may spuriously inflate Clinical Scale scores while the RC Scales are less impacted and present a purer measure of psychopathology. Examination of the overall RC Scale scores suggests that either this was not a particularly psychopathological sample, or that the RC Scales may not be sensitive enough to detect emotional problems in this group.

Hypothesis III-A: Performance on select cognitive measures (WAIS-III Arithmetic and/or Digit Symbol Coding, Digit Vigilance Test, PASAT, verbal

fluency, WCST) was expected to be more highly associated with scores on Clinical Scales 2 and 7, compared to RC2 and RC7.

Pearson product-moment correlations computed between the mean cognitive test scores and the RC and Clinical Scales did not produce significant results using a conservative criterion of $p < .001$. The correlations were quite weak, with averages (across all respective scales) for the RC Scales of $r = -.081$, and Clinical Scales of $r = -.096$. However, significant correlations were found using more liberal criteria. With a level of $p < .05$, the Clinical Scales were correlated with the DVT (Scales 2 and 8), Digit Symbol Coding (Scales 8 and 9), and the PASAT (Scales 1 and 3), the latter being correlated with Scale 6, as well, at the level of $p < .01$. The RC Scales were correlated at the level of $p < .05$ with the DVT (RC7 and RC3) and Digit Symbol Coding (RC8). As cognitive scores were predicted to be more highly associated with RC2 and RC7, compared to Clinical Scales 2 and 7, this hypothesis was not supported. Using more liberal criteria, Clinical Scales had 7 significant correlations, while the RC Scales only had 3, although all correlations were low and accounted for a very small percent of variance.

Research regarding the association between objective cognitive dysfunction and MMPI-2 scores is surprisingly limited. The literature generally describes comparisons of suspected or feigned malingerers with normal controls on symptom validity tests (Green, 2003, 2004; Green, Allen, & Astner, 1996; Hiscock & Hiscock, 1989; Slick, Hopp, Strauss, & Spellacy, 1996; Tombaugh, 1996) and MMPI-2 validity subscales, such as the Fake Bad Scale (Downing, Denney, Spray, Houston, & Halfaker, 2008; Gervais, Ben-Porath, Wygant, & Green, 2008; Greiffenstein, Baker, Gola, Donders, & Miller, 2002;

Larrabee, 2003). Peyser et al. (1980) reported elevated Scale 8 scores in a small sample of MS patients who showed cognitive impairment. However, most studies have not compared performance on standard neuropsychological measures with MMPI-2 Scale elevations.

Depression has been shown to interfere with cognitive functioning in a variety of psychiatric populations (for review, see Hartlage, et al., 1993), though some studies have found little or no relationship between cognitive deficits and depressed mood in psychiatric and neurological populations (Crews Jr. & Rhondes, 1999; Reitan & Wolfson, 1997; Rohling, et al., 2002; Wong, Wetterneck, & Klein, 2000). It has been suggested that depression may interfere with cognitive functioning due to such factors as distracting ruminations (Sarason, Sarason, Keefe, Hayes, & Shearin, 1986), discouragement and frustration (Lezak, Howieson, Loring, et al., 2004), or response slowing (Kalska, Punamaki, Makinen-Pelli, & Saarinen, 1999). Consistent with the first and third explanations, attentional difficulties, impaired working memory, and decreased processing speed have been reported in MS patients (Arnett, et al., 2001; Arnett, Higginson, Voss, Bender, et al., 1999; Arnett, Higginson, Voss, Wright, et al., 1999; Demaree, et al., 2003; Feinstein, 2006; Gilchrist & Creed, 1994; Thornton & Raz, 1997). However, Lezak (2004) noted that mild symptoms are less likely to affect cognitive test performance compared to a severe depressive disorder. The participants in the current study did not have significant RC2 scores and produced only mild Scale 2 elevations (M = 68.17, SD = 15.19), suggesting minimal depressive symptomatology, which may explain the general lack of relationship between cognitive test scores and the depression scales. Similarly, although anxiety has been shown to be associated with increased

cognitive dysfunction (Julian & Arnett, 2009; Sarason, et al., 1986), the current MS sample did not elevate RC7 or Scale 7.

Using liberal criteria, more Clinical Scales correlated with cognitive performances compared to the RC Scales. This suggests the Clinical Scales may tend to be more strongly influenced by cognitive difficulties. Had Clinical Scales 2 and 7 been higher, a stronger relationship with cognitive functioning may have been seen. The three measures with the most significant correlations across both the RC and Clinical Scales were Digit Symbol Coding, the PASAT, and the DVT, which may be influenced more by processing speed than Arithmetic, WCST, and verbal fluency tests. However, low levels of correlation in general indicate that emotional symptoms had little impact on cognitive test performances.

Hypothesis III-B: Impaired cognitive performance (i.e., scores falling ≥ 1 SD below the normative mean on at least 2 of the above cognitive measures) was expected to be associated with significantly higher elevations on Clinical Scales 2 and 7, compared to RC2 and RC7, respectively.

Hypothesis III-B was evaluated by creating two groups, one considered cognitively impaired (n = 50), and another considered non-cognitively impaired (i.e., impairment on no more than one of the cognitive measures; n = 34). Group differences in terms of RC and Clinical Scale elevations were evaluated by paired sample proportions tests and dependent t-tests. A significantly greater number of elevated Clinical Scales were observed in the cognitively impaired group for every scale pair except RC6/Scale 6 and RC9/Scale 9 (although the latter pair trended toward significance at p = .074).

Dependent t-tests between the RC and Clinical Scale mean scores in the cognitively impaired group showed significantly higher Clinical Scale scores for every scale pair except for RC6/Scale 6. In the non-cognitively impaired group, the number of Clinical Scale elevations was also greater for scale pairs RC2/Scale 2, RC3/Scale 3, RC7/Scale 7, and RC8/Scale 8. The dependent t-tests found significantly higher Clinical Scale scores for all pairs in this group except RC6/Scale 6 (t = -1.96, p = .058).

Considering both types of analyses, the cognitively impaired group produced higher Clinical Scale scores on 6 to 7 scale pairs, while the non-cognitively impaired group had higher Clinical Scale scores on 4 to 7 scale pairs. Although the non-cognitively impaired group produced higher mean Clinical Scale scores on the RC2/Scale 2 and RC7/Scale 7 pairs, Scale 2 was mildly elevated (M = 65.82, SD = 13.57), and Scale 7 trended toward clinical significance, while both RC2 and RC7 were well within normal limits. In fact, the only RC Scale that showed clinical significance in either group was RC1, with mean scores of 69.22 (SD = 11.93) and 67.32 (SD = 12.86) in the cognitively and non-cognitively impaired participants, respectively. In contrast, 5 mean Clinical Scale scores were elevated in the cognitively impaired group (Scales 1, 2, 3, 7, and 8), compared to 3 in the non-cognitively impaired group (Scales 1, 2, and 3). Comparison with mean scores for the entire sample (i.e., the combined cognitively impaired and non-cognitively impaired groups), also supported the finding of higher Clinical Scale elevations in the cognitively impaired participants.

The highest elevations in the cognitively impaired group were produced on Scale 1 (M = 72.96, SD = 11.77) and Scale 3 (M = 72.20, SD = 15.27), which showed impairment in 73% and 72% of participants, respectively. It is interesting to note that

Scale 3 showed the highest elevation in the high somatic symptom endorsers and correlates strongly with Scale 1 (r = .874, p < .01). These elevations in both the high somatic symptom endorsers and the cognitively impaired group raise the possibility that a similar mechanism may mediate the effects of cognitive and physical symptoms on Scales 1 and 3. Scales 2 and 7 were also elevated to a higher degree in the cognitively impaired versus non-cognitively impaired group, while RC2 and RC7 did not show such a relationship with the groups. Taken together, the results support the hypothesis that cognitive dysfunction is associated with higher Clinical Scale compared to RC Scale elevations for Scales 2 and 7. Moreover, the rest of the Clinical Scales, with the exception of Scale 6 (and 9, in the paired sample t-test), produced significantly higher elevations compared to the RC Scales, in this group.

Conclusions and Implications

The present study both supported and contradicted prior findings of certain improved psychometric properties in the RC Scales. Internal consistency reliability of the RC Scales, as measured by Cronbach's alpha coefficients, did not appear improved compared to the Clinical Scales in this MS sample. However, higher item-total correlations for the RC Scales support improved internal consistency, and lower inter-scale correlations are evidence of higher discriminant validity for the RC Scales compared to the Clinical Scales. Thus, although the RC Scales appeared to remain somewhat heterogeneous, results nevertheless suggested they may represent more circumscribed constructs and better discriminate among emotional symptoms than the Clinical Scales.

Whether this is advantageous should be further explored, as some have argued that these changes fail to account for comorbidity of symptoms (Nichols, 2006) captured by the "syndromal fidelity" of the Clinical Scales. Nichols illustrated this point by noting that the removal of Demoralization from Clinical Scale 2 subtracted a substantial core variance, namely symptoms of anhedonia, from RC2. Given the concentration difficulties, slowed thinking, and irritability that can be seen in MS, dividing symptoms of depression in this way may have minimized RCd, RC2, or RC7 scale elevations, thereby missing important clinical information. However, Tellegen (2003) argued that analysis of the RC Scales may provide incremental information beyond that of the Clinical Scales, a contention that has found support among other clinicians (Finn & Kamphuis, 2006). For example, RCd and RC2 scores may be able to clarify scores on Scale 2, since RCd is supposed to represent a general hedonistic valence, while RC2 tends to reflect the presence or lack of positive affect.

Although the RC Scales showed some improved psychometric properties, mean scores for the sample were almost entirely within the normal range in this sample. Rogers et al. (2006) questioned the utility of the RC Scales, given their findings of more within normal limits (WNL) profiles for clinically referred patients on the RC versus Clinical Scales. In their analysis of 7,330 patients from Caldwell's (1997) dataset, they found WNL profiles in 40.4% of female clients and 44.8% of male clients for the RC Scales, compared to 30.8% and 36.1% WNL for males and female, respectively, for the Clinical Scales. This raises the possibility that the RC Scales miss a portion of psychopathological symptoms that the Clinical Scales capture. However, an alternate

explanation is that the Clinical Scales are prone to spurious elevations due to item overlap and heterogeneity.

In addition to providing information about RC Scale scores in an MS sample, this study supported prior research that suggested somatic symptoms may tend to inflate the Clinical Scales, including Scales 2, 3, 7, and 8. Moreover, cognitive dysfunction, relative to normal cognition, was associated with higher elevations for Scales 1, 2, 3, 7, and 8. These findings strengthen the contention that MMPI-2 Clinical Scale profiles should be carefully interpreted in MS patients. Inaccurate conclusions about psychopathology in such individuals may lead to inappropriate treatment recommendations, thereby complicating recovery. The RC Scales may prove more useful and appropriate for MS patients, given the suggestion of decreased influence of cognitive and physical symptoms upon scale elevations.

Finally, given the evidence of certain improved psychometric properties, despite having fewer items, the RC Scales may be more efficient and less burdensome for MS patients, and perhaps other medical populations, in light of fatigue and concentration difficulties that are common with the disease.

Limitations of the Study

The current study contributed important information to the growing literature regarding the RC Scales, as well as additional information about cognitive and emotional functioning in MS. However, a limitation was the smaller sample size, compared to previous studies, making Type II errors a possibility. Similarly, not all cognitive measures were administered to every patient, raising the possibility that results were

influenced by selection bias or other characteristics of participants. Additionally, this sample of convenience was quite homogeneous, such as having a relatively high education (M = 15.4, SD = 2.4) and consisting of almost exclusively Caucasians, which may limit the generalizability of these findings.

This study involved the use of retrospective data, which limited the variables available for analyses, such as disease subtype or levels of disability. Disease subtype has been found to impact cognitive functioning in some studies, (e.g., Beatty, et al., 1989; Heaton, et al., 1985), although given the minimal deficits observed in the present study, and the commonalities of the types of cognitive dysfunction across MS subtypes, disease subtype may have played a minimal role in these results. In terms of physical symptomatology, the current study only examined patient *endorsement* of somatic problems. An objective measure of physical disability may have added insight into the reasons patients endorsed physical symptoms, perhaps clarifying the meaning of RC and Clinical Scale elevations. A clinician-rated measure, such as the Expanded Disability Status Scale (EDSS; Kurtzke, 1983), may have helped characterize the relationship between disease severity and emotional dysfunction. This association is uncertain (Millefiorini et al., 1992), with some researchers reporting increased psychological disturbance in more disabled patients (Bamer, Cetin, Johnson, Gibbons, & Ehde, 2008; Chwastiak et al., 2002; McIvor, Riklan, & Reznikoff, 1984; Surridge, 1969), and others finding functional impairments to be relatively independent of emotional problems (Harper, Harper, Chambers, Cino, & Singer, 1986; Meyerink, et al., 1988; Rabins, et al., 1986; Vercoulen et al., 1996).

Finally, the present study only examined the primary RC and Clinical Scales, excluding subscales that may contribute important information to the understanding of MMPI-2-RF profiles. For example, comparison of the measures' validity scales may shed light on some of the concerns authors have expressed regarding the increased face validity of the RC Scales (Rogers, et al., 2006; Simms, 2006).

Future Directions

Future research should aim for prospective research designs, so that additional variables can be analyzed and, perhaps, manipulated. For example, it would be useful to know if emotional symptoms, as detected by the RC Scales, are influenced by MS disease subtype or functional limitations. Comparison with external measures of psychopathology, such as the MDI or SCID-IV, would allow for examination of MS patient profiles to help evaluate the concurrent validity of the RC Scales and further clarify whether the WNL profiles accurately capture emotional symptoms. Examination of RC Scale scores in other neurological and medical populations is warranted, given the limited research currently available. The endorsement of different types of physical and cognitive symptoms may differentially impact scale elevations. The present study, as in prior work, found Clinical Scales 1, 2, 3, and 8 to be elevated in this sample of MS patients. Given that the RC Scales did not demonstrate similar elevations, (although RC3 would not necessarily be expected to be elevated due to its highly different nature relative to Scale 3), further examination of the influence of physical and cognitive symptoms on the RC Scales is needed to confirm these findings.

This study supports the utility for the RC Scales with MS patients and other neurological populations, given the evidence of improved psychometric properties and a reduced tendency to show spurious elevations associated with physical and cognitive symptoms. Further investigation of RC Scale psychometric properties and profiles will add to the understanding of this revised measure.

APPENDIX A

Tables and Figures

Table 1

Schumacher Criteria for a Clinical Diagnosis of MS

- Appropriate age (10-50 years)
- CNS white matter disease
- Lesions disseminated in time and space
- Two or more separate lesions
- Objective abnormalities
- Consistent time course
- Attacks lasting more than 24 hours, spaced 1 month apart
- Slow, stepwise progression for more than 6 months
- Signs and symptoms cannot be better explained by another disease process
- Minimum routine laboratory investigation
- Diagnosis by a physician competent in clinical neurology

Note. Adapted from "Problems of experimental trials of therapy in multiple sclerosis: Report by The Panel on the Evaluation of Experimental Trials of Therapy in Multiple Sclerosis," by G. A. Schumacher et al., 1965, *Annals of the New York Academy of Sciences*, 122 (Research in Demyelinating Disease), 552-568.

Table 2

Poser Committee Criteria for a Clinical Diagnosis of MS

- Clinically definite MS
  - 2 attacks and clinical evidence of 2 separate lesions
  - 2 attacks, clinical evidence of one and paraclinical evidence of another separate lesion
- Laboratory-supported Definite MS
  - 2 attacks, either clinical or paraclinical evidence of 1 lesion, and cerebrospinal fluid (CSF) immunologic abnormalities
  - 1 attack, clinical evidence of 2 separate lesions & CSF abnormalities
  - 1 attack, clinical evidence of 1 and paraclinical evidence of another separate lesion, and CSF abnormalities
- Clinically probable MS
  - 2 attacks and clinical evidence of 1 lesion
  - 1 attack and clinical evidence of 2 separate lesions
  - 1 attack, clinical evidence of 1 lesion, and paraclinical evidence of another separate lesion
- Laboratory -supported probable MS
  - 2 attacks and CSF abnormalities

Note. Adapted from "New diagnostic criteria for multiple sclerosis: Guidelines for research protocols," by C. M. Poser et al., 1983, *Annals of the Neurology*, 13(3), 227-231.

Table 3

The McDonald Consensus Criteria for a Clinical Diagnosis of MS

- At least 2 attacks with objective clinical evidence of at least 2 lesions
- At least 2 attacks with objective clinical evidence of 1 lesion plus dissemination in space shown on MRI, or 2 or more MRI lesions consistent with MS plus positive CSF finding or second clinical attack
- One attack with objective clinical evidence of at least 2 lesions plus dissemination in time on MRI or second clinical attack
- One attack with objective clinical evidence of 1 lesion, plus dissemination in space shown on MRI, or 2 or more MRI lesions consistent with MS plus positive CSF finding and dissemination in time shown on MRI or second clinical attack
- Insidious neurologic progression suggestive of MS plus 1 year of disease progression determined retrospectively or prospectively and 2 of the following: positive brain MRI result (nine T2 lesions or at least four T2 lesions with positive Visual Evoked Potential), positive spinal cord MRI result with two focal T2 lesions, and positive CSF findings.

Note. Adapted from "Recommended diagnostic criteria for multiple sclerosis: Guidelines from the International Panel on the Diagnosis of Multiple Sclerosis," by W. I. Alistair et al., 2001, *Annals of the Neurology*, 50, 121-127.

Table 4

Forms of MS

Relapsing-remitting	Characterized by clearly defined disease relapses (sudden increase of symptoms) with full remission. Periods between relapses show lack of disease progression.
Primary progressive	Disease progression is evidenced from the onset. Symptomatic improvements are generally occasional, minor, and transient.
Secondary progressive	Begins with a relapsing-remitting pattern and is followed by a steady progression of symptoms, sometimes with intermittent relapses, minor remissions, and plateaus.
Progressive relapsing	Disease progression occurs from the onset, but there are clear acute exacerbations with or without recovery. Periods between relapses are characterized by gradual progression.
Benign	Characterized by an initial symptomatic expression followed by slow or no progression at all.
Malignant	Disease progresses rapidly, leading to significant disability or death within a relatively short time after symptom onset.

Note. Adapted from "Defining the course of multiple sclerosis: Results of an international survey," by F. Lublin, & S. Reingold, 1996, *Neurology*, 46, 906-911.

Table 5

MMPI-2 Clinical Scales and Corresponding Restructured Clinical (RC) Scales with Item Counts

Standard Clinical Scales	Item Count	Restructured Clinical (RC) Scales	Item Count
----[a]		RCd – Demoralization (dem)	24
1 – Hypochondriasis (Hs)	32	RC1 – Somatic Complaints (som)	27
2 – Depression (D)	57	RC2 – Low Positive Emotions (lpe)	17
3 – Hysteria (Hy)	60	RC3 – Cynicism (cyn)	15
4 – Psychopathic Deviate (Pd)	50	RC4 – Antisocial Behavior (asb)	22
6 – Paranoia (Pa)	40	RC6 – Ideas of Persecution (per)	17
7 – Psychasthenia (Pt)	48	RC7 – Dysfunctional Negative Emotions (dne)	24
8 – Schizophrenia (Sc)	78	RC8 – Aberrant Experiences (abx)	18
9 – Hypomania (Ma)	46	RC9 – Hypomanic Activation (hpm)	28

Note. Clinical Scales 5 (Masculinity-Femininity) and 0 (Social Introversion) have been omitted here because they do not reflect psychopathology and have no corresponding RC scales.

[a]No corresponding scale

Table 6

Descriptive Characteristics of Total Sample (n = 84)

Variable	*n*	Mean	SD	Range
Age (Years)	84	43.80	9.40	21-69
Education (Years)	84	15.40	2.40	11-25
Duration of Disease (Years)	77	8.03	6.46	1 – 30
Full Scale IQ	71	102.72	12.68	78 – 135
Verbal IQ	72	105.26	11.44	80 – 131
Performance IQ	72	99.18	14.84	70 – 138
	n	%		
Female	69	82.1		
Male	15	17.9		
Race				
Caucasian	81	96.4		
African American	1	1.2		
Eastern Indian	1	1.2		
Native American	1	1.2		
Right Handed	77	91.7		
Left Handed	7	8.3		

SD = standard deviation

Table 7

Pearson Correlations between Duration of Illness, RC and Clinical Scale Scores, and Cognitive Measures

MMPI-2 Clinical/RC Scale	Correlation with Duration of Illness (n = 77)	p	Cognitive Measure	Correlation with Duration of Illness	p
Scale 1	.000	.998	Arithmetic (n = 69)	-.214	.078
Scale 2	.085	.461	Digit Symbol (n = 75)	-.145	.213
Scale 3	.001	.996	DVT (n = 51)	-.220	.121
Scale 4	-.122	.292	PASAT (n = 44)	-.139	.367
Scale 6	-.017	.880	FAS (n = 76)	-.142	.173
Scale 7	.029	.799	Animals (n = 76)	.007	.952
Scale 8	-.018	.874	WCST (n = 75)	-.030	.800
Scale 9	.050	.666			
RCd	-.039	.739			
RC1	.032	.783			
RC2	.070	.547			
RC3	-.019	.869			
RC4	.014	.901			
RC6	.160	.165			
RC7	.134	.245			
RC8	.187	.104			
RC9	-.024	.835			

Table 8

Descriptive Statistics for RC and Clinical Scales for All Patients

RC Scales					Clinical Scales				
Scale	Mean (SD)	Median	Range[a]	% > 65[b]	Scale	Mean (SD)	Median	Range	% > 65
RCd	55.87 (11.18)	54	36 – 83	19.0					
RC1	68.45 (12.28)	68	36 – 93	58.3	1	71.95 (12.56)	71	43 – 99	69.0
RC2	57.61 (12.79)	57	38 – 99	25.0	2	68.17 (15.19)	66	44 – 99	53.6
RC3	47.46 (7.49)	46	38 – 74	3.6	3	72.07 (14.61)	72	45 – 104	70.2
RC4	51.86 (9.16)	48	35 – 77	7.1	4	55.81 (11.53)	54	39 – 89	20.2
RC6	51.86 (10.37)	43	41 – 88	7.1	6	54.99 (11.61)	55	34 – 100	15.5
RC7	50.74 (11.57)	50	32 – 100	7.1	7	63.96 (12.28)	63	37 – 97	44.0
RC8	52.74 (9.97)	52	38 – 82	11.9	8	67.01 (12.32)	67	37 – 99	60.7
RC9	45.05 (7.64)	45	30 – 69	1.2	9	51.81 (9.31)	51	35 – 87	8.3

Note. $N = 84$.

SD = standard deviation.

[a]Range values are displayed as follows: lowest T score – highest T score. [b]Percent of participants with T score ≥ 65.

Table 9

Cognitive Scores of Participants

Variable	*n*	Mean (SD)	Range
Arithmetic Scaled Score[a]	75	10.24 (2.46)	4 – 15
Digit Symbol Coding Scaled Score[a]	82	8.09 (3.08)	3 – 16
Digit Vigilance Test T Score	55	40.95 (14.09)	10 – 65
PASAT T Score	47	45.13 (13.46)	12 – 67
Phonemic Fluency (FAS) T Score	83	40.18 (9.51)	14 – 63
Animal Fluency T Score	83	45.08 (10.85)	16 – 71
Wisconsin Card Sorting Test T Score	82	49.24 (14.29)	18 – 83

[a]Eighteen (21.4%) participants were administered the Wechsler Adult Intelligence Scale, Revised Edition (WAIS-R), and the remaining 66 (78.6%) participants completed the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III).

PASAT = Paced Auditory Serial Addition Test

Table 10

Number and Percent of Participants with Impaired Cognitive Performances

Measure	*n* Impaired/ Total Administered	Percent
Arithmetic Scaled Score[a]	13/75	17.3
Digit Symbol Coding Scaled Score[a]	34/82	41.5
Digit Vigilance Test T score	26/55	47.3
PASAT T score	15/47	31.9
Phonemic Fluency (FAS) T score	40/83	48.2
Animal Fluency T score	24/83	28.9
Wisconsin Card Sorting Test T Score	21/82	25.6

Note. Performance was considered impaired when the score was ≥ 1 standard deviation below the normative mean.

[a]Eighteen (21.4%) participants were administered the Wechsler Adult Intelligence Scale, Revised Edition (WAIS-R), and the remaining 66 (78.6%) participants completed the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III).

PASAT = Paced Auditory Serial Addition Test

Table 11

Internal Consistency of RC and Clinical Scales as Indicated by Internal Consistency Coefficients (Cronbach's Alpha) and Item-Total Correlations

RC Scales				Clinical Scales			
Scale	*n* of Items	Cronbach's Alpha	Mean Item-Total Correlation	Scale	*n* of Items	Cronbach's Alpha	Mean Item-Total Correlation
RCd	24	.893	.346				
RC1	27	.856	.397	1	32	.887	.448
RC2	17	.701	.324	2	55	.814	.494
RC3	15	.721	.314	3	60	.802	.520
RC4	18	.663	.205	4	48	.786	.353
RC6	11	.909	.072	6	33	.621	.351
RC7	24	.753	.262	7	48	.905	.362
RC8	17	.623	.179	8	69	.914	.288
RC9	27	.619	.340	9	44	.484	.374
Mean Value	20	.749	.271		49	.777	.399

Table 12

Pearson Product Moment Correlation Coefficients of the MMPI-2 RC Scales

	Scale								
Scale	RCd	RC1	RC2	RC3	RC4	RC6	RC7	RC8	RC9
RCd	-----	.597*	.733*	.183	.550*	.387*	.572*	.458*	.236
RC1		-----	.451*	.183	.327	.243	.363	.518*	.199
RC2			-----	.253	.390*	.271	.533*	.363	-.042
RC3				-----	.018	.293	.400*	.412*	.168
RC4					-----	.245	.415*	.388*	.235
RC6						-----	.472*	.543*	.269
RC7							-----	.603*	.360
RC8								-----	.395*
RC9									-----

*Significant at $p < .001$ (2-tailed)

Table 13

Pearson Product Moment Correlation Coefficients of the MMPI-2 Clinical Scales

	Scale							
Scale	1	2	3	4	6	7	8	9
1	-----	.767*	.874*	.404*	.410*	.642*	.724*	.317
2		-----	.701*	.479*	.522*	.791*	.734*	.260
3			-----	.440*	.487*	.621*	.671*	.354
4				-----	.589*	.588*	.648*	.394*
6					-----	.633*	.688*	.318
7						-----	.820*	.310
8							-----	.449*
9								-----

*Significant at $p < .001$ (2-tailed)

Table 14

Paired Sample Proportion Tests Comparing Elevations on RC Scales and Clinical Scales in High Somatic Symptom Endorsers, as Measured by Elevated RC1 Scores (n = 49)

Comparison	RC Scale %[a] (*n*)	Clinical Scale %[a] (*n*)	Z-test Statistic with Continuity Correction	2-Tailed *p*-value
RC2, Scale 2	37 (18)	80 (39)	4.36	<.0001
RC3, Scale 3	6 (3)	96 (47)	6.48	<.0001
RC4, Scale 4	10 (5)	29 (14)	2.67	.008
RC6, Scale 6	12 (6)	24 (12)	1.58	.114
RC7, Scale 7	12 (6)	65 (32)	4.90	<.0001
RC8, Scale 8	20 (10)	88 (43)	5.57	<.0001
RC9, Scale 9	0 (0)	14 (7)	2.27	.023

Note. High somatic symptom endorsers are individuals with RC1 T scores ≥ 65.

[a]Scales are considered elevated if T scores ≥ 65.

Table 15

Dependent T-tests between RC Scale and Clinical Scale Scores in High Somatic Symptom Endorsers, as Measured by Elevated RC1 Scores (n = 49)

Comparison	RC Scale Mean (SD)	Clinical Scale Mean (SD)	*t*	2-Tailed *p*-value
RC2, Scale 2	61.86 (14.09)	76.57 (12.61)	-11.51	<.001
RC3, Scale 3	48.98 (8.32)	80.47 (11.17)	-14.41	<.001
RC4, Scale 4	51.57 (9.67)	58.71 (12.63)	-5.27	<.001
RC6, Scale 6	54.08 (11.25)	58.59 (12.89)	-2.55	.014
RC7, Scale 7	54.35 (12.58)	69.82 (11.52)	-9.52	<.001
RC8, Scale 8	56.18 (10.33)	73.65 (10.44)	-12.00	<.001
RC9, Scale 9	46.00 (7.38)	54.59 (9.39)	-6.34	<.001

Note. High somatic symptom endorsers are individuals with RC1 T scores ≥ 65.

SD = standard deviation

Table 16

Paired Sample Proportion Tests Comparing Elevations on RC Scales and Clinical Scales in Non-Elevated Somatic Symptom Endorsers, as Measured by RC1 Scores (n = 35)

Comparison	RC Scale %[a] (*n*)	Clinical Scale %[a] (*n*)	Z-test Statistic with Continuity Correction	2-Tailed *p*-value
RC2, Scale 2	9 (3)	17 (6)	0.89	.371
RC3, Scale 3	0 (0)	34 (12)	3.18	.002
RC4, Scale 4	3 (1)	9 (3)	0.50	.617
RC6, Scale 6	0 (0)	3 (1)	0.00	1.000
RC7, Scale 7	0 (0)	14 (5)	1.79	.074
RC8, Scale 8	0 (0)	23 (8)	2.47	.013
RC9, Scale 9	3 (1)	0 (0)	0.00	1.000

Note. Non-elevated somatic symptom endorsers are individuals with RC1 T scores < 65.

[a]Scales are considered elevated if T scores ≥ 65.

Table 17

Dependent T-tests between RC Scale and Clinical Scale Scores in Non-Elevated Somatic Symptom Endorsers, as Measured by RC1 Scores (n = 35)

Comparison	RC Scale Mean (SD)	Clinical Scale Mean (SD)	*t*	2-Tailed *p*-value
RC2, Scale 2	51.66 (1.27)	56.40 (9.73)	-4.14	<.001
RC3, Scale 3	45.34 (5.59)	60.31 (10.05)	-6.76	<.001
RC4, Scale 4	47.83 (8.04)	51.74 (8.37)	-2.65	.012
RC6, Scale 6	48.74 (8.16)	49.94 (7.18)	-.756	.455
RC7, Scale 7	45.69 (7.64)	55.77 (7.91)	-6.57	<.001
RC8, Scale 8	47.91 (7.12)	57.71 (7.80)	-7.18	<.001
RC9, Scale 9	43.71 (7.91)	47.91 (7.76)	-2.71	.011

Note. Non-elevated somatic symptom endorsers are individuals with RC1 T scores < 65.

SD = standard deviation

Table 18

Paired Sample Proportion Tests with Yates Correction Comparing Percent and Number of RC and Clinical Elevations for All Participants (N = 84)

Comparison	RC Scale % (*n*)	Clinical Scale % (*n*)	Z-test Statistic with Continuity Correction	2-Tailed *p*-value
RC1, Scale 1	58 (49)	69 (58)	2.41	.016
RC2, Scale 2	25 (21)	54 (45)	4.51	<.0001
RC3, Scale 3	4 (3)	70 (59)	7.35	<.0001
RC4, Scale 4	7 (6)	20 (17)	2.77	.006
RC6, Scale 6	7 (6)	15 (13)	1.81	.070
RC7, Scale 7	7 (6)	44 (37)	5.39	<.0001
RC8, Scale 8	12 (10)	61 (51)	6.25	<.0001
RC9, Scale 9	1 (1)	8 (7)	1.77	.077

Note. Scales are considered elevated if T scores ≥ 65.

Table 19

Independent T-tests between RC Scale and Clinical Scale Scores in All Participants (N = 84)

Comparison	RC Scale Mean (SD)	Clinical Scale Mean (SD)	*t*	Sig
RC1, Scale 1	68.45 (12.28)	71.95 (12.56)	-5.98	<.001
RC2, Scale 2	57.61 (12.79)	68.17 (15.19)	-10.22	<.001
RC3, Scale 3	47.46 (7.49)	72.07 (14.61)	-13.65	<.001
RC4, Scale 4	50.01 (9.16)	55.81 (11.53)	-5.73	<.001
RC6, Scale 6	51.86 (10.36)	54.99 (11.65)	-2.54	.013
RC7, Scale 7	50.74 (11.57)	63.96 (12.28)	-11.27	<.001
RC8, Scale 8	52.74 (9.67)	67.01 (12.32)	-13.00	<.001
RC9, Scale 9	45.05 (7.64)	51.81 (9.31)	-6.49	.001

SD = standard deviation

Table 20

Pearson Product Moment Correlations between Cognitive Test Scores and the RC Scales

Scale	Arithmetic (N = 75)	Digit Symbol (N = 82)	WCST (N = 82)	PASAT (N = 47)	FAS (N = 83)	Animals (N = 83)	DVT (N = 55)
RCd	.014	-.072	.015	-.167	.096	.026	-.198
RC1	-.125	-.144	-.007	-.270	-.047	-.059	-.202
RC2	-.004	-.095	-.001	.067	.050	-.114	-.176
RC3	-.216	-.118	-.104	.011	-.161	-.036	-.344*
RC4	-.092	-.143	.062	-.255	.017	.075	-.163
RC6	-.181	-.189	.017	.138	-.045	.039	-.072
RC7	-.207	-.056	.030	-.086	.071	.052	-.299*
RC8	-.198	-.240*	-.059	-.209	-.178	-.101	-.264
RC9	-.030	-.105	.156	-.182	.033	.135	-.171

*Significant at $p < .05$ (2-tailed)

WCST = Wisconsin Card Sorting Test

PASAT = Paced Auditory Serial Addition Test

DVT = Digit Vigilance Test

Table 21

Pearson Product Moment Correlations between Cognitive Test Scores and the Clinical Scales

Scale	Arithmetic (N = 75)	Digit Symbol (N = 82)	WCST (N = 82)	PASAT (N = 47)	FAS (N = 83)	Animals (N = 83)	DVT (N = 55)
1	-.097	-.175	-.045	-.297*	-.029	-.076	-.212
2	-.044	-.079	.000	-.141	.012	-.098	-.285*
3	-.087	-.166	.008	-.358*	.020	-.004	-.252
4	.001	-.170	.128	-.064	.035	.080	-.047
6	.005	-.160	.055	-.381**	.097	.134	-.254
7	-.078	-.118	-.020	-.104	-.007	-.033	-.207
8	-.105	-.267*	-.022	-.316	-.047	.085	-.296*
9	-.191	-.273*	.006	-.254	-.082	.016	-.117

*Significant at $p < .05$ (2-tailed)

**Significant at $p < .01$ (2-tailed)

WCST = Wisconsin Card Sorting Test

PASAT = Paced Auditory Serial Addition Test

DVT = Digit Vigilance Test

Table 22

Paired Sample Proportion Tests Comparing Elevations on RC Scales and Clinical Scales in Cognitively Impaired Participants (n = 50)

Comparison	RC Scale %[a] (*n*)	Clinical Scale %[a] (*n*)	Z-test Statistic with Continuity Correction	2-Tailed *p*-value
RC1, Scale 1	58 (29)	73 (36)	2.00	.046
RC2, Scale 2	26 (13)	58 (29)	3.75	.0002
RC3, Scale 3	6 (3)	72 (36)	5.57	<.0001
RC4, Scale 4	10 (5)	24 (12)	2.00	.046
RC6, Scale 6	8 (4)	18 (9)	1.33	.182
RC7, Scale 7	10 (5)	50 (25)	4.25	<.0001
RC8, Scale 8	14 (7)	66 (33)	4.90	<.0001
RC9, Scale 9	0 (0)	10 (5)	1.79	.074

Note. Participants were considered cognitively impaired if they scored ≥ 1 standard deviation below the normative mean on at least 2 of 7 measures (Arithmetic, Digit Symbol Coding, Digit Vigilance Test, Paced Auditory Serial Addition Test, Verbal Fluency (animals or letters), or the Wisconsin Card Sorting Test.

[a]Scales are considered elevated if T scores ≥ 65.

Table 23

Dependent T-tests between RC Scale and Clinical Scale Scores in Cognitively Impaired Participants (n = 50)

Comparison	RC Scale Mean (SD)	Clinical Scale Mean (SD)	*t*	Sig
RC1, Scale 1	69.22 (11.93)	72.96 (11.77)	-4.90	<.001
RC2, Scale 2	57.90 (14.21)	69.76 (16.14)	-8.54	<.001
RC3, Scale 3	48.22 (8.02)	72.20 (15.27)	-9.73	<.001
RC4, Scale 4	51.36 (9.51)	57.04 (12.38)	-4.15	<.001
RC6, Scale 6	52.54 (10.93)	55.44 (12.09)	-1.70	.095
RC7, Scale 7	50.46 (13.58)	65.28 (12.36)	-9.81	<.001
RC8, Scale 8	53.58 (10.17)	68.72 (12.34)	-9.99	<.001
RC9, Scale 9	44.46 (7.77)	53.10 (10.14)	-5.68	<.001

Note. Participants were considered cognitively impaired if they scored ≥ 1 standard deviation below the normative mean on at least 2 of 7 measures (Arithmetic, Digit Symbol Coding, Digit Vigilance Test, Paced Auditory Serial Addition Test, Verbal Fluency (animals or letters), or the Wisconsin Card Sorting Test

SD = standard deviation

Table 24

Paired Sample Proportion Tests Comparing Elevations on RC Scales and Clinical Scales in Non-Cognitively Impaired Participants (n = 34)

Comparison	RC Scale %[a] (*n*)	Clinical Scale %[a] (*n*)	Z-test Statistic with Continuity Correction	2-Tailed *p*-value
RC1, Scale 1	59 (20)	65 (22)	0.71	.480
RC2, Scale 2	24 (8)	47 (16)	2.21	.027
RC3, Scale 3	0 (0)	68 (23)	4.59	<.0001
RC4, Scale 4	3 (1)	15 (5)	1.50	.134
RC6, Scale 6	6 (2)	12 (4)	0.71	.480
RC7, Scale 7	3 (1)	35 (12)	3.02	.003
RC8, Scale 8	9 (3)	53 (18)	3.61	.0003
RC9, Scale 9	3 (1)	6 (2)	0.00	1.00

Note. Participants were considered non-cognitively impaired if they showed impairment (i.e., ≥ 1 standard deviation below the normative mean) on no more than 1 of 7 measures (Arithmetic, Digit Symbol Coding, Digit Vigilance Test, Paced Auditory Serial Addition Test, Verbal Fluency (animals or letters), or the Wisconsin Card Sorting Test

[a]Scales are considered elevated if T scores ≥ 65.

Table 25

Dependent T-tests between RC Scale and Clinical Scale Scores in Non-Cognitively Impaired Participants (n = 34)

Comparison	RC Scale Mean (SD)	Clinical Scale Mean (SD)	*t*	Sig
RC1, Scale 1	67.32 (12.86)	70.47 (14.69)	-3.41	.002
RC2, Scale 2	57.18 (10.56)	65.82 (13.57)	-5.80	<.001
RC3, Scale 3	46.35 (6.59)	71.88 (13.80)	-9.74	<.001
RC4, Scale 4	48.03 (8.36)	54.00 (10.06)	-3.98	<.001
RC6, Scale 6	50.85 (9.55)	54.32 (11.11)	-1.96	.058
RC7, Scale 7	51.15 (7.92)	62.03 (12.08)	-6.00	<.001
RC8, Scale 8	51.50 (9.68)	64.50 (12.02)	-8.41	<.001
RC9, Scale 9	45.91 (7.49)	49.91 (7.69)	-3.49	.001

Note. Participants were considered non-cognitively impaired if they showed impairment (i.e., ≥ 1 standard deviation below the normative mean) on no more than 1 of 7 measures (Arithmetic, Digit Symbol Coding, Digit Vigilance Test, Paced Auditory Serial Addition Test, Verbal Fluency (animals or letters), or the Wisconsin Card Sorting Test

SD = standard deviation

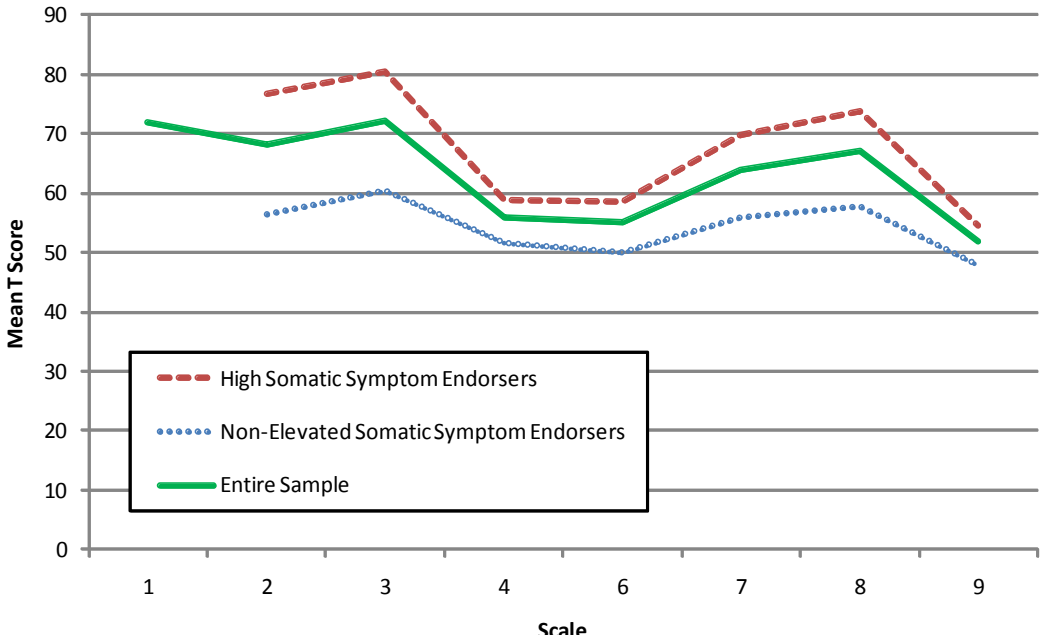

Figure 1. Clinical Scale T Scores for High and Non-Elevated Somatic Symptom Endorsers and All Participants.

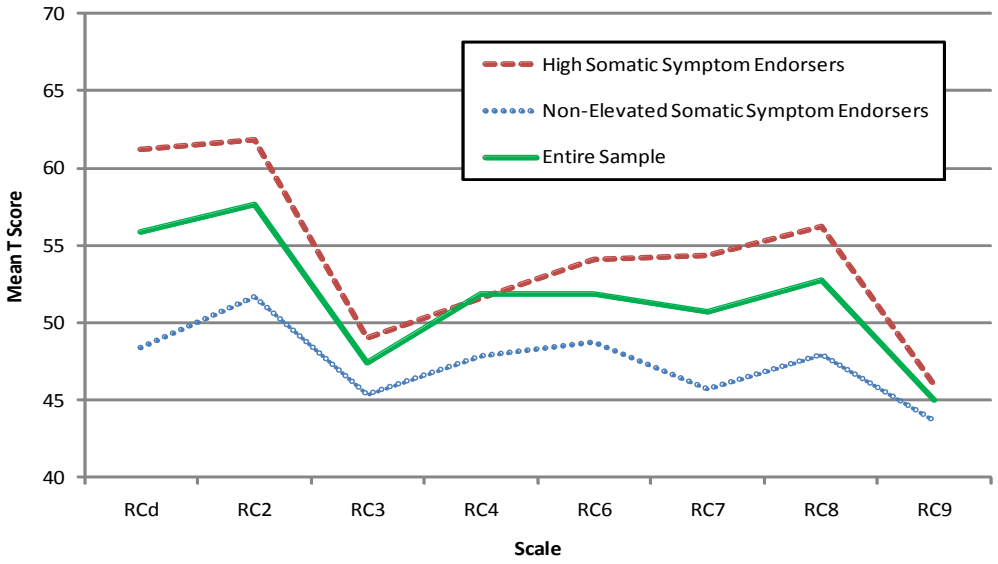

Figure 2. RC Scale T Scores for High and Non-Elevated Somatic Symptom Endorsers and All Participants.

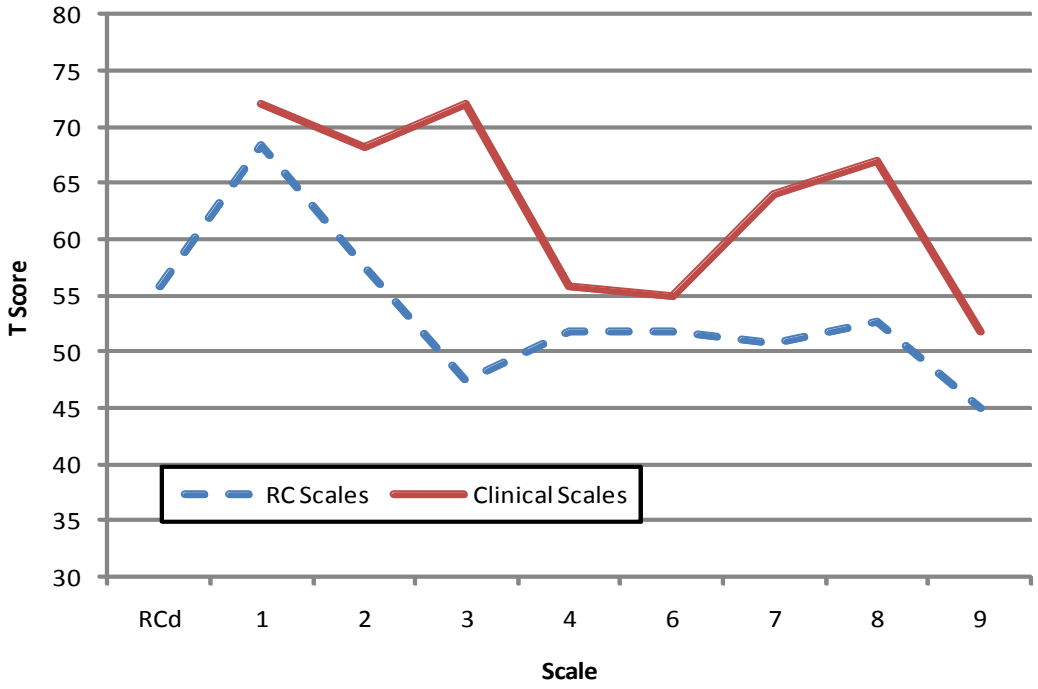

Figure 3. RC And Clinical Scale Scores for All Participants (*N* = 84)**.**

REFERENCES

Acheson, E. D. (Ed.). (1985). *The epidemiology of multiple sclerosis*. Edinburgh, Scotland: Churchill Livingstone.

Alfano, D. P., Paniak, C. E., & Finlayson, A. J. (1993). The MMPI and closed head injury: A neurocorrective approach. *Neuropsychiatry, Neuropsychology and Behavioral Neurology, 6*, 111-116.

Arbisi, P. A., Ben-Porath, Y. S., & McNulty, J. L. (2003). *MMPI-2 empirical correlates in inpatient psychiatric settings.* Unpublished manuscript.

Arnett, P. A., Higginson, C. I., & Randolph, J. J. (2001). Depression in multiple sclerosis: Relationship to planning ability. *Journal of the International Neuropsychological Society, 7*, 665-674.

Arnett, P. A., Higginson, C. I., Voss, W. D., Bender, W. I., Wurst, J. M., & Tippin, J. M. (1999). Depression in multiple sclerosis: Relationship to working memory capacity. *Neuropsychology, 13*, 546-556.

Arnett, P. A., Higginson, C. I., Voss, W. D., Wright, B., Bender, W. I., Wurst, J. M., & Tippin, J. M. (1999). Depressed mood in multiple sclerosis: Relationship to capacity-demanding memory and attentional functioning. *Neuropsychology, 13*, 434-446.

Arnett, P. A., Rao, S. M., Bernardin, L., Grafman, J., Yetkin, F. Z., & Lobeck, L. (1994). Relationship between frontal lobe lesions and Wisconsin Card Sorting Test performance in patients with multiple sclerosis. *Neurology, 44*, 420-425.

Baldwin, M. V. (1952). A clinico-experimental investigation into the psychologic aspects of multiple sclerosis. *Journal of Nervous and Mental Disease, 115*, 299-343.

Bamer, A. M., Cetin, K., Johnson, K. L., Gibbons, L. E., & Ehde, D. M. (2008). Validation study of prevalence and correlates of depressive symptomatology in multiple sclerosis. *General Hospital Psychiatry, 30*, 311-317.

Beatty, W. W. (1988). Anterograde and retrograde amnesia in patients with chronic progressive multiple sclerosis. *Archives of Neurology, 45*, 611-619.

Beatty, W. W. (1993). Age differences on the California Card Sorting Test: Implications for the assessment of problem solving by the elderly. *Bulletin of the Psychonomic Society, 31*, 511-514.

Beatty, W. W., Blanco, C. R., Wilbanks, S. L., Paul, R. H., & Hames, K. A. (1995). Demographic, clinical, and cognitive characteristics of multiple sclerosis patients who continue to work. *Journal of Neurologic Rehabilitation, 9*, 167-173.

Beatty, W. W., Goodkin, D. E., Hertsgaard, D., & Monson, N. (1990). Clinical and demographic predictors of cognitive performance in multiple sclerosis: Do diagnostic type, disease duration, and disability matter? *Archives of Neurology, 47*, 305-308.

Beatty, W. W., Goodkin, D. E., Monson, N., & Beatty, P. A. (1989). Cognitive disturbances in patients with relapsing-remitting multiple sclerosis. *Archives of Neurology, 46*, 1113-1119.

Beatty, W. W., Goodkin, D. E., Monson, N., Beatty, P. A., & Hertsgaard, D. (1988). Anterograde and retrograde amnesia in patients with chronic progressive multiple sclerosis. *Archives of Neurology, 45*, 611-619.

Beatty, W. W., & Monson, N. (1990). Semantic priming in multiple sclerosis. *Bulletin of the Psychonomic Society, 28*, 397-400.

Beatty, W. W., & Monson, N. (1996). Problem solving by patients with multiple sclerosis: Comparison of performance on the Wisconsin and California Card Sorting Tests. *Journal of the International Neuropsychological Society, 2*, 134-140.

Beck, A. T., Ward, C. H., Medelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561-571.

Benedict, R. H., Cookfair, D., Gavett, R., Gunther, M., Munschauer, F., Garg, N., & Weinstock-Guttman, B. (2006). Validity of the Minimal Assessment of Cognitive Function in Multiple Sclerosis (MACFIMS). *Journal of the International Neuropsychological Society, 12*, 549-558.

Benedict, R. H., Priore, R. L., Miller, C., Munschauer, F., & Jacobs, L. (2001). Personality disorder in multiple sclerosis correlates with cognitive impairment. *Journal of Neuropsychiatry and Clinical Neurosciences, 13*, 70-76.

Bergendal, G., Fredrikson, S., & Almkvist, O. (2007). Selective decline in information processing in subgroups of multiple sclerosis: An 8-year longitudinal study. *European Neurology, 57*, 193-202.

Blazer, D. G., Kessler, R. C., McGonagle, K. A., & Swartz, M. S. (1994). The prevalence and distribution of major depression in a national community sample: The National Comorbidity Survey. *American Journal of Psychiatry, 151*, 979-986.

Boone, K. B., Ponton, M. O., Gorsuch, R. L., Gonzales, J. J., & Miller, B. L. (1998). Factor analysis of four measures of prefrontal lobe functioning. *Archives of Clinical Neuropsychology, 13*, 585-595.

Brassington, J. C., & Marsh, N. V. (1998). Neuropsychological aspects of multiple sclerosis. *Neuropsychology Review*, 43-77.

Brokate, B., Hildebrandt, H., Eling, P., Fichtner, H., Runge, K., & Timm, C. (2003). Frontal lobe dysfunctions in Korsakoff's syndrome and chronic alcoholism: Continuity or discontinuity? *Neuropsychology, 17*, 420-428.

Bruce, J. M., Hancock, L. M., Arnett, P., & Lynch, S. G. (2010). Treatment adherence in multiple sclerosis: Association with emotional status, personality, and cognition. *Journal of Behavioral Medicine, 33*, 219-227.

Butcher, J. N., Dahlstrom, W. G., Graham, J. R., Tellegen, A., & Kaemmer, B. (1989). *Minnesota Multiphasic Personality Inventory-2: Manual for administration and scoring*. Minneapolis: University of Minnesota Press.

Butcher, J. N., Graham, J. R., Ben-Porath, Y. S., Tellegen, A., Dahlstrom, W. G., & Kaemmer, B. (2001). *Minnesota Multiphasic Personality Inventory-2: Manual for administration and scoring* (Revised ed.). Minneapolis: University of Minnesota Press.

Butcher, J. N., & Williams, C. L. (1992). *Essentials of MMPI-2 and MMPI-A interpretation*. Minneapolis: University of Minnesota Press.

Butters, M. A., Goldstein, G., Allen, D. N., & Shemansky, W. J. (1998). Neuropsychological similarities and differences among Huntington's disease, multiple sclerosis, and cortical dementia. *Archives of Clinical Neuropsychology, 13*, 721-735.

Caine, E. D., Bamford, K. A., Schiffer, R. B., Shoulson, I., & Levy, S. (1986). A controlled neuropsychological comparison of Huntington's disease and multiple sclerosis. *Archives of Neurology, 43,* 249-254.

Caldwell, A. B. (1997). *MMPI-2 data research file for clinical patients*. Unpublished raw data.

Carlton, S. G. (1996). MMPI-2 interpretation and stroke: Cross validation of a correction factor. *Journal of Clinical Psychology, 52,* 569-572.

Charcot, J. M. (1879). *Lectures on the diseases of the nervous system*, la Salpetriere.

Chiaravalloti, N. D., Balzano, J., Moore, N. B., & DeLuca, J. (2009). The Open-Trial Selective Reminding Test (OT-SRT) as a tool for the assessment of learning and memory. *Clinical Neuropsychologist, 23,* 231-254.

Chiaravalloti, N. D., & DeLuca, J. (2008). Cognitive impairment in multiple sclerosis. *Lancet Neurology, 7*, 1139-1151.

Chwastiak, L., Ehde, D. M., Gibbons, L. E., Sullivan, M., Bowen, J. D., & Kraft, G. H. (2002). Depressive symptoms and severity of illness in multiple sclerosis: Epidemiologic study of a large community sample. *American Journal of Psychiatry, 159*, 1862-1868.

Clark, C. M., Fleming, J. A., Li, D., Oger, J., Klonoff, H., & Paty, D. (1992). Sleep disturbance, depression, and lesion site in patients with multiple sclerosis. *Archives of Neurology, 49*, 641-643.

Clark, L., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment, 7*, 309-319.

Comi, G., Filippi, M., Martinelli, V., Campi, A., Rodegher, M., Alberoni, M., . . . Canal, N. (1995). Brain MRI correlates of cognitive impairment in primary and secondary progressive multiple sclerosis. *Journal of the Neurological Sciences, 132*, 222-227.

Crawford, J. R., Obansawin, M. C., & Allan, K. M. (1998). PASAT and components of WAIS-R performance: Convergent and discriminant validity. *Neuropsychological Rehabilitation, 8*, 273-272.

Crews Jr., W. D. H., D. W., & Rhondes, R. D. (1999). Neuropsychological test performances of young depressed outpatient women: An examination of executive functions. *Archives of Clinical Neuropsychology, 14*, 517-529.

Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.

Dalos, N. P., Rabins, P. V., Brooks, B. R., & O'Donnell, P. (1983). Disease activity and emotional state in multiple sclerosis. *Annals of Neurology, 13*, 573-577.

Dalton, E. J., & Heinrichs, R. W. (2005). Depression in multiple sclerosis: A quantitative review of the evidence. *Neuropsychology, 19*, 152-158.

DCCT Research Group. (1994). A screening algorithm to identify clinically significant changes in neuropsychological functions in the Diabetes Control and Complications Trial. *Journal of Clinical and Experimental Neuropsychology, 16*, 303-316.

Deary, I. J., Langan, S. J., Hepburn, D. A., & Frier, B. M. (1991). Which abilities does the PASAT test? *Personality and Individual Differences, 12*, 983-987.

DeLuca, J., Barbieri-Berger, S., & Johnson, S. K. (1994). The nature of memory impairments in multiple sclerosis. *Journal of Clinical and Experimental Neuropsychology, 16*, 183-189.

DeLuca, J., Johnson, S. K., Beldowicz, D., & Natelson, B. H. (1995). Neuropsychologic impairments in chronic fatigue syndrome, multiple sclerosis, and depression. *Journal of Neurology, Neurosurgery, and Psychiatry, 58*, 38-43.

DeLuca, J., Johnson, S. K., & Natelson, B. H. (1993). Information processing in chronic fatigue syndrome and multiple sclerosis. *Archives of Neurology, 50*, 301-304.

Demaree, H. A., Gaudino, E., & DeLuca, J. (2003). The relationship between depressive symptoms and cognitive dysfunction in multiple sclerosis. *Cognitive Neuropsychiatry, 8*, 161-171.

Denney, D. R., Sworowski, L. A., & Lynch, S. G. (2005). Cognitive impairment in three subtypes of multiple sclerosis. *Archives of Clinical Neuropsychology, 20*, 967-981.

Devins, G. M., & Seland, T. P. (1987). Emotional impact of multiple sclerosis: Recent findings and suggestions for future research. *Psychological Bulletin, 101*, 363-375.

Diamond, B. J., DeLuca, J., Kim, H., & Kelley, S. M. (1997). The question of disproportionate impairments in visual and auditory information processing in multiple sclerosis. *Journal of Clinical and Experimental Neuropsychology, 19*, 34-42.

Diaz-Olavarrieta, C., Cummings, J. L., Velazquez, J., & Garcia de al Cadena, C. (1999). Neuropsychiatric manifestations of multiple sclerosis. *Journal of Neuropsychiatry and Clinical Neurosciences, 11*, 51-57.

Downing, S. K., Denney, R. L., Spray, B. J., Houston, C. M., & Halfaker, D. A. (2008). Examining the relationship between the Reconstructed Scales and the Fake Bad Scale of the MMPI-2. *Clinical Neuropsychologist, 22*, 680-688.

Egan, V. (1988). PASAT: Oberved correlations with IQ. *Personality and Individual Differences, 9*, 179-180.

Egede, L. E. (2007). Major depression in individuals with chronic medical disorders: Prevalence, correlates, and association with health resource utilization, lost productivity, and functional disability. *General Hospital Psychiatry, 29*, 409-416. doi: DOI: 10.1016/j.genhosppsych.2007.06.002

Eklund, V. A., & MacDonald, M. L. (1991). Descriptions of persons with multiple sclerosis, with an emphasis on what is needed from psychologists. *Professional Psychology: Research and Practice, 22*, 277-284.

Elder, J. T. (1999). MMPI-1 profiles of multiple sclerosis patients: A comparison of neurocorrective approaches and the development of the multiple sclerosis neurocorrection. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 60 (3-B)*, 1299.

Elias, M. F., Elias, P. K., D'Agonstino, R. B., Silbershatz, H., & Wolf, P. A. (1997). Role of age, education and gender on cognitive performance in the Framingham Heart Study: Community-based norms. *Experimental Aging Research, 23*, 201-235.

Feinstein, A. (2006). Mood disorders in multiple sclerosis and the effects on cognition. *Journal of the Neurological Sciences, 245*, 63-66.

Feinstein, A., & Feinstein, K. (2001). Depression associated with multiple sclerosis: Looking beyond diagnosis to symptom expression. *Journal of Affective Disorders, 66*, 193-198.

Feinstein, A., Feinstein, K., Gray, T., & O'Connor, P. (1997). Prevalence and neurobehavioral correlates of pathological laughing and crying in multiple sclerosis. *Archives of Neurology, 54*, 1116-1121.

Feinstein, A., Kartsounis, L. D., Miller, D. H., Youl, B. D., & Ron, M. A. (1992). Clinically isolated lesions of the type seen in multiple sclerosis: A cognitive, psychiatric, and MRI follow up study. *Journal of Neurology, Neurosurgery, and Psychiatry, 55*, 869-876.

Feinstein, A., O'Connor, P., Gray, T., & Feinstein, K. (1999). The effects of anxiety on psychiatric morbidity in patients with multiple sclerosis. *Multiple Sclerosis, 5*, 323-326.

Feinstein, A., Roy, P., Lobaugh, N., Feinstein, K., O'Connor, P., & Black, S. (2004). Structural brain abnormalities in multiple sclerosis patients with major depression. *Neurology, 62*, 586-590.

Filley, C. M., Heaton, R. K., Nelson, L. M., Burks, J. S., & Franklin, G. M. (1989). A comparison of dementia in Alzheimer's disease and multiple sclerosis. *Archives of Neurology, 46*, 157-161.

Finn, S. E., & Kamphuis, J. H. (2006). The MMPI-2 Restructured Clinical (RC) Scales and restraints to innovation, or "What have they done to my song?". *Journal of Personality Assessment, 87*, 202-210.

First, M. B., Spitzer, R. L., Gibbom, M., & Williams, J. (1994). *Structured Clinical Interview for Axis I DSM-IV Disorders, Patient Edition (SCID-I/P, Version 2.0).* New York: Biometrics Research Department, New York State Psychiatric Institute.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (2002). Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition.

Foong, J., Rozewicz, L., Quaghebeur, G., Davie, C. A., Kartsounis, L. D., Thompson, A. J., . . . Ron, M. A. (1997). Executive function in multiple sclerosis: The role of frontal lobe pathology. *Brain, 120*, 15-26.

Forman, A. C., & Lincoln, N. B. (2010). Evaluation of an adjustment group for people with multiple sclerosis: A pilot randomized controlled trial. *Clinical Rehabilitation, 24*, 211-221.

Friedman, A. F., Lewak, R., Nichols, D. S., & Webb, J. T. (2001). *Psychological assessment with the MMPI-2*. New Jersey: Lawrence Erlbaum.

Friend, K. B., Rabin, B. M., Groninger, L., Deluty, R. H., Bever, C., & Grattan, L. (1999). Language functions in patients with multiple sclerosis. *Clinical Neuropsychologist, 13,* 78-94.

Gass, C. S. (1992). MMPI-2 interpretation of patients with cerebrovascular disease: A correction factor. *Archives of Clinical Neuropsychology, 7*, 17-27.

Gass, C. S., & Wald, H. S. (1997). MMPI-2 interpretation and closed head trauma: Cross validation of a correction factor. *Archives of Clinical Neuropsychology, 12*, 199-205.

Gaudino, E. A., Chiaravalloti, N. D., DeLuca, J., & Diamond, B. J. (2001). A comparison of memory performance in relapsing-remitting, primary progressive, and secondary progressive multiple sclerosis. *Neuropsychiatry, Neuropsychology and Behavioral Neurology, 14*, 32-44.

Gervais, R. O., Ben-Porath, Y. S., Wygant, D. B., & Green, P. (2008). Differential sensitivity of the RBS and MMPI-2 validity scales to memory complaints. *Clinical Neuropsychologist, 22*(1061-1079).

Gilchrist, A. C., & Creed, F. H. (1994). Depression, cognitive impairment, and social stress in multiple sclerosis. *Journal of Psychosomatic Research, 38*, 193-201.

Glassmire, D. M., Kinney, D. I., Greene, R. L., Stolberg, R. A., Berry, D. T. R., & Cripe, L. (2003). Sensitivity and specificity of MMPI-2 neurologic correction factors: Receiver operating characteristic analysis. *Assessment, 10*, 299-309.

Goldberg, D., & Hillier, V. F. (1979). A scaled version of the General Health Questionnaire. *Psychological Medicine, 9*, 139-145.

Goldstein, I., Siroky, M. B., Sax, D. S., & Krane, R. J. (1982). Neurologic abnormalities in multiple sclerosis. *Journal of Urology, 128*, 541-545.

Grafman, J., Rao, S., Bernadin, L., & Leo, G. J. (1991). Automatic memory processes in patients with multiple sclerosis. *Archives of Neurology, 48*, 1072-1075.

Graham, J. R. (2006). *MMPI-2: Assessing personality and psychopathology* (4th ed.). New York: Oxford University Press.

Graham, J. R., Ben-Porath, Y. S., & McNulty, J. L. (1999). *MMPI-2 correlates for outpatient community mental health settings*. Minneapolis: University of Minnesota Press.

Grant, I., Prigatano, G. P., Heaton, R. K., McSweeny, A. J., Wright, E. C., & Adams, K. M. (1987). Progressive neuropsychologic impairment and hypoxemia: Relationship in chronic obstructive pulmonary disease. *Archives of General Psychiatry, 44*, 999-1006.

Green, J., McDonald, W. M., Vitek, J. L., Evatt, M., Freeman, A., Haber, M., . . . DeLong, M. R. (2002). Cognitive impairments in advanced PD without dementia. *Neurology, 59*, 1320-1324.

Green, P. (2003). *Green's Word Memory Test for Windows: User's manual*. Edmonton, Canada: Green's Publishing.

Green, P. (2004). *Green's Medical Symptom Validity Test (MSVT): User's manual*. Edmonton, Canada: Green's Publishing.

Green, P., Allen, L., & Astner, K. (1996). *The Word Memory Test: A user's guide to the oral and computer-administered forms, U.S. Version 1.1*. Durham, NC: CogniSyst.

Greene, R. L. (1991). *The MMPI-2 / MMPI: An Interpretive Manual*. Needham Heights, MA: Allyn and Bacon.

Greene, R. L. (2000). *The MMPI-2: An Interpretative Manual* (2nd ed.). Boston: Allyn and Bacon.

Greiffenstein, M. F., Baker, W. J., Gola, T., Donders, J., & Miller, L. (2002). The Fake Bad Scale in atypical and severe closed head injury litigants. *Journal of Clinical Psychology, 58,* 1591-1600.

Gronwall, D. (1977). Paced Auditory Serial Addition Task: A measure of recovery from concussion. *Perceptual and Motor Skills, 44*, 367-373.

Gronwall, D., & Sampson, H. (1974). *The psychological effects of concussion*. Auckland, New Zealand: Auckland University Press - Oxford University Press.

Gronwall, D., & Wrightson, P. (1974). Delayed recovery of intellectual function after minor head injury. *Lancet, 2,* 605-609.

Gronwall, D., & Wrightson, P. (1981). Memory and information processing capacity after closed head injury. *Journal of Neurology, Neurosurgery, and Psychiatry, 44*, 889-895.

Haahr, M. (2008). True random number service: Random integer generator Retrieved February 15, 2010, from http://random.org/integers/.

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery, and Psychiatry, 23*, 56-62.

Harper, A. C., Harper, D. A., Chambers, L. W., Cino, P. M., & Singer, J. (1986). An epidemiological description of physical, social, and psychological problems in multiple sclerosis. *Journal of Chronic Diseases, 39,* 305-310.

Harrower, M. (1954). Psychological factors in multiple sclerosis. *Annals of the New York Academy of Sciences, 58,* 543-720.

Harter, M. C., Conway, K. P., & Merikangas, K. R. (2003). Associations between anxiety disorders and physical illness. *European Archives of Psychiatry and Clinical Neuroscience, 253*, 313-320.

Hartlage, S., Alloy, A. B., Vazquez, C., & Dykman, B. (1993). Automatic and effortful processing in depression. *Psychological Bulletin, 113*, 247-278.

Hathaway, S. R., & McKinley, J. C. (1943). *The Minnesota Multiphasic Personality Inventory*. Minneapolis: University of Minnesota Press.

Hayes, D., & Grenello, D. H. (2009). Use of the Minnesota Multiphasic Personality Inventory-2 with persons diagnosed with multiple sclerosis. *Journal of Counseling and Development, 87*, 227-233.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtis, G. (1993). *Wisconsin Card Sorting Test (WCST) manual, revised and expanded*. Odessa, FL: Psychological Assessment Resources.

Heaton, R. K., Grant, I., Butters, M. A., White, D. A., Krirson, D., Atkinson, J. H., . . . The HNRC Group. (1995). Neuropsychology of HIV infection at different disease stages. *Journal of the International Neuropsychological Society, 1*, 231-251.

Heaton, R. K., Grant, I., & Matthews, C. G. (1991). *Comprehensive norms for an expanded Halstead-Reitan Battery: Demographic corrections, research findings, and clinical applications.* Odessa, FL: Psychological Assessment Resources.

Heaton, R. K., Miller, S. W., Taylor, M. J., & Grant, I. (2004). *Revised comprehensive norms for an expanded Halstead-Reitan Battery: Demographically adjusted*

neuropsychological norms for African American and Caucasian adults. Lutz, FL: PAR.

Heaton, R. K., Nelson, L. M., Thompson, D. S., Burks, J. S., & Franklin, G. M. (1985). Neuropsychological findings in relapsing-remitting and chronic progressive multiple sclerosis. *Journal of Consulting and Clinical Psychology, 53*, 103-110.

Helmes, E., & Reddon, J. R. (1993). A perspective on developments in assessing psychopathology: A critical review of the MMPI and MMPI-2. *Psychological Bulletin, 113*, 453-471.

Henry, J. D., & Beatty, W. W. (2006). Verbal fluency deficits in multiple sclerosis. *Neuropsychologia, 44*, 1166-1174.

Henry, J. D., & Crawford, J. R. (2004). A meta-analytic review of verbal fluency performance following focal cortical lesions. *Neuropsychology, 18*, 284-295.

Hiscock, M., & Hiscock, C. K. (1989). Refining the forced-choice method for the detection of malingering. *Journal of Clinical and Experimental Neuropsychology, 11*, 967-974.

Honer, W. G., Hurwitz, T., Li, D. K. B., Palmer, M., & Paty, D. W. (1987). Temporal lobe involvement in multiple sclerosis patients with psychiatric disorders. *Archives of Neurology, 44*, 187-190.

Horn, J. L., Wanberg, K. W., & Appel, M. (1973). On the internal structure of the MMPI. *Multivariate Behavioral Research, 8*, 131-171.

Hovey, H. B. (1964). Brain lesions and five MMPI items. *Journal of Consulting Psychology, 28*, 78-79.

Huber, S. J., Paulson, G. W., Shuttleworth, E. C., Chakeres, D., Clapp, L. E., Pakalnis, A., . . . Rammohan, K. (1987). Magnetic resonance imaging correlates of dementia in multiple sclerosis. *Archives of Neurology, 44*, 732-736.

Huijbregts, S. C., Kalkers, N. F., de Sonneville, L. M., de Groot, V., & Polman, C. H. (2006). Cognitive impairment and decline in different MS subtypes. *Journal of the Neurological Sciences, 245*, 187-194.

Jackson, D. N. (Ed.). (1970). *A sequential system for personality scale development* (Vol. 2). New York: Academic Press.

Joffe, R. T., Lippert, G. P., Gray, T. A., Sawa, G., & Horvath, Z. (1987). Mood disorder and multiple sclerosis. *Archives of Neurology, 44*, 376-378.

Johnson, S. K., DeLuca, J., Diamond, B. J., & Natelson, B. H. (1996). Selective impairment of auditory processing in chronic fatigue syndrome: A comparison with multiple sclerosis and healthy controls. *Perceptual and Motor Skills, 83*, 51-62.

Judd, L. L., Paulus, M. P., Wells, K. B., & Rapaport, M. H. (1996). Socioeconomic burden of subsyndromal depressive symptoms and major depression in a sample of the general population. *American Journal of Psychiatry, 153*, 1411-1417.

Julian, L. J., & Arnett, P. A. (2009). Relationships among anxiety, depression, and executive functioning in multiple sclerosis. [Article]. *Clinical Neuropsychologist, 23*, 794-804.

Kalska, H., Punamaki, R. L., Makinen-Pelli, T., & Saarinen, M. (1999). Memory and metamomory functioning among depressed patients. *Applied Neuropsychology, 6*, 96-107.

Kantarci, O., & Wingerchuck, D. (2006). Epidemiology and natural history of multiple sclerosis: New insights. *Current Opinion in Neurology, 19*, 248-254.

Katon, W. J., & Walker, E. A. (1998). Medically unexplained symptoms in primary care. *Journal of Clinical Psychiatry, 59*(Suppl. 20), 15-21.

Kelland, D. Z., & Lewis, R. F. (1996). The Digit Vigilance Test: Reliability, validity, and sensitivity to diazepam. *Archives of Clinical Neuropsychology, 11*, 339-344.

Kerns, R. D., Kassirer, M., & Otis, J. (2002). Pain in multiple sclerosis: A biopsychosocial perspective. *Journal of Rehabilitation Research and Development, 39*, 225-232.

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Koretz, D., Merikangas, K. R., . . . Wang, P. S. (2003). The epidemiology of major depressive disorder: Results from the National Comorbidity Survey Replication (NCS-R). *JAMA, 289*, 3095-3105.

Kessler, R. C., & Wang, P. S. (2008). The descriptive epidemiology of commonly occurring mental disorders in the United States. *Annual Review of Public Health, 29*, 115-129.

Kirk, R. (1990). Statistics: An introduction (3rd ed., pp. 418). For Worth, TX: Holt, Rinehard and Winston.

Kroenke, K., Spitzer, R. L., Williams, J. B., Monahan, P. O., & Lowe, B. (2007). Anxiety disorders in primary care: Prevalence, impairment, comorbidity, and detection. *Annals of Internal Medicine, 146*, 317-325.

Kujala, P., Portin, R., Revonsuo, A., & Ruutiainen, J. (1995). Attention related performances in two cognitively different subgroups of patients with multiple sclerosis. *Neurology, Neurosurgery, and Psychiatry, 59,* 77-82.

Kujala, P., Portin, R., & Ruutiainen, J. (1997). The progress of cognitive decline in multiple sclerosis. A controlled 3-year follow-up. *Brain, 120,* 289-297.

Kurtzke, J. F. (1983). Rating neurologic impairment in multiple sclerosis: An Expanded Disability Status Scale (EDSS). *Neurology, 33,* 1444-1452.

Lacerda, A. L. T., Dalgalarrondo, P., Caetano, D., Haas, G. L., Camargo, E. E., & Keshavan, M. S. (2003). Neuropsychological performance and regional cerebral blood flow in obsessive compulsive disorder. *Progress in Neuropsychopharmacology and Biological Psychiatry, 27*, 657-665.

Larrabee, G. J. (2003). Exaggerated MMPI-2 symptom report in personal injury litigants with malingered neurocognitive deficit. *Archives of Clinical Neuropsychology, 18,* 673-686.

Lazeron, R. H., Rombouts, S. A., Scheltens, P., Polman, C. H., & Barkhof, F. (2004). An fMRI sudy of planning-related brain activity in patients with moderately advanced multiple sclerosis. *Multiple Sclerosis, 10*, 549-555.

Lewis, R. (1995). *Digit Vigilance Test: Professional user's guide*. Odessa, FL: Psychological Assessment Resources.

Lewis, R., & Rennick, P. (1979). *Manual for the Repeatable Cognitive-Perceptual-Motor Battery*. Grosse Pointe Park, MI: Axon.

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

Lezak, M. D., Howieson, D. B., & Loring, D. W. (2004). *Neuropsychological Assessment* (4th ed.). New York: Oxford University Press.

Lezak, M. D., Howieson, D. B., Loring, D. W., Hannay, H. J., & Fischer, J. S. (Eds.). (2004). *Neuropathology for neuropsychologists: Multiple sclerosis* (4th ed.). New York: Oxford University Press.

Litvan, I., Grafman, J., Vendrell, P., & Martinez, J. M. (1988). Slowed information processing in multiple sclerosis. *Archives of Neurology, 45*, 281-285.

Locke, D. E. C., Kirlin, K. A., Thomas, M. L., Osborne, D., Hurst, D. F., Drazkowski, J. F., . . . Noe, K. H. (2010). The Minnesota Multiphasic Personality Inventory-2 Restructured Form in the epilepsy monitoring unit. *Epilepsy and Behavior, 17*, 252-258.

Lublin, F., & Reingold, S. (1996). Defining the course of multiple sclerosis: Results of an international survey. *Neurology, 46*, 906-911.

Ludman, E., Katon, R. J., Russo, J., Simon, G., Von Korff, M., Lin, E., . . . Kinder, L. (2006). Panic episodes among patients with diabetes. *General Hospital Psychiatry, 28*, 475-481.

Lynch, S. G., Parmenter, B. A., & Denney, D. R. (2005). The association between cognitive impairment and physical disability in multiple sclerosis. *Multiple Sclerosis, 11*, 469-476.

Mack, J. L. (1979). The MMPI and neurological dysfunctIon. In C. S. Newmark (Ed.), *MMPI and clinical research trends* (pp. 53-79). New York: Praeger.

Macniven, J. A. B., Davis, C., Ho, M.-Y., Bradshaw, C. M., Szabadi, E., & Constantinescu, C. S. (2008). Stroop performance in multiple sclerosis:

Information processing, selective attention, or executive functioning? *Journal of the International Neuropsychological Society, 14*, 805-814.

Marciniak, M. D., Lage, M. J., Dunayevich, E., Russell, J. M., Bowman, L., Landbloom, R. P., & Levine, L. R. (2005). The cost of treating anxiety: The medical and demographic correlates that impact total medical costs. *Depression and Anxiety*, 178-184.

Marsh, G. G. (1980). Disability and intellectual function in multiple sclerosis patients. *Journal of Nervous and Mental Disease, 168*, 758-762.

Marsh, G. G., Hirsch, S. H., & Leung, G. (1982). Use and misuse of the MMPI in multiple sclerosis. *Psychological Reports, 51*, 1127-1134.

Matotek, K., Saling, M. M., Gates, P., & Sedal, L. (2001). Subjective complaints, verbal fluency, and working memory in mild multiple sclerosis. *Applied Neuropsychology, 8*, 204-210.

McDonald, W. I., Compston, A., Edan, G., Goodkin, D., Hartung, H., Lublin, F. D., . . . Wolinsky, J. S. (2001). Recommended diagnostic criteria for multiple sclerosis: Guidelines from the International Panel on the Diagnosis of Multiple Sclerosis. *Annals of Neurology, 50*, 121-127.

McIvor, G. P., Riklan, M., & Reznikoff, M. (1984). Depression in multiple sclerosis as a function of length and severity of illness, age, remissions, and perceived social support. *Journal of Clinical Psychology, 40*, 1028-1033.

McLaughlin, T. P., Khandker, R. K., Kruzikas, D. T., & Tummala, R. (2006). Overlap of anxiety and depression in a managed care population: Prevalence and association with resource utilization. *Journal of Clinical Psychiatry, 67*, 1187-1193.

Meltzer-Brody, S., Hidalgo, R., Connor, K., Davidson, J., & Jonathan, R. T. (2000). Post traumatic stress disorder: Prevalence, health care use and costs, and pharmacologic considerations. *Psychiatric Annals, 30*, 722-730.

Meyerink, L. H., Reitan, R. M., & Selz, M. (1988). The validity of the MMPI with multiple sclerosis patients. *Journal of Clinical Psychology, 44*, 764-769.

Millefiorini, E., Padovani, A., Pozzilli, C., Loriedo, C., Bastianello, S., Buttinelli, C., . . . Fieschi, C. (1992). Depression in the early phase of MS: Influence of functional disability, cognitive impairment and brain abnormalities. *Acta Neurologica Scandanavia, 86*, 354-358.

Minden, S. L., Moes, E. J., Orav, J., Kaplan, E., & Reich, P. (1990). Memory impairment in multiple sclerosis. *Journal of Clinical and Experimental Neuropsychology, 12*, 566-586.

Minden, S. L., Moes, E. J., Orav, J., Kaplan, E., & Reich, P. (1990). Memory impairments in multiple sclerosis. *Journal of Clinical and Experimental Neuropsychology, 12*, 566-586.

Minden, S. L., Orav, J., & Reich, P. (1987). Depression in multiple sclerosis. *General Hospital Psychiatry, 9*, 426-434.

Minden, S. L., & Schiffer, R. B. (1990). Affective disorders in multiple sclerosis. Review and recommendations for clinical research. *Archives of Neurology, 47*, 98-104.

Minshew, N. J., Meyer, J., & Goldstein, G. (2002). Abstract reasoning in autism: A dissociation between concept formation and concept identification. *Neuropsychology, 16*, 327-334.

Mitrushina, M., Boone, K. B., Razani, J., & D'Elia, L. F. (2005). *Handbook of normative data for neuropsychological assessment* (2nd ed.). New York: Oxford University Press.

Moehle, K. A., & Fizhugh-Bell, K. B. (1988). Laterality of brain damage and emotional disturbance in adults. *Archives of Clinical Neuropsychology, 3*, 137-144.

Moriarty, J. (2007). Psychiatric disorders in neurology patients. *Journal of Neurology, Neurosurgery, and Psychiatry, 78*, 331-331.

Mueller, S. R., & Girace, M. (1988). Use and misuse of the MMPI: A reconsideration. *Psychological Reports, 63*, 483-491.

National Multiple Sclerosis Society. (2010a). Symptoms of multiple sclerosis Retrieved March 24, 2010, from http://www.nationalmssociety.org/about-multiple-sclerosis/what-we-know-about-ms/symptoms/index.aspx

National Multiple Sclerosis Society. (2010b). Who gets MS? Retrieved July 26, 2010, from http://www.nationalmssociety.org/about-multiple-sclerosis/what-we-know-about-ms/who-gets-ms/index.aspx

Nelson, L. D., Elder, J. T., Tehrani, P., & Groot, J. (2003). Measuring personality and emotional functioning in multiple sclerosis: A cautionary note. *Archives of Clinical Neuropsychology, 18*, 419-429.

Nichols, D. S. (2006). The trials of separating bath water from baby: A review and critique of the MMPI-2 Restructured Clinical Scales. *Journal of Personality Assessment, 87*, 121-138.

Nyenhuis, D. L., Rao, S. M., Zajecka, J. M., & Garron, D. C. (1993). *The development and initial validation of the Multiscale Depression Inventory for use with*

multiple sclerosis patients. Paper presented at the Meeting of the International Ncuropsychological Society, Galveston, Texas.

Nyenhuis, D. L., Rao, S. M., Zajecka, J. M., Luchetta, T., Bernardin, L., & Garron, D. C. (1995). Mood disturbance versus other symptoms of depression in multiple sclerosis. *Journal of the International Neuropsychological Society, 1*, 291-296.

O'Connor, J. P., & Stefic, E. C. (1959). Some patterns of hypochondriasis. *Educational and Psychological Measurement, 19*, 363-371.

Pallett, P. J., & O'Brien, M. T. (1985). *Multiple sclerosis: Textbook of neurological nursing*. Boston: Little, Brown.

Pancoast, D. L., & Archer, R. P. (1989). Original adult MMPI norms in normal samples: A review with implications for future developments. *Journal of Personality Assessment, 53*, 376-395.

Parker, D. M., & Crawford, J. R. (1992). *Assessment of frontal lobe function*. London: Erlbaum.

Parmenter, B. A., Shucard, J. L., Benedict, R. H., & Shucard, D. W. (2006). Working memory deficits in multiple sclerosis: Comparison between the N-back task and the Paced Auditory Serial Addition Test. *Journal of the International Neuropsychological Society, 12*, 677-687.

Parvizi, J., Arciniegas, D. B., Bernardini, G. L., Hoffmann, M. W., Mohr, J. P., Rapoport, M. J., . . . Tuhrim, S. (2006). Diagnosis and management of pathological laughter and crying. *Mayo Clinic Proceedings, 81*, 1482-1486.

Patten, S. B., Beck, C. A., Williams, J. V., Barbui, C., & Metz, L. M. (2003). Major depression in multiple sclerosis: A population-based perspective. *Neurology, 61*, 1524-1527.

Pelosi, L., Geesken, J. M., Holly, M., Hayward, M., & Blumhardt, L. D. (1997). Working memory impairment in early multiple sclerosis: Evidence from an event-related potential study of patients with clinically isolated myelopathy. *Brain, 120*, 2039-2058.

Peyser, J. M., Edwards, K. R., Poser, C. M., & Filskov, S. B. (1980). Cognitive function in patients with multiple sclerosis. *Archives of Neurology, 37*, 577-579.

Peyser, J. M., Rao, S. M., LaRocca, N. G., & Kaplan, E. (1990). Guidelines for neuropsychological research in multiple sclerosis. *Archives of Neurology, 47*, 94-97.

Phillips, L. H. (1997). *Do "frontal tests" measure executive function? Issues of assessment and evidence from fluency tests*. Hove, England: Psychology Press.

Piras, M. R., Magnano, I., Canu, E. D., Paulus, K. S., Satta, W. M., Soddu, A., . . . Aiello, I. (2003). Longitudinal study of cognitive dysfunction in multiple sclerosis: Neuropsychological, neuroradiological, and neurophysiological findings. *Journal of Neurology, Neurosurgery, and Psychiatry, 74*, 878-885.

Poser, C. M., Paty, D. W., Scheinberg, L., McDonald, W. I., Davis, F. A., Ebers, G. C., . . . Tourtellotte, W. W. (1983). New diagnostic criteria for multiple sclerosis: Guidelines for research protocols. *Annals of Neurology, 13*, 227-231.

Pozzilli, C., Passafiume, D., Bernardi, S., Pantano, P., Incoccia, C., Bastianello, S., . . . Fieschi, C. (1991). SPECT, MRI, and cognitive functions in multiple sclerosis. *Journal of Neurology, Neurosurgery, and Psychiatry, 54,* 110-115.

Prigatano, G. P., Parsons, O., Wright, E. C., Levin, D. C., & Hawryluk, G. (1983). Neuropsychological test performance in mildly hypoxemic patients with chronic obstructive pulmonary disease. *Journal of Consulting and Clinical Psychology, 51,* 108-116.

Pujol, J., Bello, J., Deus, J., Martí-Vilalta, J. L., & Capdevila, A. (1997). Lesions in the left arcuate fasciculus region and depressive symptoms in multiple sclerosis. *Neurology, 49,* 1105-1110.

Rabins, P. V., Brooks, B. R., O'Donnell, P., Pearlson, G. D., Moberg, P., Jubelt, B., . . . Folstein, M. F. (1986). Structural brain correlates of emotional disorder in multiple sclerosis. *Brain, 109,* 585-597.

Rao, S. M., Grafman, J., DiGiulio, D., Mittenberg, W., Bernadin, L., Leo, G. J., . . . Unverzagt, F. (1993). Memory dysfunction in multiple sclerosis: Its relation to working memory, semantic encoding, and implicit learning. *Neuropsychology, 7,* 364-374.

Rao, S. M., Hammeke, T. A., McQuillen, M. P., Khatri, B. O., & Lloyd, D. (1984). Memory disturbance in chronic progressive multiple sclerosis. *Archives of Neurology, 41,* 625-631.

Rao, S. M., Leo, D. O., Ellington, L., Nauertz, T., Bernardin, L., & Unverzagt, F. (1989). Cognitive dysfunction in multiple sclerosis: Impact on employment and social functioning. *Neurology, 41,* 692-696.

Rao, S. M., Leo, G. J., Bernardin, L., & Unverzagt, F. (1991). Cognitive dysfunction in multiple sclerosis. I. Frequency, patterns, and prediction. *Neurology, 41*, 685-691.

Rao, S. M., Leo, G. J., & St. Aubin-Faubert, P. (1989). On the nature of memory disturbance in multiple sclerosis. *Journal of Clinical and Experimental Neuropsychology, 11*, 699-712.

Reddon, J. R., Marceau, R., & Jackson, D. N. (1982). An application of singular value decomposition to the factor analysis of MMPI items. *Applied Psychological Measurement, 6*, 275-283.

Reingold, S. C. (1995). *Research directions in multiple sclerosis*. New York: National Multiple Sclerosis Society.

Reitan, R. M., & Wolfson, D. (1994). A selective and critical review of neuropsychological deficits and the frontal lobes. *Neuropsychology Review, 4*, 161-198.

Reitan, R. M., & Wolfson, D. (1997). Emotional disturbances and their interaction with neuropsychological deficits. *Neuropsychology Review, 7*, 3-19.

Revesz, T., Kidd, D., Thompson, A. J., Barnard, R. O., & McDonald, W. I. (1994). A comparison of the pathology of primary and secondary multiple sclerosis. *Brain, 117*, 756-765.

Rezai, K., Andreasen, N. C., Alliger, R., Cohen, G., Swayze II, V., & O'Leary, D. S. (1993). The neuropsychology of the prefrontal cortex. *Archives of Neurology, 59*, 636-642.

Rich, J. B., & Brown, G. G. (1992). Selective dissociations of sedation and amnesia following ingestion of diazepam. *Psychopharmacology, 106*, 346-350.

Robinson, R. G., Parikh, R. M., Lipsey, J. R., Starkstein, S. E., & Price, T. R. (1993). Pathological laughing and crying following stroke: Validation of a measurement scale and a double-blind treatment study. *American Journal of Psychiatry, 150*, 286-293.

Rogers, R., Sewell, K. W., Harrison, K. S., & Jordan, M. J. (2006). The MMPI-2 Restructured Clinical Scales: A paradigmatic shift in scale development. *Journal of Personality Assessment, 87*, 139-147.

Rohling, M. L., Green, P., Allen, L. M., & Iverson, G. L. (2002). Depressive symptoms and neurocognitive test scores in patients passing symptom validity tests. *Archives of Clinical Neuropsychology, 17*, 205-222.

Ron, M. A., & Logsdail, S. J. (1989). Psychiatric morbidity in multiple sclerosis: A clinical and MRI study. *Psychological Medicine, 19*, 887-895.

Ross, T. P. (2003). The reliability of cluster and switch scores for the Controlled Oral Word Association Test. *Archives of Clinical Neuropsychology, 18*, 153-164.

Rosselli, M., & Ardila, A. (1996). Cognitive effects of cocaine and polydrug abuse. *Journal of Clinical and Experimental Neuropsychology, 18*, 122-135.

Rosti, E., Hamalainen, P., Koivisto, K., & Hokkanen, L. (2007). PASAT in detecting cognitive impairment in relapsing-remitting MS. *Applied Neuropsychology, 14*, 101-112.

Ruff, C. F., Ayers, J. L., & Templer, D. I. (1977). The Watson and the Hovey MMPI Scales: Do they measure organicity or "functional" psychopathology? *Journal of Clinical Psychology, 33*, 732-734.

Sadovnick, A. D., Remick, R. A., Allen, J., Swartz, E., Yee, I. M. L., Eisen, K., . . . Paty, D. W. (1996). Depression and multiple sclerosis. *Neurology, 46*, 628-632.

Salthouse, T. A., Atkinson, T. M., & Berish, D. E. (2003). Executive fuctnioning as a potential mediator of age-related cognitive decline in normal adults. *Journal of Experimental Psychology: General, 132*, 566-594.

Sampson, H. (1956). Pacing and performance on a serial addition task. *Canadian Journal of Psychology, 10*, 219-225.

Santiago, O., Guardia, J., Casado, V., Carmona, O., & Arbizu, T. (2007). Specificity of frontal dysfunctions in relapsing-remitting multiple sclerosis. *Archives of Clinical Neuropsychology, 22*, 623-629.

Sarason, I. G., Sarason, B. R., Keefe, D. E., Hayes, B. E., & Shearin, E. N. (1986). Cognitive interference: Situational determinants and trailike characteristics. *Journal of Personality and Social Psychoogy, 51*, 215-226.

Sareen, J., Cox, B. J., Clara, I., & Asmundson, G. J. (2005). The relationship between anxiety disorders and physical disorders in the U.S. National Comorbidity Survey. *Depression and Anxiety, 21*, 193-202.

Sareen, J., Jacobi, F., Cox, B. J., Belik, S. L., & Stein, M. B. (2006). Disability and poor quality of life associated with comorbid anxiety disorders and physical conditions. *Archives of Internal Medicine, 166*, 2109-2016.

Schaffer, S., Barr, W., Brand, J., Alper, K., & Devinsky, O. (2007). Final program, abstracts presented at the thirty-fifth annual International Neuropsychological Society Conference, February 7–10, Portland, Oregon, USA. *Journal of the International Neuropsychological Society, 13*(Suppl. 1), 218.

Schear, J. M., & Sato, S. D. (1989). Effects of visual acuity and visual motor speed and dexterity on cognitive test performance. *Archives of Clinical Neuropsychology, 4*, 25-32.

Schiffer, R. B. (2002). Neuropsychiatric problems in patients with multiple sclerosis. *Psychiatric Annals, 32*, 128-132.

Schiffer, R. B., & Caine, E. D. (1991). The interaction between depressive affective disorder and neuropsychological performance in multiple sclerosis patients. *Journal of Neuropsychiatry and Clinical Neurosciences, 3*, 28-32.

Schiffer, R. B., Caine, E. D., Bamford, K. A., & Levy, S. (1983). Depressive episodes in patients with multiple sclerosis. *American Journal of Psychiatry, 140*, 1498-1500.

Schiffer, R. B., Wineman, N. M., & Weitkamp, L. R. (1986). Association between bipolar affective disorder and multiple sclerosis. *American Journal of Psychiatry, 143*, 94-95.

Schubert, D. S., & Foliart, R. H. (1993). Increased depression in multiple sclerosis patients: A meta-analysis. *Psychosomatics, 34*, 124-130.

Schumacher, G. A., Beebe, G., Kibler, R. F., Kurland, L. T., Kurtzke, J. F., McDowell, F., . . . Willmon, T. L. (1965). Problems of experimental trials of therapy in multiple sclerosis: Report by The Panel on the Evaluation of Experimental Trials

of Therapy in Multiple Sclerosis. *Annals of the New York Academy of Sciences, 122*(Research in Demyelinating Disease), 552-568.

Schwartz, M. S., & Brown, J. R. (1973). MMPI differentiation of multiple sclerosis vs. pseudoneurologic patients. *Journal of Clinical Psychology, 29*, 471-474.

Sellbom, M., Ben-Porath, Y. S., & Graham, J. R. (2006). Correlates of the MMPI–2 Restructured Clinical (RC) Scales in a college counseling setting. *Journal of Personality Assessment, 86*, 88-99.

Sellbom, M., Ben-Porath, Y. S., Graham, J. R., Arbisi, P. A., & Bagby, R. M. (2005). Susceptibility of the MMPI-2 Clinical, Restructured Clinical (RC), and Content Scales to overreporting and underreporting. *Assessment, 12*, 79-85.

Shaw, D. J., & Matthews, C. G. (1965). Differential MMPI performance of brain-damaged vs. pseudo-neurologic groups. *Journal of Clinical Psychology, 21*, 405-408.

Sherman, E. M. S., Strauss, E., & Spellacy, F. (1997). Validity of the Paced Auditory Serial Addition Test (PASAT) in adults referred for neuropsychological assessment after head injury. *Clinical Neuropsychologist, 11*, 34.

Shucard, J. L., Parrish, J., Shucard, D. W., McCabe, D. C., Benedict, R. H., & Ambrus Jr., J. (2004). Working memory and processing speed deficits in systemic lupus erythematosus as measured by the Paced Auditory Serial Addition Test. *Journal of the International Neuropsychological Society, 10*, 35-45.

Simms, L. J. (2006). Bridging the divide: Comments on the Restructured Clinical Scales of the MMPI-2. *Journal of Personality Assessment, 87*, 211-216.

Simms, L. J., Casillas, A., Clark, L. A., Watson, D., & Doebbeling, B. N. (2005). Psychometric evaluation of the Restructured Clinical Scales of the MMPI-2. *Psychological Assessment, 17*, 345-358.

Simon, G. E., & VonKorff, M. (1991). Somatization and psychiatric disorder in the NIMH Epidemiologic Catchment Area Study. *American Journal of Psychiatry, 148*, 1494-1500.

Slick, D. J., Hopp, G., Strauss, E., & Spellacy, F. J. (1996). Victoria Symptom Validity Test: Efficiency for detecting feigned memory impairment and relationship to neuropsychological tests and MMPI-2 validity scales. *Journal of Clinical and Experimental Neuropsychology, 18*, 911-922.

Snyder, P. J., & Cappelleri, J. C. (2001). Information processing speed deficits may be better correlated with the extent of white matter sclerotic lesions in multiple sclerosis than previously suspected. *Brain and Cognition, 46*, 279-284.

Solari, A., & Filippini, G. (1995). About self-assessment of neurological disability in multiple sclerosis. *International Journal of Epidemiology, 24*, 466.

Strauss, E., Sherman, E. M., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed.). New York: Oxford University Press.

Stuss, D. T., Levine, B., Alexander, M. P., Hong, J., Palumbo, C., Hamer, L., . . . Izukawa, D. (2000). Wisconsin Card Sorting Test performance in patients with focal frontal and posterior brain damage: Effects of lesion location and test structure on separable cognitive processes. *Neuropsychologia, 38*, 388-402.

Surridge, D. (1969). An investigation into some psychiatric aspects of multiple sclerosis. *British Journal of Psychiatry, 115*, 749-764.

Taylor, A. E., Saint-Cyr, J. A., Lang, A. E., & Kenny, F. T. (1986). Parkinson's disease and depression: A critical reevaluation. *Brain, 109*, 279-292.

Tellegen, A., Ben-Porath, Y. S., McNulty, J. L., Arbisi, P. A., Graham, J. R., & Kaemmer, B. (2003). *The MMPI-2 Restructured Clinical (RC) Scales: Development, validation, and interpretation*. Minneapolis: University of Minnesota Press.

Tellegen, A., Ben-Porath, Y. S., Sellbom, M., Arbisi, P. A., McNulty, J. L., & Graham, J. R. (2006). Further evidence on the validity of the MMPI-2 Restructured Clinical (RC) Scales: Addressing questions raised by Rogers, Sewell, Harrison, and Jordan and Nichols. *Journal of Personality Assessment, 87*, 148-171.

Tellegen, A., & Watson, D. (1999). On the dimensional and hierarchical structure of affect. *Psychological Science, 10*, 297-303.

Thompson, A. J., Kermode, A. G., Wicks, D., MacManus, D. G., Kendall, B. E., Kingsley, D. P. E., & McDonald, W. I. (1991). Major differences in the dynamics of primary and secondary progressive multiple sclerosis. *Annals of Neurology, 29*, 53-62.

Thornton, A. E., & Raz, N. (1997). Memory impairment in multiple sclerosis: A quantitative review. *Neuropsychology, 11*, 357-366.

Tombaugh, T. N. (1996). *Test of Memory Malingering*. Toronto, Canada: MultiHealth Systems.

Tombaugh, T. N., Kozak, J., & Rees, L. (1999). Normative data stratified by age and education for two measures of verbal fluency: FAS and animal naming. *Archives of Clinical Neuropsychology, 14*, 167-177.

Trapp, B. D., & Nave, K. (2008). Multiple sclerosis: An immune or neurodegenerative disorder? *Annual Review of Neuroscience, 31*, 247-269.

Trapp, B. D., Peterson, J., Ransohoff, R. M., Rudick, R. A., Mork, S., & Bo, L. (1998). Axonal transection in the lesions of multiple sclerosis. *New England Journal of Medicine, 338*, 278-285.

Vercoulen, J. H., Hommes, O. R., Swanink, C. M. A., Jongen, P. J. H., Fennis, J. F. M., Galama, J. M. D., . . . Bleijenberg, G. (1996). The measurement of fatigue in patients with multiple sclerosis: A multidimensional comparison with patients with chronic fatigue syndrome and healthy subjects. *Archives of Neurology, 53*, 642-649.

Walker, E. A., Katon, W., Russo, J., Ciechanowski, P., Newman, E., & Wagner, A. W. (2003). Health care costs associated with posttraumatic stress disorder symptoms in women. *Archives of General Psychiatry, 60*, 369-374.

Wallace, A., & Liljequist, L. (2005). A comparison of the correlational structures and elevation patterns of the MMPI-2 and Restructured Clinical (RC) and Clinical Scales. *Assessment, 12*, 290-294.

Waller, N. G. (Ed.). (1999). *Searching for structure in the MMPI*. Mahwah, NJ: Erlbaum.

Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin, 98*, 219-235.

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale-Revised*. New York: The Psychological Corporation.

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale-III*. San Antonio: The Psychological Corporation.

Weinberger, D. R., Berman, K. F., & Zec, R. F. (1988). Physiological dysfunction of dorsolateral prefrontal cortex in schizophrenia; I: Regional cerebral blood flow (rCBF) evidence. *Archives of General Psychiatry, 45*, 609-615.

Weinshenker, B. G., Bass, B., Rice, G. P. A., Noseworthy, J., Carriere, W., Baskerville, J., & Ebers, G. C. (1989). The natural history of multiple sclerosis, a geographically based study: Clinical course and disability. *Brain, 112*, 1419-1428.

Wells, K. B. (1995). The role of depression in hypertension-related mortality. *Psychosomatic Medicine, 57*, 436-438.

Wells, K. B., Stewart, A., Hays, R. D., Burnam, M. A., Rogers, W., Daniels, M., . . . Ware, J. (1989). The functioning and well-being of depressed patients: Results from the Medical Outcomes Study. *JAMA, 262*, 914-919.

Whetten-Goldstein, K., Sloan, F. A., Goldstein, L. B., & Kulas, E. D. (1998). A comprehensive assessment of the cost of multiple sclerosis in the United States. *Multiple Sclerosis, 4*, 419-425.

Whitlock, F. A., & Siskind, M. M. (1980). Depression as a major symptom of multiple sclerosis. *Journal of Neurology, Neurosurgery, and Psychiatry, 43*, 861-865.

Wishart, H., & Sharpe, D. (1997). Neuropsychological aspects of multiple sclerosis: A quantitative review. *Journal of Clinical and Experimental Neuropsychology, 19,* 810 - 824.

Wong, J. L., Wetterneck, C., & Klein, A. (2000). Effects of depressed mood on verbal memory performance versus self-reports of cognitive difficulties. *International Journal of Rehabilitation and Health, 5,* 85-97.

Wortzel, H. S., Oster, T. J., Anderson, C. A., & Arciniegas, D. B. (2008). Pathological laughing and crying: Epidemiology, pathophysiology, and treatment. *CNS Drugs, 22,* 531-546.

Wygant, D. B., Boutacoff, L. I., Arbisi, P. A., Ben-Porath, Y. S., Kelly, P. H., & Rupp, W. M. (2007). Examination of the MMPI-2 Restructured Clinical (RC) Scales in a sample of bariatric surgery candidates. *Journal of Clinical Psychology in Medical Settings, 14*, 197-205.

Zakzanis, K. K. (2000). Distinct neurocognitive profiles in multiple sclerosis subtypes. *Archives of Clinical Neuropsychology, 15*, 115-136.

Zorzon, M., de Masi, R., Nasuelli, D., Ukmar, M., Mucelli, R. P., Cazzato, G., . . . Zivadinov, R. (2001). Depression and anxiety in multiple sclerosis: A clinical and MRI study in 95 subjects. *Journal of Neurology, 248*, 416-421.

Zorzon, M., Zivadinov, R., Nasuelli, D., Ukmar, M., Bratina, A., Tommasi, M. A., . . . Cazzato, G. (2002). Depressive symptoms and MRI changes in multiple sclerosis. *European Journal of Neurology, 9*, 491-496.