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Cognitive Dysfunction in the Earliest Stages of Multiple Sclerosis

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Through recent advances in neuroimaging we can now visualize a range of neuropathology in multiple sclerosis (MS). MS has long been considered the prototypical white matter disease characterized by demyelinating white matter "plaques" identified by conventional magnetic resonance imaging (MRI) techniques. As a result, neuropathology in MS has traditionally been believed to primarily involve the myelin sheath protecting the axons, with other aspects of the central nervous system (CNS) being relatively spared.

Though early histopathological studies documented CNS changes in MS that were not restricted to myelin (Charcot, 1868; Kornek & Lassmann, 1999), neuropathology outside demyelinating lesions was not fully appreciated until more recent histopathological studies pointed to commonly occurring structural changes including axonal damage and transection (Trapp et al., 1998) and even lesions in the cortex (Peterson, Bo, Mork, Chang, & Trapp, 2001; Pirko, Lucchinetti, Sriram, & Bakshi, 2007). With an increased focus on neuropathology outside of demyelinating lesions, researchers have now turned to advances in neuroimaging to better visualize structural alterations in grey matter and non-lesioned white matter [also called normal appearing white matter (NAWM)] in MS.

The conventional MRI marker of disease burden in MS, T2-MRI white matter lesion volume (See Figure 1), is often poorly correlated with measures of MS disease progression and disability (typically assessed using Expanded Disability Status Scale; EDSS) (Filippi et al., 1995; Mammi et al., 1996). Though correlations between T2-MRI lesion volume and cognitive functioning are slightly stronger, the strength of these relationships remains modest (Arnett et al., 1994; Foong et al., 1997; Rao, Leo, Haughton, St. Aubin-Faubert, & Bernardin, 1989; Rovaris et al., 1998; Swirsky-Sacchetti et al., 1992).

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From The Editor

Dear Division 40 Members,

How quickly time passes! This issue serves as the last in my 3-year term as Editor of *Newsletter 40.* The past 6 years as associate editor and then editor of the newsletter have been extremely enjoyable and a tremendous learning experience for me. I want to thank all of you who have contributed to *Newsletter 40* during my tenure. Your hard work was greatly appreciated and I am proud of each of the resulting publications. I also want to thank Dr. William Barr, as well as the entire Executive Committee for their feedback and assistance in creating the new format for *Newsletter 40*. The addition of "Committee Reports" as well as a more structured "Announcements" section has been a great improvement in our ability to communicate with the members of the division.

The current issue of the newsletter focuses on a population close to my heart – individuals with Multiple Sclerosis. Both Clinical Corner and the research piece address particularly hot topics in MS care today – the application of neuroimaging and cognitive rehabilitation. The articles are well written and very information – I hope you enjoy them! As always, the summer/fall issue contains the APA programs for Divisions 22 and 40. The program is packed with interesting speakers and topics – I hope you enjoy the conference!

Again, I would like to thank all who have taken the time to contribute to this issue, as well as all of the issues published during the last 6 years. Dr. Bonny Forrest will be taking the reigns as Newsletter Editor and I am certain she will do an excellent job! Thanks again!

Nancy D. Chiaravalloti, PhD
Editor

Clinical Corner

Multiple Sclerosis and Cognition: Implications for Cognitive Rehabilitation

Lauren S. Caruso, Ph.D. and Amy Ash, M.A.

Introduction

This paper will present a longitudinal case study of a patient with multiple sclerosis (MS) experiencing cognitive difficulties. An overview of the literature on MS and cognition as well as the role of cognition in everyday functioning will be discussed. Results from the patient's successive neuropsychological assessments over a span of five years and changes in functioning over time will be reviewed. Neuroimaging findings from two MRIs will be discussed as well. All of this information will be examined within the context of the patient's cognitive rehabilitation, and its implications for further study in this population will be explored.

Multiple Sclerosis

MS is a progressive disease of the central nervous system (CNS) which is characterized by widespread lesions, or plaques, in the brain and spinal cord. These plaques are formed in the myelin sheath of the CNS, which is vital to the normal transmission of nerve impulses (Rumrill, Kaleta, & Battersby, 1996). As a result, MS results in a wide symptom array, including motor, cognitive, and neuropsychiatric problems (Brassington & Marsh, 1998). No two individuals with MS experience exactly the same symptoms or disease course (Gordon, Lewis, & Wong, 1994). In addition, cognitive deficits may occur independently of physical disability which complicates their identification and recognition (Cobble, 1992). The wide variability in symptoms and disease course creates a significant obstacle in understanding the disease process and identifying effective treatments. Current epidemiological studies indicate that women are approximately twice as likely to suffer from MS than men (Kraft, 1981), and MS is significantly more prevalent in specific geographic regions (Rumrill et al., 1996). MS is currently thought to be the result of unspecified immunologic, genetic, and viral factors (Rumrill et al., 1996).

Cognitive Limitations in MS

Currently prevalence rates of cognitive dysfunction in MS range from 43% to 70% (Peyser, Rao, LaRocca, & Kaplan, 1990; Rao, Leo, Bernardin, & Unverzagt, 1991). MS has been shown to negatively effect various aspects of cognitive functioning including encoding in learning (Litvan, Grafman, Vendrell, & Martinez, 1988; Beatty et al., 1996) information processing abilities (Litvan et al., 1988; Diamond, DeLuca, Kim, & Kelley, 1997; Grafman, Rao, Bernardin, & Leo, 1991) and memory functioning (Brassington & Marsh, 1998). Memory is one of the most consistently impaired functions identified in persons with MS, and is evident in approximately 40%-65% of patients (Rao et al., 1993). Early literature on memory impairment in MS suggests that retrieval failure is the primary cause for the memory deficit (Caine, Bamford, Schiffer, Shoulson, & Levy, 1986; Rao, 1986; Rao, Leo, & St. Aubin-Faubert, 1989). However, recent research has demonstrated that many persons with MS may have impaired verbal and visual new learning abilities, but normal long-term recall and recognition (DeLuca, Barbieri-Berger, & Johnson, 1994; DeLuca, Gaudino, Diamond, Christodoulou, & Engel, 1998; Thornton & Raz, 1997). When equated on the amount of information initially acquired, MS subjects did not demonstrate deficits in the recall or recognition of newly learned information. These results suggest that the memory deficit in MS may be one of acquisition of new information, rather than retrieval from long term storage. Other researchers

have also found memory and new learning deficits to be an integral component of cognitive dysfunction in MS. Differences between memory and new learning performance in a cognitively preserved versus cognitively impaired MS sample are apparent (Kujala, Portin, & Ruutiainen, 1996).

The Role of Cognition in the Everyday Lives of Individuals with MS

Estimates of the prevalence of MS indicate that MS affects at least 250,000 Americans (Anderson et al., 1992). Onset typically occurs between the ages of 20 and 40, the time at which individuals are most active and productive in many aspects of their lives (Reingold, 1995), and often leads to the loss of gainful employment for a large number of patients (Beatty, Blanco, Wilbanks, Paul, & Hames, 1995). Specifically, research in the US and Europe indicates that 40-80% of individuals with MS are unemployed (Mitchell, 1981; Gronning, Hannisdal, & Mellgren, 1990; Kornblith, LaRocca, & Baum, 1986). A national survey looking at employment issues in MS indicated unemployment rates of 84% for women with MS and 72% for men with MS. These rates are drastically higher than those of the normal population (Kornblith, LaRocca, & Baum, 1986). The literature indicates that cognitive impairment is a large contributor to this high unemployment rate (Rao et al., 1991; Beatty et al., 1995; LaRocca, 1995). For example, Beatty et al (Beatty et al., 1995) found only that five variables account for 49% of the variance in employment status in MS, three of which were measures of cognitive functioning. Additional studies have noted that 50-80% of MS patients are unemployed within 10 years of the onset of the disease (Gronning et al., 1990; LaRocca, Kalb, Scheinberg, & Kendall, 1985; Kornblith et al., 1986; Bauer, 1978; LaRocca, Kalb, Schneinberg, & Kendall, 1985). Beatty (1995) found that individuals with MS who maintained employment performed significantly better on cognitive testing than those who were unemployed. Interestingly, information processing and memory were the two domains that best predicted work status in this study.

Cognitive dysfunction is also closely related to functional status in MS (Abraham, Scheinberg, Smith, & LaRocca, 1997; Beatty, Blanco, Wilbanks, Paul, & Hames, 1995; Kessler, Cohen, Lauer, & Kausch, 1992; Rao et al., 1991). Common functional impairments in this population include difficulty shopping independently, doing housework, washing clothes, ironing, completing home repairs, cooking, driving, and using public transportation (Staples & Lincoln, 1979). While physical disability is important to the performance of everyday activities, it cannot account for all of the difficulties individuals with MS experience with many everyday activities, particularly those with a significant cognitive load. For example, Rao and colleagues (1991) found that cognitively impaired individuals with MS, versus those with a purely physical disability, were less likely to be employed, engaged in fewer social and vocational activities, had greater difficulties in carrying out routine household tasks, and were more vulnerable to psychiatric illness.

Case History

AF is right-handed male who was diagnosed with relapsing-remitting MS at the age of 36. He is married with one child and reported no history of MS in his family. He had previously received bachelor's and master's degrees from a local university. At the time of the initial evaluation in 1997, AF had been working as a business analyst for nine years. However, four years earlier he requested a demotion because he felt that his reading skills and problem solving abilities had deteriorated. He also complained of being overwhelmed at work and with his job responsibilities. In 1998, AF went on long-term disability.

AF was diagnosed with MS in 1989, but reported that the onset of symptoms began in 1981, when he was in college. He noted continued periods of exacerbations and remissions of symptoms over time. Approximately three and a half years before the initial evaluation, AF experienced an exacerbation which resulted in paralysis on his left side. Although this mostly resolved, his left hand remained weak. Additional symptoms included recurring episodes of optic neuritis and stiffness in his lower extremities. AF also complained of cognitive issues to his neurologist, but this was discounted and he was told that there were "no cognitive issues in MS." Consequently, AF's stress

and anxiety levels increased significantly, and instead he felt that he must be "losing his mind."

Two brain MRIs' and one cervical spine MRI with and without contrast were completed: one around the time of AF's diagnosis in 1989 and the other several years later in 1994. Both of these images found white matter demyelination consistent with MS. Specifically, the initial imaging findings revealed multiple small foci of abnormal intensity in both hemispheres within the deep white matter and periventricular white matter of the frontal, parietal, and occipital lobes. Later MRI findings also noted periventricular white matter and abnormal signals in the brainstem. Images of the cervical spine determined that there were small abnormal signals in the upper and mid-cervical spinal cord, which were also consistent with MS.

At the time of the initial neuropsychological evaluation, AF reported increased fatigue and changes in cognition, memory and personality. During this time, he was receiving psychiatric treatment for depression, intermittent panic attacks, and personality issues. The examiner noted that he appeared easily overwhelmed by external stimuli and was distractible. He also had difficulty regulating his anger and was prone to having temper outbursts at home. Other significant stressors for AF were his extreme sensory sensitivities to heat and loud noises. The heat and humidity caused him to be very agitated, especially during the summer months. The effect of loud noises was tempered with the occasional use of ear plugs.

Initial Neuropsychological Test Results

AF's overall premorbid ability was estimated as having been in the high average range, with abilities in specific areas fluctuating from the average to superior range. This was based on his educational and employment histories, overall scores of intellectual abilities, and reading comprehension scores.

The Wechsler Adult Intelligence Scale-Revised (WAIS-R) was administered as part of the initial evaluation. AF obtained a Full Scale IQ (FSIQ) of 111 (77th percentile), a Verbal IQ (VIQ) of 109 (73rd percentile), and a Performance IQ (PIQ) of 113 (81st percentile). These scores indicated that his overall level of intelligence fell in the high average range. Specifically, his overall fund of knowledge and ability to read single words were both within the average to above average range. His levels of attention and concentration and abstract verbal abilities were also intact. When asked to copy abstract designs, AF's performance also was in the average to above average range, with a mild tremor noted.

Memory functions in the areas of information storage and retrieval were found to be erratic. AF performed in the average range (43rd percentile) when asked to recall details from orally presented stories, but his ability to recall this information after a long delay was in the low average range (17th percentile). He also demonstrated some impairment when he was asked to learn a list of related and unrelated word pairs across trials. AF's visual memory was assessed by having him copy a complex geometric design after a time delay. His performance was in the average range (46th percentile).

AF's language functioning and verbal fluency were also measured His naming ability was judged to be intact, but his verbal fluency skills, as seen by the generation of words when provided with a phonetic cue, fell in the mildly impaired range (10th percentile). AF adequately completed complex verbal tasks that required crossing the midline. During a test of motor speed, he showed decreased coordination with his left hand while performance with his right hand was considered within normal limits.

Following these results, AF's psychiatrist referred him to a neuropsychologist specializing in cognitive rehabilitation in MS. Supplemental neuropsychological testing conducted at that time indicated a decreased ability to quickly organize, store, and retrieve verbal information. In addition, AF had considerable difficulty alternating or dividing his attention between tasks and processing verbal information (e.g., reading speed) or visual information (e.g., tracking numbers and symbols) quickly. Further assessment of AF's executive functioning, which required the conceptualization of visual sets, was within expectations. Most of the cognitive changes experienced by AF were judged to

be consistent with those found in MS. However, the decay of previously stored verbal information over time was considered atypical and felt to be related to motivational factors (e.g., diminished reserves, fatigue, affect).

Thus, AF's cognitive deficits, coupled with his environmental sensitivities and affective issues, made many tasks appear even more overwhelming and resulted in further anxiety and temper outbursts. Consequently, it was suggested that AF might benefit from a comprehensive cognitive rehabilitation program with the neuropsychologist, focusing on making his environment, ability to function, and mood more manageable.

Cognitive Rehabilitation Intervention

Cognitive rehabilitation, or cognitive remediation as it is sometimes referred to, has long been utilized as a method of treatment for persons with stroke and traumatic brain injury. However, until recently, it has not been used consistently to treat cognitive deficits in MS (LaRocca et al., 2006). One method of cognitive rehabilitation is to help develop external and internal "compensatory" strategies which help patients adapt to their environment by learning alternative strategies (LaRocca et al., 2006). An example of an external strategy includes someone who has difficulty planning activities creating a "schedule" the night beforehand. "Substitution" is an example of an internal strategy and usually involves using an intact cognitive ability to "replace" one that is impaired, such as using visual memory to aid failing verbal memory. Another cognitive rehabilitation technique that is frequently used is called "restorative" (LaRocca et al., 2006). This method attempts to improve the patient's abilities in a specific area by having them complete exercises or practice drills. This commonly takes the form of having the patient memorize a list of words or practice memory exercises.

To date, the research on cognitive rehabilitation in MS has yielded some conflicting results. This may be due, at least in part, to a wide variety of study methodologies and small sample sizes as well as the large variance of cognitive difficulties across MS patients (LaRocca et al., 2006). However, there is some evidence of substantial benefit, especially when restorative and compensatory approaches are combined (LaRocca et al., 2006) and the program is tailored to the patient's specific needs and goals. In addition, as is especially the case in an unpredictable and often progressive disease such as MS, addressing environmental, interpersonal, and affective issues as part of a cognitive rehabilitation program is paramount for its success.

AF participated in an individualized cognitive rehabilitation program on a mostly weekly basis from mid 1998 through early 2004. Initial sessions were conducted in conjunction with his wife to help establish environmental and interpersonal issues, but then sessions continued on a one-to-one basis with periodic joint sessions for follow-up information. Over this time period, AF developed a good relationship with the clinic staff. Early sessions began by instituting a stress management protocol and reorganizing AF's workload so that he could better handle his environment. It is important to note that AF was very receptive to many of the approaches and integrated them into his daily routine and lifestyle, often customizing them on his own to meet his affective and cognitive needs.

One of the first exercises required AF to break down tasks to "bite size pieces" so that he could better manage his daily routine. He was also instructed to pace his activities and check his breathing throughout the day to help him relax. In addition, a substantial amount of time was spent developing healthier sleep habits to decrease his distractibility, fatigue, and stress. AF worked diligently to keep a log of his sleep schedules and daily activities. In fact, he revised the neuropsychologist's original log and added more categories. Additional strategies in this area included having AF decrease environmental distractions, such as the television, phone, and lights, around sleep times. The use of daytime naps and limiting levels of caffeine were also encouraged. These tactics were very successful in the first year of the program and helped AF maintain good sleep hygiene, thereby improving the restorative quality of his nocturnal sleep and daytime attention. This, in turn, also helped to combat his fatigue and reduce his anxiety and frustration levels.

As noted previously, another hurdle for AF to overcome was his extreme sensitivity to temperature increases, which sometimes led to aggressive and anxious behaviors. To help him better manage his behavior during the warmer months, daily temperatures and barometric pressures were noted on a supplemental log. The use of a cooling vest during the summer months was also suggested and implemented.

Once AF's environment became more manageable, additional cognitive and behavioral strategies were employed to maintain organizational skills and stabilize his mood. In an effort to control his temper outbursts, AF completed deep breathing exercises. When a situation felt as if it was getting out of control, AF was instructed to inhale for 10 seconds, hold his breath for 10 seconds, and then exhale for 10 seconds. Other suggestions by the neuropsychologist were to have him group common tasks in an effort to expend less energy, and execute more complicated tasks when his energy was at its highest. AF was also encouraged to leave the room during a stressful incident or confrontation. In conjunction with these tactics, he created a "hot list" (e.g., "nap, pace, breathe") of "to do" items or "tools" to manage his environment on a daily basis.

During the next stage of cognitive rehabilitation, AF worked with the neuropsychologist on tasks requiring cognitive flexibility, and developed internal and external compensatory strategies related to verbal memory. Visualization and auditory organization strategies were incorporated into AF's program to help compensate for these limitations. For visualization, the "method of loci" was used. This method links items that need to be remembered with a list of familiar objects or places, such as a room in one's house. To date, there is not a great amount of research on this strategy. However, one randomized, controlled study, which embedded items to be remembered into the body of a story, produced promising results. It was found that subsequent to intervention, the treatment group's ability to memorize a list of words was greater than that of the control group (LaRocca et al., 2006). Clinical practice suggests that the method of loci is useful in patients with strong, pre-existing visual memory skills. In AF's case, it proved to be a useful tool and provided him with a visual structure to place verbal information that otherwise remained disorganized.

In addition, a significant amount of time was spent working on AF's perceptions of others and of various situations. This helped him to see things more objectively and learn about his own misconceptions in order to ameliorate his anxiety. To this end, environmental stressors and affective responses were addressed in session through various communication, restructuring, and role-playing exercises.

To further improve memory and cognitive functioning, additional exercises were completed. For name recognition and conversational memory, AF was shown photographs of famous people (e.g., U.S. presidents) and was asked to recall them by looking at their pictures. He also was asked to read articles and present them in session as a communication tool. To this end, he selected short pieces on various presidents and texts that were of interest to him, such as woodworking. These were followed by general and specific questions on the topic. A more enhanced version of the task, geared at tapping into prose memory, was also implemented by the neuropsychologist. During this exercise, AF would read passages and then re-organize and present the information in terms of the main idea and supporting details.

Other activities worked on AF's ability to cognitively switch sets between tasks. The "Big/Little" task, which is similar to the Stroop, has the patient read either the word directly as it is written on the page or to read it according to size (e.g., large/small font size). A more complicated, three-tiered version, "High-Mid-Low," requires identifying placement along a horizontal line (e.g., high versus mid versus low in the line) versus simply reading the words across the line. AF also practiced sorting cards according to a specific variable (e.g., turn over all the cards whose names contain the letter "e") which changed with each deck administration. For all of these exercises, completion time and number of errors were monitored. On these tasks AF's abilities steadily improved across sessions and task complexity. He also completed activities which worked on maintaining his levels of attention and

concentration as well as visuospatial skills (e.g., three-dimensional "Tic-Tac-Toe").

After five years of cognitive remediation, AF demonstrated and maintained overall gains in the areas of attention, concentration, verbal memory, and cognitive flexibility, despite progression of his MS neuropathology, increasing difficulties with fatigue, and continued affective disturbances. In particular, his increased fatigue seemed to become most problematic and precluded work on additional tasks. Therefore, it then became necessary to continue a maintenance schedule throughout the year, which in the past was only used during the summer months when the heat was a disabling factor; in fact, at times the sessions had to be conducted via e-mail since AF felt too disabled to drive.

At home, AF was successful in limiting his stress level, but felt that this took a toll on his family because of their increased responsibilities. Nocturnal sleep schedules, as well as daytime naps were also effective. However, around the time of the final evaluation, AF reported an increase in interpersonal conflicts and misunderstandings of social situations, especially in the summer time. As a result, he started to isolate himself from social activities in order to decrease his exposure to stressful situations and resulting temper outbursts.

Thus, as a result of his individualized cognitive rehabilitation program, AF was able to maintain considerable gains with regard to his organizational skills, complex attention abilities, processing speed, cognitive flexibility, conceptual reasoning, and verbal memory. In particular, continued uses of visualization strategies and remedial sessions allowed AF to maintain his significant improvements seen in verbal memory over the years. He was very receptive to these strategies and was successful at incorporating them into his daily routine. Thus, his gains from cognitive rehabilitation were generalized to his everyday life and interpersonal communications. However, fluctuations in mood and increases in fatigue were limiting factors for this patient, which over time limited additional cognitive intervention.

Subsequent Neuropsychological Test Results

The last neuropsychological evaluation was completed in late 2003. During the final evaluation, the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III) was administered. AF obtained a FSIQ of 111 (77th percentile), which indicated that his general cognitive thinking and reasoning abilities were in the high average range. His VIQ was 115, which fell in the 84th percentile and his PIQ was 105, which fell in the 63rd percentile. This performance was similar to that measured by the WAIS-R in 1997, which is to be expected.

In comparison to previous years, it appeared that AF's verbal memory had stabilized in the high average range. This denoted the maintenance of significant improvements, since his moderately impaired scores in 1998. These results are more likely than not indicative of his work in this area during cognitive rehabilitation, in which he presented information and was asked to recall it with and without contextual cues. In contrast, his visual memory, a pre-existing strength used to help compensate for verbal memory, showed some fluctuations. Although an improvement in recognizing faces was noted, after an imposed interference delay, AF's recall dropped to the borderline normal range. This is not surprising as his performance during cognitive rehabilitation showed his ability to recognize the faces of various presidents had peaked several months earlier and then dropped off at a lower level because of diminished reserves secondary to fatigue.

An assessment of AF's language skills found his ability to produce words with phonetic first letter restraints were similar to his performance in 2002. His expressive abilities remained mildly impaired, which was more likely than not indicative of cognitive fatigue. Reading speed, which was average in 2000 and 2001, and low average in 2002, was again in the average range in 2003. This may also be related, at least in part, to the reading exercises he completed in later sessions. In addition, AF's ability to understand written information in the form of short passages was in the high average range, which again is more likely than not secondary to the reading exercises conducted during his sessions.

As for visuospatial abilities, as in previous years, AF's abilities were in the average range. Similarly, when asked to compare lines of similar orientation, his abilities were again in the average range and suggested intact abilities to orient items in space. These findings continued to indicate visual acuity (primary visual cortex) as well as visuospatial discrimination of fine detail to organization (secondary visual cortex) and orientation (parietal lobe), despite his history of MS-related visual symptomatology.

AF's sensorimotor skills were also measured during this visit. On a test of motor speed and dexterity, he performed in the mildly impaired range for the dominant right hand and both hands used simultaneously, but within normal limits for the non-dominant left hand. These limitations were relatively better than those seen in previous years with some fluctuation seen in manual dexterity over the past year.

In addition, cognitive fatigue, secondary to MS-related diminished reserves, was noted on several tasks. Word finding problems, a new concern as of 2002, continued. This was most apparent during repeated trials as cognitive fatigue increased, and is more likely than not demonstrative of the MS-related fatigue that eventually limited his ability to proceed with cognitive rehabilitation.

In sum, AF's skills in the areas of visuospatial processing, reading speed, and immediate verbal memory had been maintained. He also demonstrated gains in his organizational skills, complex attention, speed of information processing, cognitive flexibility, and conceptual reasoning. These results are mostly likely reflective of his participation in cognitive rehabilitation during which a restorative process was used requiring the repetition of targeted exercises across many sessions. His visual memory and sensorimotor abilities, which were not yet addressed in AF's sessions, seem to have fluctuated or slightly decreased over time. It is important to note that, apart from the noted improvements secondary to the cognitive rehabilitation program, the maintenance of cognitive abilities while experiencing a multi-dimensional, progressive disease such as MS, is in and of itself an especially noteworthy accomplishment.

Discussion

AF is a right-handed male who was diagnosed with relapsing-remitting MS in 1989, at age 36. At the time of the initial evaluation, he was experiencing symptoms in the areas of cognition, memory, affect, and personality.

AF's overall premorbid ability was estimated as having been in the high average range with abilities in specific areas fluctuating from the average to superior range. The findings of successive neuropsychological evaluations over a period of five years indicated considerable gains and maintenance of many abilities. It seems that the visualization, written, and auditory organization strategies employed during cognitive rehabilitation mostly contributed to the significant improvements realized in verbal memory. However, it is important to keep in mind that continued mood instability and increased fatigue were limiting factors. Secondary issues, such as distress caused by traveling to the sessions, became primary factors limiting the ability to continue the cognitive rehabilitation sessions. Thus, during his visit in early 2004, shortly after his final neuropsychological evaluation was completed, it was determined that cognitive rehabilitation sessions should be terminated and resumed, if necessary, at a later date. As affective issues remained paramount, psychotherapy sessions and medication management with his psychiatrist on a monthly basis continue at the present time.

This longitudinal case study underscores the need to address cognitively impaired patients using a holistic approach, which allows for the compounding effects of disease pathogenesis, psychopathology, environment, and patient individuality. In this way, it can be determined how accommodations in the patient's world can be best made, using an individualized approach to allow for better generalization to everyday life. In the case of AF, this meant that in order for him to function effectively, various cognitive strategies, both compensatory (i.e., external and internal) and restorative, as well as behavioral and environmental adaptations, needed to be employed. These strategies proved to be effective, as they helped to create and maintain gains in many areas of cognition and everyday functioning. In addition, AF seemed to

enjoy the sessions and reportedly continues to incorporate many of the strategies presented into his daily life. However, due to this particular individual's issues with personality, sensory sensitivities, and psychiatric problems, maintenance of appropriate behavior in certain social situations was problematic, causing some isolation, and ultimately limiting the rehabilitation. Perhaps if AF's psychiatric and personality issues were more easily controllable, these strategies would have proven to be even more effective and more generalizable.

In conclusion, the effects of cognitive rehabilitation in persons with MS need to be evaluated individually and include: cognitive sequalae, affective disorders, pre-morbid personality tendencies, and environmental surroundings. Conducting larger scale, randomized clinical research studies in cognitive rehabilitation for persons with MS will help us to determine what strategies may work best for specific individuals as well as the MS population as a whole. This case study highlights the need to have numerous cognitive and behavioral strategies at hand, as well as the ability to be flexible in their use. This, in turn, may help to better accommodate individuals with MS who are experiencing cognitive impairments by enabling them to incorporate effective techniques into their environment. Only as individuals are better able to integrate these strategies into their everyday life and routine, may daily functioning and overall outcomes be significantly improved.

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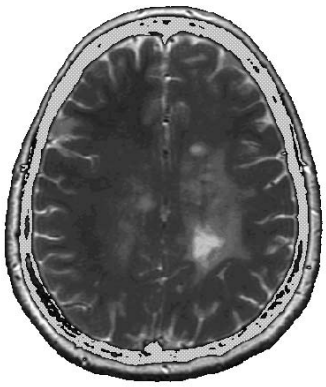

Figure 1.
T2-weighted MRI image of an MS-related white matter lesion

Neuroimaging technologies that have improved our ability to visualize neuropathology in MS have paved the way for a number of recent studies that have observed robust relationships between clinical measures of cognitive functioning and underlying structural alterations in both cortical and subcortical brain regions (Amato et al., 2004; R. Benedict et al., 2002; Brass, Benedict, Weinstock-Guttman, Munschauer, & Bakshi, 2006; Lazeron, de Sonneville, Scheltens, Polman, & Barkhof, 2006; Parmenter et al., 2007; Zivadinov et al., 2001). It is now understood that other structural abnormalities, including cortical atrophy and changes in "normal appearing white matter" (NAWM) may be more closely tied to important clinical outcomes including cognitive functioning and disability (Tedeschi et al., 2005) than previously thought.

Diffusion tensor imaging (DTI) is an increasingly utilized MRI technique developed to improve detection of microstructural changes within and outside of the macroscopic lesions typically visualized by T2-MRI in MS. DTI evaluates the motion of water molecules in cellular structures that should impede water motion, such as cell membranes and myelin. White matter fiber tracts consist of aligned myelinated axons and hindrance of water diffusion is greater across rather than along the major axis of these fibers (Beaulieu & Allen, 1994). MR diffusion measurements lead to 3 derived diffusion coefficients that describe the shape and orientation of water molecules (i.e., eigen values λ_1, λ_2, and λ_3; see Figure 2). A primary index derived from DTI is fractional anisotropy (FA) which reflects the presence and degree of alignment of cellular structures. FA decreases when there is a loss of structural integrity in NAWM (Cercignani,

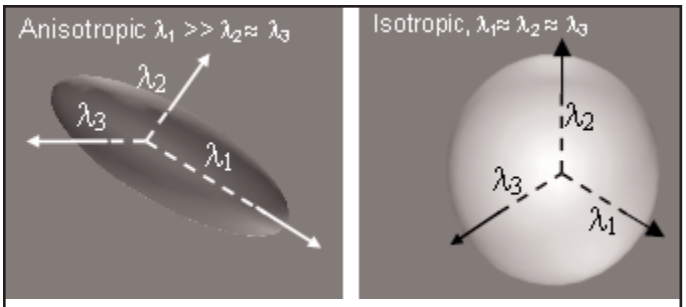

Figure 2. DTI describes the restriction of water molecules in cellular structures.

Inglese, Pagani, Comi, & Filippi, 2001). These advances in the field of neuroimaging have improved our understanding of neuropathology in MS, but have also facilitated the use cognitive assessment as an important measure of clinical outcomes (indices of cognitive functioning are more sensitive to underlying CNS activity in MS than other conventional clinical outcomes, e.g. disability).

Cognitive function and MS

Despite variability in methodology, prevalence rates of cognitive impairment in MS have remain consistently in the range of 40-65% across almost 50 years of inquiry (See Table 1). Cognitive impairment can have a significant impact on a patient's quality of life and impedes participation in life roles including employment (Rao et al., 1991; M. M. Smith & Arnett, 2005).

Early assumptions about the nature of cognitive impairment in MS included the belief that cognitive impairment typically appears late in the disease course of MS (i.e., several years after disease onset). In addition, it was often assumed that cognitive impairment appeared only after the onset of substantial physical disability. However, a number of more recent studies have observed cognitive dysfunction very early in the disease process, prior to physical disability.

The first stage of the MS disease process is often characterized by a clinically isolated syndrome (CIS). Patients are classified as CIS after the first neurologic episode caused by inflammation/ demyelination in one or more CNS locations. Approximately 60-90% of patients with CIS who also have abnormal MRI findings convert to a diagnosis of MS (Brex et al., 2002; Morrissey et al.,

Continued on page 17

APA Division 22 (Rehabilitation Psychology)
2007 Convention Program Summary

Friday, August 17, 2007

8:00 AM - 9:50 AM — Symposium: Sexual and Psychological Adjustment Among OIF/OEF Veterans With Disabilities
Linda R. Mona, PhD, Leigh A. Messinides, PhD, Rebecca P. Cameron, PhD, Sarah S. Fraley, PhD, Suzie S. Chen, PhD, Sandor Gardos, PhD
Moscone Center, Rooms 228 and 230

10:00 AM - 11:50 AM — Symposium: Translational Cognitive Rehabilitation---From Functional Neuroimaging to Functional Performance
Gerald T. Voelbel, PhD, Yael Goverover, PhD, Carolyn Baum, PhD, Amanda R. O'Brien, PhD, John DeLuca, PhD
Moscone Center, Room 2001

1:00 PM - 2:50 PM — Symposium: Social Competence in Children With Neurological Conditions
Janet E. Farmer, PhD, Keith O. Yeates, PhD, Seth Warschausky, PhD, Elena H. Drewel, MA, Sally J. Rogers, PhD, Ronald T. Brown, PhD
Moscone Center, Room 2004

3:00 PM-3:50 PM — Division 22 Poster Session
Moscone Halls A,B,C

Saturday, August 18, 2007

2:00 PM-3:50 PM — Symposium: Ethical and Interdisciplinary Issues in Medical and Rehabilitation Populations
David B. Peterson, PhD, Kathleen B. Kortte, PhD, Doug Johnson-Greene, PhD, MPH, Julie B. Hautamaki, MS, Stephen H. Behnke, JD, PhD, Shane S. Bush, PhD, Susanne M. Bruyère, PhD, Alan L. Goldberg, PsyD, JD
Moscone 3004

4:00 PM-5:50 PM — Division 22 Presidential and Fellows Addresses
San Francisco Marriott Hotel Yerba Buena Salon 14

6:00 PM-7:50 PM — Division 22 Social Hour
San Francisco Marriott Hotel Yerba Buena Salon 15

Sunday, August 19, 2007

8:00 AM - 9:50 AM — Symposium: Outcomes Measurement in Rehabilitation Psychology---State of the Science, Current Initiatives, and Future Directions
Amanda R. O'Brien, PhD, David S. Tulsky, PhD, David Victorson, PhD, Dagmar Amtmann, PhD, Allen Heinemann, PhD, Ruth Brannon, MPH, Louis Quatrano, PhD
Moscone Center, Room 2006

10:00 AM - 10:50 AM	Symposium: Critical Psychological Issues Facing People Living Long-Term With a Disability Bryan J. Kemp, PhD, Yaga Szlachcic, MD, Judith M. Mitchell, PhD Moscone Center, Room 2009
11:00 AM - 11:50 AM	Symposium: Engage, Retain, Adhere--- Psychological Interventions With Family Caregivers Kathleen Chwalisz, PhD, Patricia A. Rivera, PhD, Delores Gallagher-Thompson, PhD, John E. Crews, DrPH Moscone Center, Room 2006
12:00 PM - 12:50 PM	Symposium: Spirituality and Health--- Current Upgrades in Research, Teaching, and Clinical Services Barry P. Nierenberg, PhD, Brick Johnstone, PhD, Rob Glueckauf, PhD Moscone Center, Room 310
1:00 PM - 1:50 PM	Symposium: Putting Rehabilitation Psychology Into Practice---Diverse Options David R. Cox, PhD, Paul M. Richards, PhD, Ronald M. Ruff, PhD, Stephen T. Wegener, PhD, Alan L. Goldberg, PsyD, JD Moscone Center, Room 305
5:00 PM-6:50 PM	Division 40/Division 22 Shared Social Hour San Francisco Marriott Hotel, Golden Gate Salon B3

Monday, August 20, 2007

8:00 AM - 9:50 AM	Symposium: International and Socioeconomic Status Perspectives on Disability David B. Peterson, PhD, Catherine A. Marshall, PhD, Erin Martz, PhD, Chrisann Schiro-Geist, PhD, Martha E. Banks, PhD, Paul Leung, PhD Moscone Center, Room 232 and 234
10:00 AM - 11:50 AM	Symposium: Innovative Interventions for SCI Pain and Associated Distress Dawn Ehde, PhD, Ivan Molton, PhD, Gabriel Tan, PhD, J.S. Richards, PhD Moscone Center, Room 2000

APA Division 40
2007 Convention Program Summary

Friday, 8-17-07

7:00 AM - 9:50 AM	Executive Committee Meeting (N): Executive Committee Meeting San Francisco Marriott Hotel, Walnut Room
8:00 AM - 9:50 AM	Symposium: Michael D. Miran, PhD; Criminalization of Clinicians---How to Protect Yourself Moscone Center, Room 2011
10:00 AM - 11:50 AM	Symposium: Monica Rivera Mindt, PhD; Implementing Diversity Training in Graduate Student Assessment and Neuropsychology Programs Moscone Center, Room 2008
10:00 AM - 11:50 AM	Symposium: Zoe E. Proctor-Weber, PhD; Training in Clinical Neuropsychology Moscone Center, Room 2016
12:00 PM - 12:50 PM	Workshop: En Español por Favor--- Assessment of Spanish-Speaking Clients Moscone Center, Room 3003
12:00 PM - 1:50 PM	Poster Session: Psychological Assessment of Children and Adolescents Measuring Cognitive Abilities and Deficits Moscone Center, Halls ABC
1:00 PM - 1:50 PM	Invited Address: Dr. Laurence Binder: *Neuropsychological Abnormalities Are Not Diagnostic of Acquired Brain Dysfunction* Moscone Center, Room 2016
2:00 PM - 2:50 PM	Invited Address: Dr. Edith Sullivan: *Neuroimaging Contributions to Neuropsychology: Perspectives From Aging and Alcoholism Research* Moscone Center, Room 2020
3:00 PM - 3:50 PM	Invited Address: Dr. Stephen Rao: *Role of fMRI in Preclinical Detection of Neurodegenerative Disorders* Moscone Center, Room 3001

Saturday, 8-18-07

8:00 AM - 8:50 AM	Invited Address: Ronald Petersen, MD, PhD; *Title: Mild Cognitive Impairment: Is It Alzheimer's Disease?* Moscone Center, Room 2014
9:00 AM - 9:50 AM	Invited Address: Dr. Bruce Miller; *Title: Frontotemporal Dementia: Insights Into Social Cognition* Moscone Center, Room 2014
11:00 AM - 12:50 PM	Poster Session: Psychological Assessment of Adults---Measuring Cognitive Abilities and Deficits Moscone Center, Halls ABC
12:00 PM - 1:50 PM	Discussion: Interviewing for Internships---Tips on How to Shine Moscone Center, Rooms 3022 and 3024
2:00 PM - 2:50 PM	Invited Address: Keynote Address Dr. Jeffrey Cummings; *Neuropsychiatry of Alzheimer's Disease* Moscone Center, Room 2014
3:00 PM - 3:50 PM	Invited Address: Dr. Carl Dodrill; *What Can We Do to Improve Our Profession?* Moscone Center, Room 2014

4:00 PM - 4:50 PM	Paper Session: Early Career Award Moscone Center, Room 2011
5:00 PM - 5:50 PM	Paper Session: Blue Ribbon Awards Moscone Center, Room 2011

Sunday, 8-19-07

8:00 AM - 9:50 AM	Symposium: Promoting Transdisciplinary and Translational Research in Neuropsychology Moscone Center, Room 2007
10:00 AM - 10:50 AM	Invited Address: David J. Schretlen, PhD; *Method and Logic of Inference in Psychodiagnostic Testing: What Is an Abnormal Neuropsychological Examination?* Moscone Center, Room 301
10:00 AM - 11:50 AM	Symposium: New Testing Codes--- Problems, Audits, Practice, and Training Models Moscone Center, Room 2002
11:00 AM - 11:50 AM	Invited Address: Keynote Address Robert Butler, PhD; *Title: Pediatric Brain Injury Rehabilitation: The New Standard of Care* Moscone Center, Room 301
12:00 PM - 12:50 PM	Invited Address: Eileen B. Fennell, PhD; *Title: Behavioral Issues in Pediatric Epilepsy* Moscone Center, Room 3009
12:00 PM - 12:50 PM	Symposium: Prenatal Tobacco Exposure---Impact on Cognitive and Emotional Processes Across Development Moscone Center, Room 301
1:00 PM - 1:50 PM	Invited Address: Antonio E. Puente, PhD; *Title: Neuropsychology Interview and Testing Codes: Rationale, Evolution, Complications, Current Status* Moscone Center, Room 301
3:00 PM - 3:50 PM	Presidential Address: Dr. Keith Yeates San Francisco Marriott Hotel, Golden Gate Salon B2
4:00 PM - 4:50 PM	Business Meeting San Francisco Marriott Hotel, Golden Gate Salon B2
5:00 PM - 6:50 PM	Division 40/Division 22 Shared Social Hour San Francisco Marriott Hotel, Golden Gate Salon B3
8:00 AM - 8:50 AM	Fellows Addresses: Celiane Rey-Casserly, PhD; *Title: Enhancing Links Between Pediatric and Adult Neuropsychology* Moscone Center, Room 2001

Monday, 8-20-07

9:00 AM - 9:50 AM	Paper Session: Student Awards Moscone Center, Room 301
10:00 AM - 11:50 AM	Poster Session: Clinical Neuropsychology Moscone Center, Halls ABC
12:00 PM - 1:50 PM	Discussion: Careers in Neuropsychology Moscone Center, Room 276

Cognitive Dysfunction in the Earliest Stages of Multiple Sclerosis
Continued from page 12

1993; Tintore et al., 2006). Although few studies have been conducted to evaluate cognition in CIS, cognitive dysfunction has been consistently observed at this stage in the disease (Achiron & Barak, 2003; Callanan, Logsdail, Ron, & Warrington, 1989; Feinstein, Kartsounis, Miller, Youl, & Ron, 1992; Anthony Feinstein, Youl, & Ron, 1992; Feuillet et al., 2007). The relationships among cognitive functioning and both conventional and advanced neuroimaging markers in the earliest stages of the MS disease process remain understudied.

This article presents preliminary findings from a longitudinal study of MS patients beginning with CIS. In this investigation, we determined the incidence of cognitive dysfunction in individuals with CIS and also evaluated the relationships between cognitive functioning and conventional and advanced MRI markers of CNS activity. Conventional MRI markers of disease burden included T2-weighted lesions in white matter regions and advanced MRI markers included DTI markers of FA in NAWM. Here we present data from our first 2 years of this study.

Methods:

Participants:

This study was approved by institutional review board for human subject research and all subjects provided informed consent. Participants included 26 patients diagnosed with CIS enrolled in a larger investigation investigating MRI correlates of early MS. All CIS patients had at least 1 white matter lesion present on T2-MRI. The mean age of the participants was 36.4±10.4 years and the mean level of education was 15.0±2.6 years. Eighty-one percent of participants were female and 89% were Caucasian. Initial presenting symptoms ranged in origin from brainstem- 38.5%, optic neuritis – 7.7%, spinal cord/ motor – 3.8%, and spinal cord/ sensory – 50.0%.

MRI Procedures:

All imaging was performed on a 1.5 T General Electric Medical Systems Signa scanner (General Electric, Milwaukee, WI) with 4 G/cm gradients and a standard quadrature head coil. The imaging protocol included two axial view T1-weighted 3D spoiled gradient recalled echo (SPGR) image volumes with different flip angles (40 and 8 degrees), with all other imaging parameters kept identical between the two acquisitions (27/6 ms TR/TE; field of view, 180 x 240 x 186 mm^3; matrix, 192 x 256 x 124). The imaging examination also included a single shot, multi-repetition echo planar DTI sequence (1.7 x 1.7 x 2.1 mm; TR/TE = 7 s/100 ms; nine averages, b value = 2000 s/mm^2). Axial T2-weighted spin-echo images (TE/TR = 20/2500 ms, 192x256 matrix, 180x240 mm FOV, 3 mm thick slices, 50 slices) were also acquired to aid in lesion identification.

DTI measures of fractional anisotropy were evaluated using whole brain NAWM regions of high anisotropy (in the top 25th percentile). This approach

Table 1. Prevalence of cognitive impairment in multiple sclerosis

Sample characteristics	N	% Impaired	Reference
Clinic	17	65 %	(Parsons, Stewart, & Arenberg, 1957)
Clinic	18	64%	(Surridge, 1969)
Clinic	64	60 %	(Staples & Lincoln, 1979)
Clinic	22	55 %	(Bertrando, Maffei, & Ghezzi, 1983)
Clinic	100	56 %	(Heaton, Nelson, Thompson, Burks, & Franklin, 1985)
Clinic	44	64 %	(Rao, Hammeke, McQuillen, Khatri, & Lloyd, 1984)
Clinic	46	65 %	(Medaer, De Smedt, Swerts, & Geutjens, 1984)
Clinic	30	60 %	(Lyon-Caen et al., 1986)
Clinic	52	54 %	(Peyser, Edwards, Poser, & Filskov, 1980)
Community	100	43 %	(Rao, Leo, Bernardin, & Unverzagt, 1991)
Community	147	46%	(McIntosh-Michaelis et al., 1991)
Clinic	291	60 %	(R. H. Benedict et al., 2006)

Note: Table adapted from Amato et al. (Amato, Zipoli, & Portaccio, 2006)

was utilized in order to maximize the assessment of white matter in highly anisotropy regions, typically within regions where white matter fiber bundles are highly concentrated. Diffusion images were acquired at the same image matrix size as the FLAIR T2-weighted image and therefore the b=0 step of the echo planar scans (T2-weighted, but not diffusion weighted) were co-registered with the non-echoplanar T2-weighted images using an algorithm based on mutual information. FA normalized histogram maps are created after the removal of the extra cerebral tissue and the cerebrospinal fluid (CSF) to conform to a brain ROI histograms are derived from NAWM, and the average values are calculated amongst the regions of high anisotropy.

Neuropsychological Assessment:

Participants underwent a brief neuropsychological assessment annually that included the following indices: 1) Symbol Digit Modalities Test (SDMT) - Oral version (Smith, 1982); 2) Hopkins Verbal Learning Test - Revised (HVLT-R)– total learning (Brandt & Benedict, 2001); 3) HVLT-R delayed recall; 4) Letter fluency; 5) Category fluency; 6) Digit span test(Wechsler, 1991); 7) Delis Kaplan Executive Function System (D-KEFS) – Color Word Interference Test (CWT) – Inhibition contrast score (Delis, Kaplan, Kramer, & Ober, 2001), 8) D-KEFS CWT – Switching/ Inhibition contrast score, 9) D-KEFS Card Sorting Test – Correct sorts. Performance was considered to be impaired when z-scores were 1.5 SD below normative data. Depressive symptoms were evaluated using the Beck Depression Inventory – Fast Screen (Beck & Steer, 2000), and the Hamilton Rating Scale for Depression (Hamilton, 1960).

Results:

Cognitive Impairment:

At baseline, CIS participants yielded the following rates of impairment: 1) SDMT – 19.2%; 2) HVLT-R Learning Score – 19.2%; 3) HVLT-R Delayed recall – 19.2%; 3) Letter fluency – 30.8%; 4) Category fluency – 25%; 5) Digit Span test – 11.5%; 6) D-KEFS CWT Inhibition contrast score – 19.2%; 7) D-KEFS CWT Switching/ Inhibition contrast score – 23.1%; 8) D-KEFS Card Sorting Test Correct sorts – 5%. Fifty-four percent of participants demonstrated performance in the impaired range on at least 3 of the 9 cognitive indices. Mean BDI-FS was 4.4±4.9; with 37.5% of persons reaching symptom elevations using a BDI-FS score cutoff ? 4. Mean HRSD was 7.6±5.4 with 12.5% reaching symptom elevations using a HRDS score cutoff of ?14.

Relationship among cognitive functioning and MRI markers:

Correlations evaluating the relationships among cognitive indices and neuroimaging markers (T2 lesion volume, and DTI FA), revealed that at baseline, T2 lesion volume was not significantly associated with any of the neuropsychological assessment indices. At baseline, DTI FA was only significantly associated with the D-KEFS CWT Switching/ Inhibition test ($r=0.51$, $p<0.05$). Hierarchical stepwise regression predicting performance on the Switching/ Inhibition test suggested that after accounting for age, education, gender, estimated ability levels (North American Adult Reading Test estimated VIQ), and T2 lesion volume, DTI FA predicted an additional 13% ($F\Delta =5.78$. $p<0.05$) of the variance in performance on this measure above and beyond all demographics and T2 lesion volume.

DTI FA at baseline was significantly predictive of cognitive indices at Time 2 assessment (mean interval = 1.23±0.42; N=14) including: category fluency ($r =0.62$, $p<0.05$), and D-KEFS CWT Switching/ Inhibition ($r =0.85$, $p<0.001$). In addition, DTI FA at baseline was associated with the number of indices impaired at Time 2 ($r = -0.74$, $p<0.01$). DTI FA predicted the number of indices impaired at Time 2 after accounting for impairment at Time 1 and T2 lesion volume (see Table 2).

Table 2.
Hierarchical regression analyses predicting number of impaired cognitive indices at Time 2

Predictors	$R^2\ \Delta$	β	F Δ	p-value
# Impaired at Time 1	0.12	0.35	1.77	0.21
T2 Lesion Volume	0.32	0.57	6.71	<0.05
DTI- FA	0.24	-0.71	7.95	<0.05

Relationship among cognitive functioning, MRI markers and diagnosis of MS:

Over the course of the first 3 years of this study, 7 of the 14 participants converted from CIS to clinically definite MS (CDMS). Change in cognitive functioning and MRI markers were compared among participants who converted to CDMS compared to those who remained CIS. Change in T2 lesion volume and change in DTI FA were not significantly different among the CIS vs. CDMS participants. The two groups did differ with respect to change in total neuropsychological summary score ($F=6.90$, $p<0.05$, ANOVA). One of 7 participants whose clinical status remained CIS performed worse over time on the cognitive summary index. Conversely, 4 of 7 participants subsequently diagnosed with CDMS performed more poorly over time.

Discussion and Implications:

These data suggest that cognitive impairment is not only a feature of late stage disease processes in MS, but can present alongside the initial symptoms characteristic of MS. In our sample, over half of our participants performed in the impaired range on at least one-third of the cognitive indices. In addition, stronger associations were determined among microscopic alterations in NAWM and cognitive functioning, compared to correlations with conventional markers of disease burden. These findings suggest that cognitive functioning may be a sensitive marker of early structural alterations in non-lesioned white matter, and that these changes are often not detectable via conventional imaging.

Change in cognitive functioning that occurs in the earliest stages of MS is perhaps an important clinical indicator of prognosis. In our small sample, patients who showed cognitive decline over the course of one year reached a diagnosis of MS earlier in the study. Longitudinal change in neuroimaging markers was not associated with this clinical outcome. These data are hypothesis generating, but highlight the potential importance of detecting cognitive functioning early in the disease process and tracking cognition longitudinally.

The study of neuropathology in relation to clinical course, prognosis, and treatment outcomes is a rapidly expanding field of research in MS. Clinical neuropsychology represents a way to quantify functioning across behavioral domains and can provide a unique niche to the assessment and care of patients with MS. A significant area of future research is the identification of cognitive markers, accessible in the course of clinical care, that are predictive of important clinical outcomes. In addition, cognitive functioning can be useful in identifiying early CNS alterations that remain undetected through the use of conventional imaging technologies.

The use of DTI in neurological and neurodegenerative disorders is rapidly expanding. DTI has the ability to visualize structural alterations in white matter integrity that cannot be detected using conventional methods. Another application of DTI, not evaluated in this study, is DTI fiber tracking. Fiber tracking is the process of using the directionality of water diffusion in white matter fibers to estimate the location and direction of white matter fiber tracts (See Figure 3). Fiber tracking can facilitate our understanding of important neuroanatomical structures and connections. New insights into important brain behavior relationships will be attainable through these technologies now available.

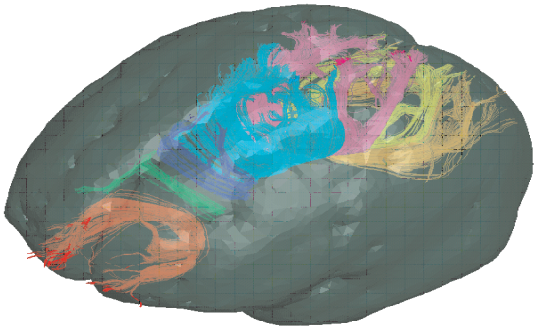

Figure 3.
DTI fiber tracking can help to determine neuroanatomical locations and connections of white matter fiber bundles.

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Division 40 Committee Reports

PUBLIC INTEREST ADVISORY COMMITTEE (PIAC)

Doug Johnson-Greene, Ph.D., ABPP, Chair

We have been busy since the start of the year and as always owe many thanks to our hardworking subcommittee chairs and members, liaisons, and monitors. Division 40 members who are interested in any of these committees or posts and wish to become more involved in division activities are encouraged to contact the PIAC Chair. Recent highlights for PIAC since the last newsletter include the following:

A total of six PIAC liaisons attended the three-day long spring consolidated meeting (March 2007) in Washington D.C. on behalf of the division. Liaisons interact with their respective APA committees and provide guidance and advice on issues of importance to neuropsychology.

The Women in Neuropsychology (WIN) Committee under the leadership of **Cheryl A. Luis, Ph.D., ABPP** has continued to promote the professional development of women in the field at all stages of their careers through a variety of educational and mentoring activities including two educational seminars: 1) An event at APA 2006 titled "Keeping Active in Research (Even When It Seems Impossible)," and 2) WIN hosted a panel discussion at the INS conference (February 2007) titled "The Do's and Don'ts of Career Development: What I Wish Someone Told Me."

Ethnic Minority Affairs (EMA) Committee under the leadership of **Desiree Byrd, Ph.D.** Continues to promoting and facilitating the needs of ethnic-minority neuropsychologists and trainees. EMA's activity during the past six months included: 1) Hosting an APA Mentoring Breakfast in conjunction with Division 22 and the annual conference in New Orleans, 2) a mentoring event and panel discussion at the INS conference (February, 2007).

Other persons currently serving the division through PIAC include:

Josette Harris, Ph.D. Chair, Ethics Subcommittee (ES**)**
Shelley Heaton, Ph.D., Liaison, APA Committee on Children, Youth and Families (CYF)
Angela L. Jefferson, PhD Liaison, APA Committee on Aging (CONA)
Fred Unverzagt, Ph.D. Monitor, APA Committee on International Relations in Psychology (CIRP)
Felicia Hill-Briggs, Ph.D., ABPP/ABRP Monitor, Committee on Disability Issues in Psychology (CDIP)
Scott Hunter, Ph.D. Monitor, APA Committee on Urban Initiatives (CUI) and APA Office on AIDS (OA)
Rex Swanda, Ph.D. Monitor, APA Committee on Lesbian, Gay, & Bisexual Concerns (LGBC)
Debra Sheppard, Ph.D., ABPP Monitor, APA Committee on Rural Health (CRH)

PRACTICE ADVISORY COMMITTEE

Neil H. Pliskin, PhD, Chair

Your Practice Advisory Committee has been monitoring and working on the following issues during the past 6 months that may both directly and indirectly affect clinical practice:

PRACTICE ISSUES

New York Technician Issue

There has been some progress in the New York Technician issue. The New York State Psychological Association (NYSPA), with strong urging from the Practice Directorate is actively working on a longer term legislative solution that is based on the Arkansas legislation model. The Arkansas law was chosen as a model because it limits the use of technicians/assistants to neuropsychological evaluations in a state with a generic psychologist license. Significant political obstacles remain however, as evidenced by this recent letter sent to the current NYSPA President:

January 14, 2007
Dianne Polowczyk, PhD, President & Members of Council
NYS Psychological Association
Albany, New York

Dear Dianne and Council Members:

The Executive Board of the Suffolk County Psychological Association is deeply concerned about the path NYSPA seems to be taking in regard to the use of "technicians" by neuropsychologists. We have read the motion that Council passed at its November 2006 meeting which directed the Legislative Committee to propose legislation to allow the use of "technicians." We understand that you will be reviewing their proposal at your March meeting. We believe that **ONLY** licensed psychologists, certified school psychologists and psychology graduate students in a supervised training program should be permitted to administer psychological and/or neuropsychological tests. We believe that NYSPA should be protecting our scope of practice, which we fought so long and hard for, by opposing the use of "technicians" under any circumstances. Supporting a bill to allow "technicians" sends the wrong message to our legislators, i.e. that one does not need to be a psychologist to administer psychological tests. As we all know, a psychologist who administers a test gleans more than raw data; observations and nuances matter. This work should not be done by a non-psychologist.While we understand that this has been a long-standing practice among neuropsychologists, we believe that the good of our profession and the majority of psychologists takes priority over the wishes of a few. We also understand that Russ Newman at APA is pushing for legislation to allow "technicians" in New York. We see this as inconsistent with APA policy that our's is a doctoral level profession. In closing, we ask that you vote against endorsing any legislation that would allow the use of "technicians" since opposing their use is in the best interests of our profession and the vast majority of NYSPA members
Warm regards,
Barbara
Barbara Fontana, Ph.D.
President

The grassroots organization of NY neuropsychologists (NYSAN) also continues their independent efforts aided in part by the generous support of Division 40. I have attached their most recent financial update (Appendix A). PAC and NYSAN will update the EC at the meeting.

CPT Update

The unexpected challenges to our new CPT codes from CMS are well chronicled on the Division 40 website in the *Practitioner's Corner* section. By way of review, I include the following excerpt from the APA October Alert:

New Medicare Billing Rules for Testing Services
Effective 10/1/2006

Earlier this year, a series of expanded Current Procedural Terminology® (CPT) codes took effect for psychological and neuropsychological testing services. Now a new rule implemented by Medicare's National Correct Coding Initiative (NCCI) will impact those psychologists and neuropsychologists who use technicians and/or computers for test administration under these codes. Despite our efforts to stop this rule, restrictions imposed by NCCI may require those psychologists who bill Medicare to adjust their billing practices for testing services in specified circumstances involving technicians or computers, effective October 1st 2006.

The Problem

NCCI is a contract program of the Center for Medicare and Medicaid Services (CMS) intended to prevent incorrect payments for Medicare services. In March, 2006, the NCCI contractor solicited APA's comments, as required by Medicare, on proposed reimbursement changes for psychological and neuropsychological testing services. NCCI proposed applying restrictions (referred to as edits) to testing reimbursement, so that the CPT codes used to capture a psychologist's or neuropsychologist's time could not be billed together with technician or computerized testing CPT codes for the performance and/or interpretation of the same test(s).
Unfortunately, these restrictions were finalized and sent to Medicare carriers for implementation as of October 1st.

APA has vigorously challenged this restriction, arguing that psychologists should bill the professional CPT codes for the time they spend on the integration of all test results and the comprehensive report writing, in addition to time billed for a technician's or computer's test administration.

The NCCI position is in direct conflict with the original understanding between APA and CMS at the time the new series of CPT testing codes were created. APA has spent many years advocating for an increase in Medicare reimbursement rates for psychological and neuropsychological testing, because under the old CPT codes the psychologist's "professional work component" in the reimbursement formula was literally zero. In 2005, CMS finally agreed to recognize the value of the psychologist's professional skill and expertise, in return for the creation of additional CPT codes to differentiate who was providing which services as part of an assessment battery. These changes resulted in higher payment rates for the professional CPT codes which went into effect January 1, 2006, yielding typically higher overall Medicare reimbursement for an assessment battery.

Despite the original understanding with CMS, however, the recent NCCI edits -- and a draft CMS clarification published in September 2006 has led to reimbursement problems in those situations when technicians or computers are used as part of the assessment process.

Current CPT Status

APA has been working to facilitate the implementation of the revised codes since they first became effective in January, with the clear understanding that the professional code would be billed to capture the integrative interpretation and comprehensive report writing by the psychologist when the test administration is performed by either a technician or computer. In addition, the American Medical Association (AMA), in its November *CPT Assistant*, included an article co-written by our CPT representative, Dr. Antonio Puente, on how to bill using the revised codes. The article has examples demonstrating that the psychologist would bill for interpretation and report writing under the professional codes.

APA Practice is preparing both short and long-term approaches to resolve the problem of billing for services under the testing codes. These include working with CPT and CMS officials to convey how the codes were purposely designed to be used as well as devising strategic ways to bring this issue to the attention of relevant members of Congress. If all else fails, APA we will consider proposing to have the language in the testing codes changed to clarify how interpretation and report writing should be captured. In addition to being a potentially long and very political process, rewriting the CPT codes is also a risky proposition. As we have already seen, language in the current CPT codes is being interpreted in a manner that none of us anticipated. Most importantly, any changes to the code descriptors could result in a need to resurvey, thus jeopardizing the assigned values that took so many years to obtain.

APA Practice remains committed to seeking a solution to this problem so that psychologists and neuropsychologists can be properly reimbursed for the valuable testing services that they provide. Division 40 representatives will continue to work closely with the Practice Organization to assist wherever needed.

Other Practice Issues:
National Provider Identification Number, Pay For Performance
Federal Advocacy Updates
Relevant Practice Documents

Please Visit See Our New Practitioner's Corner on the Webpage:
http://div40.org/Committee_Activities_Pages/Advisory_Committee/prac_corner.htm

PUBLICATIONS AND COMMUNICATIONS COMMITTEE (PAC)

William B. Barr, Ph.D., Chair

A reminder to all training directors and students to check out the Division 40 website's new Listing of Training Programs in Clinical Neuropyschology [http://www.div40.org/tprograms.html]. This interactive listing, developed jointly with the division's Education Advisory Committee (EAC) was launched successfully in December 2006. To date, listings are provided for 17 Doctoral Programs, 20 Internship Programs, and 59 Postdoctoral Residency Programs. Training directors interested in getting their programs added to the website should follow the guidelines listed on the Training Page.

PROGRAM COMMITTEE

Julie A. Bobholz, Ph.D., Chair

The APA 2007 Program has been finalized and includes a selection of keynote and invited speakers who are known for their outstanding work in neuroscience. The meeting will be held over a weekend, Friday-Saturday-Sunday-Monday (August 17-20, 2007). The program summary, included in this newsletter, lists the times and locations for each presentation. We hope you enjoy the conference!

SCIENCE ADVISORY COMMITTEE

Committee Membership: Lucas (Chair), Aloia, Barr, Butters, Byrd, Ferman, Flashman, Forrest, Hart, Hopkins, Kozora, Loring (Awards Subcommittee Chair), Machulda, Paul, Pedraza, Rilling, Welsh-Bohmer.

The Div40 Science Membership Database was placed on hold until the Training Program Database project was completed. The purpose of database is to more easily and efficiently identify Div40 members with interest and expertise to serve on APA committees and work groups, and to assist the EC in responding to calls from APA for timely reviews/critiques of science-related documents. Funding for this project was approved at the August 2006 EC meeting.

Dr. Bonny Forrest attended the Fall BSA meeting in November. Discussions included APA's desire to encourage increased representation of science within the organization, and the reintegration of scientists back into the annual convention.

The SAC subcommittee on Transdisciplinary (TD) Research held an open meeting during the 2007 INS meeting in Portland, OR to discuss "The Transdisciplinary Future of Neuropsychology". Dr. Robert Paul has succeeded Dr. Liza Kozora as chair of the TD subcommittee. Dr. Paul and Dr. Meryl Butters will co-chair a symposium at the 2007 APA convention entitled: "Promoting transdisciplinary and translational research in neuropsychology". Methods for developing successful lines of TD research will be discussed and examples of successful externally funded programs will be reviewed.

Divisions 19, 22, 38, and 40 were awarded an APA Interdivisional Grant to develop a symposium on "Psychological Care of Returning Military Service Members from Operation Enduring Freedom and Operation Iraqi Freedom" for the 2007 APA convention. Dr. Mark Kelly serves as Div40's representative in this effort, which will serve as a "cross-cutting" activity. Participating divisions have allocated an additional $500 each to further support this activity.

The SAC has been charged with identifying a delegate to represent Div40 at a conference sponsored by the American Congress of Rehabilitation Medicine. The goal of the conference is to develop a taxonomy of rehabilitation interventions.

WOMEN IN NEUROPSYCHOLOGY (WIN)

A subcommittee of the Public Interest Advisory Committee

Cheryl A. Luis, Ph.D., ABPP-CN, Chair

Women in Neuropsychology (WIN) was established with seed money provided by the APA Division 40 Executive Committee in 2000 in order to establish a mentoring system for women at all levels of professional development and to enhance career opportunities through dissemination of information via a listserv. WINs goals are: 1) to support women in our field ranging from student to senior career level; 2) to increase the representation of women in elected office within Division 40 and in other leadership positions throughout APA; and 3) to encourage women to pursue Fellow status. WIN also seeks to promote awareness of women's achievements. WIN collaborates with other Public Interest Advisory Committees and works closely with the broader APA Committee for Women in Psychology and student organizations.

WIN regularly hosts events at the Annual Convention of the American Psychological Association and the Annual Meeting of the International Neuropsychological Society. Example of past events have included: "How to become a journal reviewer,' "Balancing career and family responsibilities: Survival tips," "Women pioneers in neuropsychology: A perspective from the beginning," and "The do's and don'ts of career development: What I wish someone had told me." WIN is planning of co-hosting 'A mock interview for internship" with the Ethnic and Minority Affairs (EMA), and Association of Neuropsychology Students in Training (ANST) at the APA convention in San Francisco this summer.

WIN mentoring initiative is facilitated by a mentoring database including an updated list of mentees and mentors and their respective areas of interest. For information on or to be included in this database, contact our student Steering Committee member, Lauren Ayr, M.S., at ayr@email.chop.edu. The other members of the WIN Steering Committee are Drs. Betsy Parker, Bonny Forrest, Chris Morrison, Meryl Butters, and Robin Hilsabeck. To join the WIN listserv, contact the current Steering Committee chair, Cheryl A. Luis, Ph.D., ABPP-CN at cluis@rfdn.org.

Newsletter 40 is the official publication of Division 40. The Editor is Nancy Chiaravalloti. Dr. Chiaravalloti's address is: Neuropsychology Laboratory, Kessler Medical Research Rehabilitation and Education Corporation, 1199 Pleasant Valley Way, West Orange, NJ 07052. Email: nchiaravalloti@kmrrec.org.
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Michael Cole, Ph.D.

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