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Capacity for Financial Decision-Making in Multiple Sclerosis

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Abstract

Introduction—Cognitive impairment often occurs in people with multiple sclerosis (MS), and dysfunction involving executive function, new-learning, and working memory is especially common. Compromised activities of daily living are linked to this cognitive impairment, and people with MS are apt to be unemployed and struggle to manage domestic responsibilities. Financial decision-making is an important activity of daily living, and no study has examined whether it is compromised by neuropsychological dysfunction in people with MS.

Method—A battery of neuropsychological tests and a measure of financial decision making (Financial Capacity Instrument: Marson 2001) were administered to 50 participants (34 patients with MS and 16 cognitively healthy adults). Based on the neuropsychological test results, 14 patients were classified as having cognitive impairment, and 20 had no significant impairment.

Results—The impaired MS patients performed significantly worse than unimpaired patients and the healthy comparison group on most financial tasks. The impaired group retained abilities to count money and display adequate financial judgment. Regression analyses showed that measures of mental flexibility and working memory correlated most strongly with performance on the FCI domains across groups.

Conclusions—Cognitively-impaired patients with MS have degraded financial skills which are linked to executive function and working memory deficits.

Keywords

multiple sclerosis; financial decision making; activities of daily living; executive function; working memory

Multiple Sclerosis (MS) is the most common neurological disease among young adults, and as many as 400,000 Americans are affected (Feinstein, 2007). Etiology is uncertain, but the disease degrades axonal integrity, ultimately leading to loss of neuronal tissue (Trapp, Peterson, Ransohoff, Rudick, Mörk, & Bö, 1998), especially in the parenchyma of the frontal lobes. A variety of symptoms occur, and include motor weakness, coordination difficulties, sensory abnormalities, fatigue, and pain (Miller, 2001; Feinstein, 2007; Vucic, 2010). Furthermore, as many as 65% of patients manifest significant cognitive impairment (Chiaravalloti & DeLuca, 2008; Rao, Leo, Bernardin, & Unverzagt, 1991a), and these deficits correspond with degraded activities of daily living (Basso, Shields, Lowery, Ghormley, Combs, Arnett, & Johnson, 2008; Chiaravalloti, DeLuca, Moore, & Ricker, 2005; Rao, Leo, Ellington, Nauertz, Bernardin, & Unverzagt, 1991b). For instance, neuropsychological dysfunction correlates with increased unemployment, diminished work performance, reduced psychosocial function, compromised ability to provide informed consent to medical treatment, and degraded management of daily domestic activities (Basso, Candilis, Johnson, Ghormley, Combs, & Ward, 2010; Baughman, Basso, Sinclair, Combs, & Roper, 2015; Rao et al., 1991b).

Capacity to make decisions regarding finances is considered an instrumental activity of daily living (IADL) (Earnst et al, 2001; Griffith et al, 2003; Marson, 2001; Wadley, Harrell, & Marson, 2003). IADLs include using the telephone, driving an automobile, and complying with medical treatment (Marson, 2001). Among IADLs, financial capacity is perhaps most fundamental to maintaining independence during adulthood. Yet despite its importance, few theoretical models of financial functioning exist.

Marson et al (2000) characterized financial capacity as “a series of discrete, clinically relevant domains of activity rather than a unitary construct (p. 878),” and created the Financial Capacity Instrument (FCI) to assess these multiple domains. Fundamental concepts (e.g., such as knowledge of currency value and ability to make change) and complex reasoning (e.g., knowledge of estate holdings) are measured. The FCI provides scores across multiple domains, and includes a composite score to reflect overall financial capacity (Marson et al, 2000).

Most research using the FCI has focused upon elderly individuals with neurodegenerative diseases. For instance, Griffith et al (2003) found that patients with Alzheimer’s disease (AD) or Mild Cognitive Impairment (MCI) displayed poor performance on the FCI compared to a healthy comparison group. Moreover, those with AD performed more poorly than those with MCI. The most salient weaknesses for the two patient groups concerned basic financial skills, and they obtained their poorest scores on the FCI domains of *Financial Concepts*, *Bank Statement Management*, *Bill Payment*, and *Cash Transactions*. Remarkably, the FCI domains pertaining to more complex and abstract skills (i.e., *Financial Judgment* and *Knowledge of Personal Assets/Estate*) showed little differences between the healthy comparison group and the two patient groups. This is likely due to the fact that the scale posed a salient challenge to even the neurologically-normal individuals. Similar results have been reported in other studies of people with AD and MCI as well as in people with schizophrenia or depression (Marson, 2001; Okonkwo et al, 2006; Niekawa, Sakuraba, Uto, Kumazawa, & Matsuda, 2007; Mackin & Areán, 2009). Overall, these investigations imply

that cognitive impairment corresponds with diminished capacity for financial decision-making. Indeed, executive function, new-learning, and working memory seem to be salient predictors of financial capacity at both the overall and domain levels (Marson, 2001; Okonkwo et al, 2006). Notably, these cognitive domains are often diminished in people with MS (e.g., Rao et al., 1991), suggesting that people with MS may likewise manifest degraded financial decision-making capacity.

As yet, however, no research, to our knowledge, has examined this issue. Towards this end, the present study evaluated financial decision-making among people with MS and in a healthy comparison group. The FCI, a performance based financial measure, was used to operationalize financial decision-making capacity. Consistent with previous research involving other patient populations (e.g., Marson, 2001; Okonkwo et al, 2006; Niekawa et al., 2007; Mackin & Areán, 2009), measures of executive function, new-learning, and working memory were expected to emerge as key predictors of financial decision-making ability.

Method

Participants

Participants were recruited from the community instead of clinic sources. The study was publicized in notices appearing in the local National Multiple Sclerosis Society newsletter. The second author also visited support groups to recruit participants. To minimize potential confounds, participants were excluded if they had a history of developmental disability, learning disorder, neurological disorder apart from MS, or mental health diagnosis that preceded onset of MS. They were further excluded if they reported a past or current history of substance misuse. Additionally, participants were excluded if they had experienced any loss of consciousness (regardless of length) in six months prior to study enrollment or if they had a lifetime loss of consciousness exceeding five minutes. Because of the significant demand upon language comprehension in this study and lack of equivalent neuropsychological instruments in foreign languages, non-native English speakers were also excluded. The same exclusion criteria were applied to members of the healthy comparison group. Participants in the patient MS group were diagnosed by board-certified neurologists according to the McDonald et al. (2001) criteria.

Measures

Chicago Multiscale Depression Inventory (CMDI: Nyenhuis, Luchetta, Yamamoto, Terrien, Bernardin, Rao, & Garron, 1998)—The CMDI is a 50-item self-report measure of depressed mood and vegetative symptoms associated with depression. It is a reliable and valid indicator of depressed mood in people with MS (Chang, Nyenhuis, Cella, Dineen, & Reder, 2003). In the current investigation, the mood scale was examined to evaluate depressed mood. Notably, because of time restraints, three healthy comparison participants did not complete the CMDI. It was administered to the remaining 47 participants, however.

Timed 25-Foot Walk (TTFW: Cutter, Baier, Rudick, Cookfair, Fischer, Petkau, Syndulko, et al., 1999)—This is a measure of ambulation and gross motor disability, and is often used as an overall indicator of disease impact on physical functioning. Examiners measuring the time taken for participants to walk 25 feet over two trials. A score on this measure is derived by averaging the participants' two completion times.

Measures of Neuropsychological Function

Wechsler Test of Adult Reading (WTAR: Wechsler, 2001): On this test, participants read aloud a list of words that do not follow typical rules of pronunciation. This measure is highly correlated with premorbid intelligence, and is relatively resistant to declines associated with brain disease.

Wide Range Achievement Test, third edition (WRAT-3: Wilkinson, 1993), Arithmetic Subtest: The WRAT-3 measures academic achievement and yields both age equivalent and grade equivalent scores. The arithmetic subtest measures basic computational skill. This subtest was used to determine participants' computational ability so that the relationship between these skills and performance on the FCI could be tested.

Multilingual Aphasia Examination (MAE: Benton & Hamsher, 2000), Token Test: The Token Test measures auditory comprehension of language. On this test, participants are given verbal instructions that direct them to perform a series of actions using a set of plastic tokens. Ability to comprehend and respond accurately to the instructions is measured.

Delis-Kaplan Executive Function Scale (DKEFS: Delis, Kaplan, & Kramer, 2001), Verbal Fluency Subtest: The Verbal Fluency subtest of the DKEFS measures phonemic, semantic, and switching fluency. In each of the three conditions, participants are given one minute to generate as many words as possible based upon specific guidelines (phonemic, semantic, and semantic switching) given to them by the examiner.

Wisconsin Card Sorting Test (WCST: Heaton et al., 1981, 1993): The Wisconsin Card Sorting Test is a measure of conceptual reasoning. Participants must discern the correct means of matching cards to a criterion. After they do so, the matching principle changes without warning, and examinees must adapt their responses to the changing criterion.

Verbal Concept Attainment Test (VCAT: Bornstein & Leason, 1985): The VCAT is a 23-item test measuring verbal problem solving and conceptual reasoning. Each item consists of lines comprised of four words. Examinees must choose one word from each line that collectively forms a cogent category. From a sample item, line one consists of the words oak-shirt-yellow. Line two includes belt-egg-car, and line three consists of throw-star-shoes. The correct choice from each line is shirt, belt, and shoes, because they are items of clothing. No other combination of words conforms with a coherent concept. Research indicates that the VCAT is a sensitive indicator of executive dysfunction in people with brain damage, especially involving the frontal lobes (Bornstein & Leason, 1985).

Wechsler Adult Intelligence Scale, Third Edition (WAIS-III: Wechsler, 1997), Digit Span Subtest: Examinees are read sequences of digits of increasing length. They attempt to repeat them in either a forward or reverse sequence.

California Verbal Learning Test, second edition (CVLT-II: Delis, Kramer, Kaplan, & Ober, 2000): On this test of new learning and memory, a list of 16-words is read aloud five times. Examinees recite as many of the words as they can remember. After 20-minutes, delayed recall and recognition memory are assessed.

Paced Auditory Serial Addition Test (PASAT: Cutter et al., 1999): The PASAT measures sustained auditory working memory, and rudimentary arithmetic skills. Participants hear a series of digits, and produce sums of the two most recently presented pair of digits.

Boston Naming Test (BNT: Goodglass & Kaplan, 2000): On this measure of confrontation naming, examinees view a series of illustrations, and attempt to name them.

Measure of Financial Capacity

Financial Capacity Instrument (FCI: Marson, Sawrie, Snyder, McInturff, Stalvey, Boothe, 2000): An overall summary of the FCI appears in Table 1 (Marson et al. 2000). The FCI presents examinees with items that assess financial reasoning across eight domains: Domain 1-Basic Monetary Skills; Domain 2- Financial Conceptual Knowledge; Domain 3- Cash Transactions; Domain 4- Checkbook Management; Domain 5- Bank Statement Management; Domain 6- Financial Judgment; Domain 7- Bill Payment; and Domain 8- Knowledge of Personal Assets/Estate. Scores for each domain are summed to compute the FCI-Total score.

The domains of the FCI are briefly summarized here. On Domain 1 – Basic Monetary Skills, examinees identify money and demonstrate an understanding of its value. Regarding Domain 2 – Financial Conceptual Knowledge, examinees are asked to define words having to do with financial tasks, such as “savings” or “loan.” With respect to Domain 3 – Cash Transactions, examinees demonstrate their ability to carry out simple financial transactions. Vignettes requiring patients to purchase items from a grocery store and vending machine are used here. On Domain 4 – Checkbook Management, examinees demonstrate proper use of a checking account by making fictional grocery store item purchases, and recording the transaction in a register. Regarding Domain 5 – Bank Statement Management, examinees are shown a fictional bank statement, and must answer questions concerning the balance.

With respect to Domain 6 – Financial Judgment, items assess ability to identify and avoid fraud such as identity theft. On Domain 7 – Bill Payment, examinees are asked questions regarding payment of routine bills (i.e., utility bills), and they must also prepare bills for mailing. To do this they are required to match utility statements with the corresponding checks and insert them into pre-addressed envelopes. For Domain 8 – Knowledge of Personal Assets & Estate Arrangements was not administered. It requires a proxy informant, which was not available for this study. Regarding Domain 9 – Investment Decision Making, ability to make investment decisions is assessed. Examinees are read investment scenarios and make choices whether to invest their money. Scores on each of the Domains are summed

to compute the FCI Total. A scoring manual exists for the instrument, and reliabilities of the total and individual Domain scores are satisfactory (cf. Marson et al., 2000).

Procedure

Upon obtaining informed consent, examinees were administered the neuropsychological test battery and TTFW. The Financial Capacity Instrument (FCI) was then administered. All measures were administered according to standard procedures. Participants were compensated for their time with a gift card to a national retail chain.

Results

Neuropsychological Test Performance

To study the effects of cognitive impairment, people with MS were classified as unimpaired or impaired based on their neuropsychological test performance. Rather than over-represent individual measures, a single summary score was examined from each measure. From each test the following indices were represented in the impairment index: WTAR Standard Score; Digit Span Age Corrected Scaled Score; Wisconsin Card Sorting Test Perseverative Errors; VCAT Total Score; Boston Naming Test Total Score; Phonemic Fluency Scaled Score; PASAT Trial 1 Correct Score; WRAT-3 Arithmetic Standard Score; and Token Test Total Correct Score. Performance on each test was compared to published normative standards. If test performance fell more than one standard deviation below the mean for that measure, the performance was classified as impaired. This criterion for impairment has been employed in various studies and normative classification systems (Heaton, Miller, Taylor, & Grant, 2004). The sum of these impaired scores was then used to classify participants as impaired or not. If participants performed in the impaired range on 30% of the neuropsychological test indices (i.e., performance fell 1 standard deviation below the normative mean on three or more tests), they were classified as impaired. This criterion is commonly employed in research and clinical practice (Reitan & Wolfson, 1993). Fourteen patients were impaired on three or more of the neuropsychological measures and were assigned to the MS-Impaired group. Twenty patients had fewer than three impaired scores, and were therefore assigned to the MS-Unimpaired group. All members of the healthy comparison group had fewer than three impaired scores.

Demographics, Disease Course, and Medication Use by Impairment Group

Demographic status and neuropsychological performance was compared across the three groups (i.e., control, MS-unimpaired, and MS-impaired), and Table 1 summarizes this data. Chi-square and one-way analyses of variance (ANOVA) were employed to assess for differences in demographic status, neuropsychological performance, disease course, and use of immunomodulatory medication among impairment groups. There were no differences between the three groups according to age ($F(2,47) = 0.21, p > 0.05$), education ($F(2,47) = 1.32, p > 0.05$), sex ($\chi^2 [2, N = 50] = 2.41, p > 0.05$), or ethnicity ($\chi^2 [6, N = 50] = 7.44, p > 0.05$). MS Disease Course was equally represented in the two patient groups ($\chi^2 (3, N = 34) = 2.30, p > 0.05$), and there was no significant difference in motor impairment on the TTFW ($F(1,33) = 0.81, p > 0.05$) or depressed mood on the CMDI ($F(2, 47) = 3.09, p > 0.05$). To determine whether the proportion of patients who were using immunosuppressant

medication was equal across the two patient groups, a chi square test was conducted with the significance set at $p < .05$. Results suggested that the proportion was different across groups, ($X^2 [1, N = 34] = 7.22, p < 0.01$). Ninety-five percent of the unimpaired group ($n = 19$) were taking disease modifying medication at the time of testing, whereas only 57% of the impaired group ($n = 8$) were taking medication. Effects of immunomodulating medications upon cognitive function are typically modest or negligible and potentially confounded by practice effects (e.g., Kappos, et al., 2009; Penner et al., 2012; Schwid, Goodman, Weinstein, McDermott, & Johnson, 2007). Paralleling this finding in the literature, medication status was correlated with neuropsychological function and FCI performance, and no correlation was significant.

Neuropsychological Performance by Impairment Group

To determine whether the three impairment groups differed in overall neuropsychological performance, a one-way between-groups multivariate analysis of variance (MANOVA) was performed. Mean values of performance appear in Table 3. Participant group (i.e., control, MS-unimpaired, and MS-impaired) served as the between groups variable, while scores from ten neuropsychological tests served as the dependent variables. Specifically, these variables included the Wechsler Test of Adult Reading (WTAR), the Digit Span subtest scaled score of the Wechsler Adult Intelligence Scale, 3rd Edition, perseverative errors on the Wisconsin Card Sorting Test, the Verbal Concept Attainment Test total score, the Boston Naming Test total score, the Letter Fluency subtest scaled score from the DKEFS, the California Verbal Learning Test-II Total Recall T-score, the PASAT Trial 1 score, the Arithmetic subtest standard score from the Wide Range Achievement Test, 3rd Edition, and the Token Test total score from the Multilingual Aphasia Exam. The multivariate main effect of participant group was significant (Hotelling's Trace (20, 74) = 4.2, $p < 0.001$, $\eta^2 = 0.67$).

To follow up this multivariate effect, univariate one way analyses of variance were conducted for each of the neuropsychological tests. Participant group again served as the between groups variable. The main effect of group was significant for the Digit Span subtest of the Wechsler Adult Intelligence Scale, 3rd Edition, ($F(2,47) = 18.53, p < 0.001, \eta^2 = .44$), perseverative errors on the Wisconsin Card Sorting Test, ($F(2,47) = 6.65, p < 0.01, \eta^2 = .22$), the Verbal Concept Attainment Test, ($F(2,47) = 7.69, p = 0.001, \eta^2 = .25$), the Letter Fluency subtest from the DKEFS, ($F(2,47) = 4.67, p = 0.01, \eta^2 = .17$), the California Verbal Learning Test-II, ($F(2,47) = 6.65, p = 0.003, \eta^2 = .22$), the PASAT ($F(2,47) = 17.52, p < 0.001, \eta^2 = 0.43$), and the WRAT-3 Arithmetic subtest ($F(2,47) = 9.99, p < 0.001, \eta^2 = 0.30$). The groups did not differ on the WTAR ($\eta^2 = 0.08$), Boston Naming Test ($\eta^2 = 0.03$), or Token Test ($\eta^2 = 0.09$) (all p 's $> .05$).

Follow-up contrasts were computed to explain these significant effects. Tukey Honestly Significant Difference (HSD) contrasts were employed to protect against Type I error. On the Wisconsin Card Sorting Test, D-KEFS Letter Fluency, VCAT, CVLT-II, PASAT, and WRAT-3 Arithmetic subtest, the healthy comparison group and the MS-Unimpaired patients performed better than the MS-Impaired group, but they did not differ significantly from each other. On the Digit Span subtest, the control group performed better than both groups of

patients with MS, and the MS-Unimpaired group performed better than the MS-Impaired group.

Neuropsychological Impairment and Financial Capacity

To evaluate whether the impaired MS group had worse financial decision-making than the unimpaired MS and healthy comparison group, FCI scores were entered into a one-way between-groups multivariate analysis of variance (MANOVA). Scores of the groups are summarized in Table 4. To control for Type I error, a MANOVA was computed. The significant main effect was followed by univariate ANOVAs. Furthermore, a conservative $p < .01$ was employed, and Tukey HSD contrasts were applied to follow-up significant univariate effects. Impairment group (i.e., control, MS-unimpaired, and MS-impaired) served as the between-groups variable, and the FCI total score and eight domain scores served as dependent variables. A significant main effect of group was found (Hotelling's Trace (16, 78) = 2.28, $p < 0.01$; $\eta^2 = 0.32$).

Mean FCI performances of the groups appears in Table 4. Significant differences at the overall group level were found for FCI Domains *1-Basic Monetary Skills*, ($F(2, 47) = 4.92$, $p = 0.01$, $\eta^2 = 0.17$); *2- Financial Conceptual Knowledge*, ($F(2, 47) = 11.14$, $p < 0.001$, $\eta^2 = 0.32$); *4- Checkbook Management*, ($F(2, 47) = 4.29$, $p = 0.010$, $\eta^2 = 0.15$); *5- Bank Statement Management*, ($F(2, 47) = 6.94$, $p = 0.002$, $\eta^2 = 0.23$); *7- Bill Payment*, ($F(2, 47) = 9.94$, $p < 0.001$, $\eta^2 = 0.30$); *9- Making Investment Decisions*, ($F(2, 47) = 8.53$, $p = 0.001$, $\eta^2 = 0.27$); and the FCI total score, ($F(2, 47) = 11.96$, $p > 0.001$, $\eta^2 = 0.34$). No group differences were found for FCI domains *3- Cash Transactions* ($F(2, 47) = 3.01$, $p = 0.05$, $\eta^2 = 0.11$) or *6-Financial Judgment* ($F(2, 47) = 0.60$, $p = 0.55$, $\eta^2 = 0.03$).

Tukey HSD contrasts showed that the MS-Impaired group performed significantly worse than both the control group and the MS-Unimpaired group on FCI domains *1-Basic Monetary Skills*, *2- Financial Conceptual Knowledge*, *4- Checkbook Management*, *5- Bank Statement Management*, *7- Bill Payment*, *9- Making Investment Decisions*, and the FCI total score. The healthy comparison group did not differ significantly from the MS-Unimpaired group on any of the FCI domains or the FCI total score.

Predicting Performance on the Financial Capacity Instrument (FCI)

Using multiple regression, we sought to identify what neuropsychological abilities were most highly correlated with individual FCI Domains. Data from all participants were included in these analyses. To reduce the number of independent variables in the regression and minimize risk of overfitting the data, indices from the neuropsychological battery were subjected to a principal components analysis. It included the 10 neuropsychological variables that comprised the impairment index. Two components with eigenvalues greater than 1.0 emerged. The first achieved an eigenvalue of 4.04, and accounted for 40.39% of the variance, whereas the second had an eigenvalue of 1.26 and accounted for 12.57% of the variance. To simplify interpretation of the factors, a direct oblimin rotation was used. An oblique rotation was used, because the neuropsychological measures were anticipated to be correlated with one another. See Table 5 for the rotated component loadings.

Component 1 was defined by the PASAT Trial 1, CVLT-II Total Recall T-score, WCST perseverative errors, D-KEFS Letter Fluency scaled score, Verbal Concept Attainment Test total score, and the WRAT-3 Arithmetic Subtest standard score. Component 2 was defined by WTAR Standard Score, Token Test Raw score, Digit Span scaled score, and the Boston Naming Test raw score. Component 1 was labeled *Mental Flexibility/Working Memory*, and Component 2 was labeled *Verbal Reasoning*. Component scores were computed for each participant.

To evaluate whether these neuropsychological components accounted for significant variance in financial capacity, multiple regression analyses were computed. Prior to doing so, preliminary analyses were conducted using the CMDI. Notably, the CMDI Mood scale score was not entered into the regression as an independent variable. With only 50 participants, a sixth independent variable would jeopardize stability of the regression equations. Nonetheless, Pearson correlation coefficients were computed between the CMDI Mood score and the FCI indices. In no case did a significant correlation emerge, implying that depressed mood had negligible relationship with FCI performance.

Regarding the multiple regression analyses, FCI Total Score and domain scores served as dependent variables, and the two neuropsychological component scores were entered as independent variables. To control for the potential effects of age and education, these variables were entered simultaneously with the component scores. Furthermore, TTFW was entered to evaluate the effect of motor disability. Tolerances for each variable fell no lower than 0.61, implying that multicollinearity was negligible. To control for Type I error, a $p < .01$ was used to determine significance for each independent variable. In no instance did age or education account for significant variance on FCI performance.

Domain 1 – Basic Monetary Skills: Regarding the *Basic Monetary Skills* domain of the FCI, both the *Mental Flexibility/Working Memory* component (semi-partial $r = 0.32$), and the TTFW (semi-partial $r = -0.34$) achieved significance. High scores on these neurocognitive tasks were associated with a better ability to manage the most basic financial tasks, and greater motor disability correlated with worse Basic Monetary Skills.

Domain 2 – Financial Conceptual Knowledge: *Mental Flexibility/Working Memory* (semi-partial $r = 0.42$) and *Verbal Reasoning* (semi-partial $r = 0.30$) emerged as significant predictors of scores on the *Financial Conceptual Knowledge* domain.

Domain 3 – Cash Transactions: Regarding the *Cash Transactions* domain, only the *Mental Flexibility/Working Memory* component achieved significance (semi-partial $r = 0.34$).

Domain 4 – Checkbook Management: Regarding the *Checkbook Management* domain, only the *Mental Flexibility/Working Memory* component achieved significance (semi-partial $r = 0.38$).

Domain 5 – Bank Statement Management: Only the *Mental Flexibility/Working Memory* (semi-partial $r = 0.36$) emerged as a significant predictor of the *Bank Statement Management*.

Domain 6 – Financial Judgment: None of the independent variables reliably predicted scores on the *Financial Judgment* domain.

Domain 7 – Bill Payment: *Mental Flexibility/Working Memory* (semi-partial $r = 0.59$), proved to be a significant predictor of scores on the *Bill Payment* domain of the FCI.

Domain 9 – Investment Decision Making: The *Mental Flexibility/Working Memory* component was the sole independent variable to achieve significance (semi-partial $r = 0.32$).

FCI Total: Only the *Mental Flexibility/Working Memory* component achieved significance (semi-partial $r = .50$).

Discussion

In the present study, unimpaired patients with MS were able to perform financial tasks at a level similar to healthy participants. In contrast, the neuropsychologically-compromised people with MS performed significantly worse on the FCI. Specifically, they showed poor performance on the FCI Total-score and on the following Domains: *1-Basic Monetary Skills, 2- Financial Conceptual Knowledge, 4- Checkbook Management, 5- Bank Statement Management, 7- Bill Payment, 9-Making Investment Decisions*. As such, people with MS who manifest neuropsychological dysfunction appear at risk for diminished financial capacity and impaired financial decision-making. Their greatest vulnerability seems to involve basic financial management and investment skills, and mental flexibility and working memory dysfunction seems to be the most potent predictor of incapacity. No significant differences between groups emerged on the following Domains: *3-Cash Transactions; 6-Financial Judgment*. Thus, regardless of neuropsychological status, individuals with MS appear capable of handling simple transactions and of detecting mail fraud and telephone scams.

These results are consistent with existing studies of neuropsychological impairment and functional outcomes in MS (Rao et al., 1991b; Kessler et al., 1992). Specifically, patients with cognitive impairment seem to perform poorly on a variety of functional outcomes, whereas those patients without neuropsychological dysfunction manage activities of daily living relatively better. The current data extend those studies by showing a relationship between neuropsychological deficits and financial decision-making.

In addition, research concerning financial decision making in other clinical populations reveal that neuropsychological dysfunction corresponds with diminished financial capacity. In particular, prior investigations of people with Alzheimer's disease, mild cognitive impairment, schizophrenia, depression, and traumatic brain injury (Dreer, DeVito, Novack, & Marson, 2012; Mackin & Areán, 2009; Marson, 2001; Niekawa, Sakuraba, Uto, Kumazawa, & Matsuda, 2007; Okonkwo et al., 2006) show that cognitive impairment in these populations is linked to poor financial decision-making. The current research extends those findings by demonstrating similar results among people with MS.

Notably, in patients with Alzheimer's disease or Mild Cognitive Impairment, Griffith et al. (2003) found that the *Financial Judgment* domain of the FCI was robust to

neuropsychological impairment, but *Basic Monetary Skills*, *Checkbook Management*, *Investment Decision Making*, *Financial Concepts*, *Bank Statement Management*, *Bill Payment*, and *Cash Transactions* were diminished among patients with cognitive dysfunction. The present study found the same pattern of impairment in MS patients with one notable exception. In the current study, MS patients performed normally on *Domain 3 – Cash Transactions*. It may be that the patients in the current study were not as severely impaired as those with Alzheimer's disease or Mild Cognitive Impairment from previous research. As such, they were better able to manage the demands of Cash Transactions. Because a different set of neuropsychological tests were administered across research projects, this assertion is speculative but plausible.

Previous research revealed that the neuropsychological domains of executive function and working memory are the best predictors of financial capacity at both the overall and domain levels (Marson, 2001; Okonkwo et al., 2006). In the present study, a principal components-derived index of mental flexibility and working memory emerged as the most salient and potent predictors of financial decision making. Additionally, the magnitude of semi-partial correlations for this neuropsychological domain tended to be moderate to large in magnitude. As such, these results accord well with prior investigations involving elderly patients with neurodegenerative conditions. Mental flexibility and working memory deficits seem to diminish financial decision-making across clinical conditions. As such, deficits involving this aspect of neurocognition may serve as a key vulnerability for financial decision-making capacity among patients with neuropsychiatric illness. Future research should endeavor to delineate whether more specific facets of executive function and working memory contribute to poor financial capacity in clinical conditions.

Implications for Patients

Data from this study show that cognitive impairment impairs financial decision-making in people with MS. These data accord well with an emerging body of research showing that neuropsychological dysfunction diminishes ability to manage activities of daily living and vocational performance (Rao et al., 1991b). Specifically, financial decision-making is considered to be an instrumental activity of daily living (IADL; Marson et al., 2000; Marson 2001b; Marson, Triebel, & Knight, 2012; Wolinsky & Johnson, 1991), and it was compromised among cognitively-impaired MS patients.

Because neuropsychological compromise is common in MS, Benedict et al. (2002) suggested that a neuropsychological evaluation be conducted on MS patients when cognitive function is in question, and Kalmar et al. (2008) recommended that patients who manifest neuropsychological dysfunction should undergo a follow-up examination of functional capacities. Data from the present study support these suggestions and indicate there is likely a need to specifically assess financial capacity when cognitive dysfunction is evident.

Loss of financial capacity has important implications for patients with MS. In addition to the obvious economic consequences of mishandling one's own finances, the underlying cognitive dysfunction also places patients at risk of falling victim to fraud or scams, or of being exploited by others (often by family members). These economic consequences may lead to related legal consequences. For example, in similarly compromised populations such

as dementia, legal implications of competency are common (Marson, 2001). Indeed, proceedings to determine both conservatorship and guardianship are common when individuals demonstrate that they are unable to care for their own financial affairs. If such precautions are not addressed, cognitively-impaired patients with MS, who already face a variety of challenges concerning mobility, recreation, social activities, and vocational status, may compound their difficulties by making poor-financial choices, ultimately, risking economic instability or penury.

Strengths and Limitations

The current research possesses a number of strengths and weaknesses. Among its strengths, the present findings are novel, and are the first, to our knowledge, to evaluate financial decision-making in people with MS. These data also extend previous research by evaluating financial decision-making in a clinical population besides elderly patients with dementia. The data show that young adults with MS are apt to manifest cognitive impairment and concomitant compromises to financial capacity. Poor financial reasoning was not associated with depressed mood, medication status, age, or education, and was largely unrelated to severity of disability. Rather, the regression analyses showed that poor financial decision-making was largely associated with mental flexibility and working memory function. This should highlight the need for clinicians to attend to this issue in their evaluations of patients with MS, particularly when neuropsychological impairment is suspected.

Among the limitations of the current investigation is the relatively small sample size. Despite this, sufficient power existed to reveal significant relationships between cognitive impairment and compromised financial capacity in MS. Nonetheless, the sample size made it impossible to control for all potentially confounding variables. For example, the current study included a patient group that was heterogeneous with regards to disease course, yet insufficient patient numbers prohibited dividing patients by disease course (i.e., relapsing remitting, primary progressive, secondary progressive, and progressive relapsing courses) and comparing their financial capacity on this variable.

A number of researchers have begun developing cognitive rehabilitation strategies for people with MS. For instance, the work of Basso et al. (2006) and Goverover et al. (2011) offers hope that cognitive remediation strategies can improve MS patients' ability to function independently. The current study demonstrates the need for utilization of such treatment strategies, and outcome research specific to financial capacity. Future research should focus upon efforts to enhance financial decision-making in vulnerable patients with MS.

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Table 1

Description of FCI Domains and Tasks

FCI Domain	Task Description	Core Knowledge
1: Basic monetary skills		
Task 1a Naming coins/currency	Identifying specific coins and currency	Declarative
Task 1b Valuing coins/currency	Indicate relative monetary values of coins and currency	Declarative
Task 1c Counting coins/currency	Accurately count groups of coins and currency	Procedural
2: Financial conceptual knowledge		
Task 2a Define financial concepts	Define a variety of simple financial concepts	Declarative
Task 2b Apply financial concepts	Practical application and computation using financial concepts	Declarative/ Procedural
3: Cash transactions		
Task 3a 1-item grocery transaction	Enter into simulated 1-item transaction and verify change	Procedural
Task 3b 3-item grocery transaction	Enter into simulated 3-item transaction and verify change	Procedural
Task 3c Vending machine transaction	Obtain proper change for vending machine use and verify change	Procedural
Task 3d Tipping	Calculate the appropriate tip based on the amount of a bill	Procedural
4: Checkbook management		
Task 4a Understanding checkbook	Identify and explain parts of a check and check register	Declarative
Task 4b Using checkbook	Enter into simulated transaction and make payment by check	Procedural
5: Bank statement management		
Task 5a Understanding bank statement	Identify and explain parts of a bank statement	Declarative
Task 5b Using bank statement	Identify aspects of specific transactions on a bank statement	Procedural
6: Financial judgment		
Task 6a Detect mail fraud risk	Detect and explain risks in a mail fraud solicitation	Declarative / Judgmental
Task 6b Detect telephone fraud risk	Detect and explain risks in a telephone fraud solicitation	Declarative / Judgmental
7: Bill payment		
Task 7a Understanding bills	Explain the reasons for paying bills	Declarative
Task 7b Identifying and prioritizing bills	Identify and explain parts of bills and prioritizing payment	Declarative / Judgmental
Task 7c Preparing bills for mailing	Complete necessary steps for preparing bills for mailing	Procedural
9: Investment decision making		
	Understand options, determine returns, and make an investment decision	Declarative / Judgmental

Table 2

Sample Demographics

	Healthy Group	MS-Unimpaired	MS-Impaired
Sex	10 F/6 M	17 F/3 M	10 F/4 M
Age	44.3 (13.4)	44.3 (11.7)	46.8 (11.1)
Education	14.2 (2.1)	15.3 (2.5)	14.2 (1.9)
CMDI	45.5 (6.0)	54.1 (13.8)	58.0 (17.2)
TTFW		25.2 (54.7)	45.2 (73.3)
Ethnicity	13 Caucasian 2 African-American 0 American-Indian 1 Asian-American	20 Caucasian	12 Caucasian 1 African-American 1 American-Indian
Disease Course		12 Relapsing Remitting 2 Secondary Progressive 1 Progressive Relapsing 5 Uncertain	10 Relapsing Remitting 6 Uncertain

Note. Standard deviations appear in parentheses. TTFW: Timed Twenty-Five Foot Walk in seconds.

Table 3

Neuropsychological Performance

	Healthy Group ^A	MS-Unimpaired ^B	MS-Impaired ^C	Tukey HSD Significant Comparisons
WTAR	109.8 (10.7)	109.8 (10.8)	102.6 (13.5)	ns
WCST PE	9.9 (7.5)	14.4 (13.5)	26.9 (17.1)	A+B<C
VCAT	20.3 (3.2)	20.0 (2.6)	16.6 (2.7)	A+B>C
D-KEFS LF	10.7 (3.5)	10.6 (2.9)	7.6 (3.2)	A+B>C
PASAT Trial 1	49.9 (8.7)	47.5 (7.8)	31.0 (12.3)	A+B>C
Digit Span	12.5 (2.5)	10.6 (1.8)	8.1 (1.6)	A>B>C
Boston Naming Test	56.3 (2.2)	56.4 (2.0)	55.3 (4.1)	ns
Token Test	42.9 (2.0)	43.3 (1.0)	42.1 (1.9)	ns
WRAT-3 Arithmetic	107.0 (10.3)	99.6 (10.0)	87.9 (15.2)	A+B>C
CVLT-II Total Recall	50.1 (9.0)	47.9 (8.3)	38.0 (11.9)	A+B>C
Impaired Scores	0.75 (1.3)	0.85 (0.7)	4.0 (1.5)	A+B<C

Note. WTAR: Wechsler Test of Adult Reading standard score. WCST PE: Wisconsin Card Sorting Test Perseverative Errors. VCAT: Verbal Concept Attainment Test raw score. D-KEFS LF: Delis-Kaplan Executive Function System Letter Fluency scaled score. PASAT Trial 1: Paced Auditory Serial Addition Test Trial 1 raw score. Digit Span is a scaled score. Boston Naming Test: raw total score. WRAT-3 Arithmetic: Wide Range Achievement Test-3 Arithmetic standard score. CVLT-II Total Recall: California Verbal Learning Test-II Total Recall T-score. Standard deviations appear in parentheses. ns: Not significant.

^A Healthy Comparison Group.

^B MS Unimpaired Group.

^C MS Impaired Group. For Tukey HSD contrasts, $p < .01$ was required for significance.

Table 4

Average FCI Performances Across Groups

FCI Domains	Healthy Group ^A	MS-Unimpaired ^B	MS-Impaired ^C	Tukey HSD Significant Comparisons
FCI Total Score	289.3 (10.1)	282.4 (13.4)	260.0 (25.8)	A+B>C
1-Basic Monetary Skills	47.0 (2.2)	46.6 (2.1)	44.2 (3.5)	A+B>C
2-Conceptual Knowledge	38.4 (2.6)	38.3 (2.4)	34.6 (2.6)	A+B>C
3-Cash Transactions	28.9 (1.4)	28.1 (2.1)	26.8 (3.3)	ns
4-Checkbook Management	53.5 (1.2)	53.3 (1.9)	49.9 (6.7)	A+B>C
5-Bank Statement Management	35.9 (2.2)	34.9 (2.7)	32.1 (3.6)	A+B>C
6-Financial Judgment	24.8 (2.6)	23.7 (4.7)	23.4 (4.1)	ns
7-Bill Payment	44.6 (2.6)	42.1 (4.8)	36.4 (7.4)	A+B>C
9-Investment Decisions	16.1 (1.5)	15.6 (1.9)	12.6 (3.8)	A+B>C

Note. FCI: Financial Competency Instrument. Standard deviations appear in parentheses. ns: Not significant.

^AHealthy Comparison Group.

^BMS Unimpaired Group.

^CMS Impaired Group. For Tukey HSD contrasts, $p < .01$ was required for significance.

Table 5

Rotated Component Loadings

	<i>Mental Flexibility/Working Memory</i>	<i>Verbal Reasoning</i>
PASAT Trial 1	.85	–.10
CVLT-II Total Recall T-Score	.80	–.23
WCST Perseverative Errors	– .63	–.05
D-KEFS LF	.62	.17
VCAT	.51	.14
WRAT-3 Arithmetic Subtest	.49	.35
WTAR	–.11	.92
Token Test	–.01	.78
Digit Span	.45	.49
Boston Naming Test	.30	.42

Note. Loadings reflect direct oblimin rotation. Defining loadings are highlighted in bold font.

Table 6

Multiple Regression Results

<u>FCI Score</u>	<u>Semi-Partial Correlation Coefficients</u>			
	<u>Education</u>	<u>Age</u>	<u>TTFW</u>	<u>Mental Flexibility/Working Memory</u>
FCI Total Score	-0.11	0.10	-0.09	0.50***
1-Basic Monetary Skills	-0.03	-0.05	-0.34***	0.32**
2-Conceptual Knowledge	0.15	-0.14	0.09	0.42***
3-Cash Transactions	-0.07	0.05	-0.20	0.34**
4-Checkbook Management	-0.15	0.05	-0.11	0.38**
5-Statement Management	-0.11	0.10	0.09	0.36**
6-Financial Judgment	-0.14	0.19	-0.11	0.07
7-Bill Payment	-0.14	0.15	-0.03	0.59***
9-Investment Decisions	-0.01	0.10	0.05	0.32**

Note.

**
p<.01.***
p<.001.