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## Contributing factors to depressed mood in Multiple Sclerosis

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### Abstract

By applying the behavioral theory of Lewinsohn et al. [1985. An integrative theory of depression. In: S. Reiss, & R. R. Bootzin (Eds.), *Theoretical issues in behavior therapy* (pp. 331–359). San Diego, CA: Academic Press.] to Multiple Sclerosis (MS), it was hypothesized that physical disability, fatigue, and psychosocial dysfunction would be significantly predictive of depressed mood in MS patients. Seventy-six MS patients completed the following measures: the Sickness Impact Profile (SIP), the Fatigue Impact Scale (FIS), and the mood subscale from the Chicago Multiscale Depression Inventory (CMDI). Structural equation modeling revealed that physical disability and fatigue were indirectly predictive of depressed mood via their effects on recreational functioning. Fatigue also had a direct effect on mood. If reductions in recreational activities actually cause decrements in mood, depressed mood in MS may be treatable by helping patients identify recreational activities that they can enjoy regardless of physical or fatigue-related difficulties. © 2001 National Academy of Neuropsychology. Published by Elsevier Science Ltd.

*Keywords:* Neuropsychology; Multiple sclerosis; Depression

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Multiple Sclerosis (MS) has been associated with emotional dysfunction since the days of Charcot (1877). Most of the research on emotional functioning in MS patients has focused on depression (Minden, Oray, & Reich, 1987; Nyenhuis et al., 1995; SurrIDGE, 1969; Whitlock & Siskind, 1980). Although depression is much more common among MS patients than among persons from the general population (Fischer et al., 1994; Minden & Schiffer, 1990; Schiffer,

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Caine, Bamford, & Levy, 1983), little is known about its etiology in MS. According to the behavioral theory of Lewinsohn and colleagues, disease leads to depression only if it interferes with the person's normal level of functioning (Lewinsohn, Hoberman, Teri, & Hautzinger, 1985; Zeiss, Lewinsohn, Rohde, & Seeley, 1996). Because MS is a disease that can affect multiple domains of functioning (e.g., occupational, physical), it is possible that Lewinsohn's model might explain the development of depression among MS patients. The purpose of the current study was to test Lewinsohn's model with a sample of MS patients using depression, physical disability, fatigue, and psychosocial functioning measures.

Lewinsohn's model suggests that disease will lead to depressive affect only if it disrupts physical or psychosocial functioning (Lewinsohn, 1974; Lewinsohn et al., 1985). For example, physical dysfunction caused by disease might interfere with a person's ability to compete in sports, perform at work, or socialize with friends. If a person's ability to obtain positive reinforcement is disrupted, it is proposed that dysphoric mood will result (Lewinsohn et al., 1985). An adaptation of Lewinsohn's model is presented in Fig. 1. Although Lewinsohn's model has never been tested directly in an MS sample, there are many findings from the MS literature that are consistent with this theory.

Consistent with Fig. 1, physical disability is associated with psychosocial problems in MS (Hutchinson & Hutchinson, 1995; Vickrey, Hays, Harooni, Myers, & Ellison, 1995; Zeldow & Pavlou, 1988). In a study by Vickrey et al. (1995), MS patients who required outside aid to walk at least a city block or who were essentially wheelchair-bound reported more social problems compared with fully ambulatory patients. Because Vickrey et al. used a correlational design, it is open to many interpretations; however, it is not unreasonable to suggest that physical disability makes it more difficult for a person to participate in previously enjoyed social activities (e.g., transportation to a friend's house). Also consistent with Fig. 1, physical dysfunction is associated with recreational and occupational problems in MS (Beatty et al., 1995; Hutchinson & Hutchinson, 1995; Zeldow & Pavlou, 1988).

Studies examining the relationship between physical disability and depression in MS have been mixed. Although previous literature suggests that physical disability is independent of depression in MS patients (Fischer et al., 1994), much of this research has been inadequate for

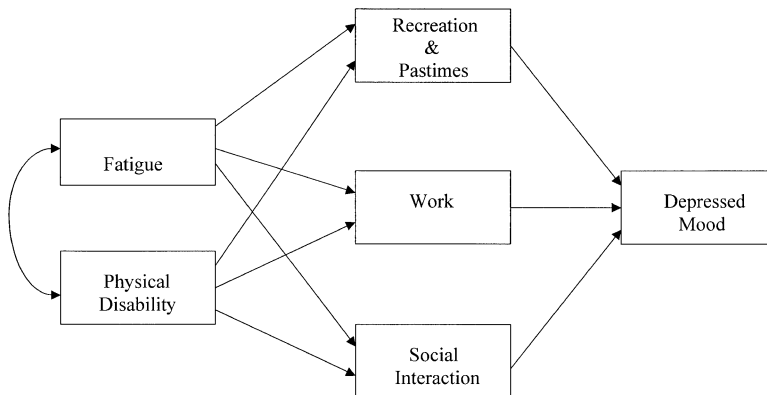


Fig. 1. A priori model of depressed mood in MS.

two methodological reasons. First, as Huber and Rao (1993) have indicated, diagnosing depression in MS is not directly comparable to identifying depression in the general population. More specifically, MS is a disease accompanied by symptoms not easily distinguished from those of depression. For example, sleep abnormalities, sexual dysfunction, and concentration difficulties might appear to be symptoms of depression when in reality they may be MS symptoms. Ultimately, symptom overlap is problematic because it may spuriously inflate the prevalence of depression among MS samples, thereby confounding clear interpretations of data (cf. Aikens et al., 1999). Nyenhuis et al. (1995) suggest that a solution to symptom overlap is to use depression measures that focus on mood symptoms, rather than cognitive or vegetative symptoms. To correct for this perceived limitation, we use a measure of mood to define depression in the present study. This approach is consistent with our prior work (e.g., Arnett, Higginson, Voss, Bender, et al., 1999; Arnett, Higginson, Voss, Wright, et al., 1999; Randolph, Arnett, Higginson, & Voss, 2000).

A second limitation of previous studies that have examined the relationship between physical disability and depression can also be reduced to measurement specificity. Most studies in the MS literature have operationalized physical disability using Kurtzke's Expanded Disability Status Scale (EDSS; Kurtzke, 1983). Although a very useful instrument, the EDSS is problematic as a pure measure of physical disability because it includes items that also measure neurological impairment (e.g., double vision and slurred speech). It could be the case that a relationship between physical disability and depression in MS actually exists, but because neurological impairment is also measured by the EDSS, this association is confounded. Consistent with this, Devins et al. (1993) found that, although physical disability, as measured by the Sickness Impact Profile (SIP), was significantly predictive of psychopathology and distress, the EDSS was not.

In addition to physical disability, many MS patients also suffer from fatigue (Krupp, Alvarez, LaRocca, & Scheinberg, 1988; Vercoulen et al., 1996). For example, in a study by Krupp et al. (1988), 88% of the MS patients complained of fatigue and, compared to healthy adults, were significantly more likely to report their fatigue as a cause of frequent problems in everyday functioning. Fisk, Pontefract, Ritvo, Archibald, and Murray (1994) found that MS-related fatigue, as measured by the Fatigue Impact Scale (FIS), was significantly predictive of physical and psychosocial functioning status as measured by the SIP. In addition, FIS scores accounted for 38% of the variance on the Mental Health Inventory, a measure of distress and positive well-being. Although the Mental Health Inventory is not exclusively a measure of depression, these findings suggest that fatigue is significantly related to the physical, psychological, and social handicaps that MS patients often experience. These studies are consistent with Lewinsohn's model because they suggest that fatigue is related to physical, psychosocial, and emotional difficulties. More specifically, the proposed model posits that fatigue will lead to psychosocial disability and, if it persists, depressed mood.

Although the specific causes of depression are currently unknown, interpersonal and psychosocial factors have been implicated in the development and treatment of depression for decades (Coyne, 1976; Safran, 1990; Sullivan, 1953). For example, research has shown that, compared with nondepressed people, depressed individuals possess social skills deficits (Krantz, 1985), have less social support (Andrews, Tennant, Hewson, & Vaillant, 1978; Lewinsohn, Hoberman, & Rosenbaum, 1988), experience more marital and work-related

difficulties (Broadhead, Blazer, George, & Tse, 1990; Feather & Barber, 1983; Lewinsohn et al., 1988), and engage in fewer pleasurable activities (Lewinsohn et al., 1988). Similar problems in psychosocial functioning have also been found in depressed MS patients (Gilchrist & Creed, 1994; Maybury & Brewin, 1984; Ritvo, Fisk, Archibald, Murray, & Field, 1996).

In a study by Gilchrist and Creed (1994), depression was significantly related to social stress as measured by the social stress and support interview (SSSI) in a group of 34 outpatients with relapsing–remitting MS. Further analysis of the SSSI revealed that depressed patients were experiencing significantly more stress in the domains of occupation, marriage, and family relationships. Maybury and Brewin (1984) found that frequency of contact with able-bodied people was significantly correlated with self-esteem and psychological health in a sample of MS patients. Although these studies can be interpreted in a variety of ways, one explanation for the results is that the inability to socialize with other people, because of fatigue or physical functioning difficulties, will negatively influence MS patients' emotional health.

To summarize, the current study was designed to test an etiological model of depressed mood in MS patients using fatigue, physical disability, and psychosocial functioning measures. Differences between the present vs. previous studies include our data analytic strategy and measurement selection. Instead of using the EDSS, physical disability was measured using the SIP. The SIP has an advantage over the EDSS in that it is not confounded by neurological impairment. Consistent with the recommendation of Nyenhuis et al. (1995), depression in our sample was measured using the mood subscale of the Chicago Multiscale Depression Inventory (CMDI). The current study is also different from previous studies because we used structural equation modeling to analyze the results. Structural equation modeling has an advantage over regression or correlation because, not only does it test the predictive power of one variable regressed onto another, a structural equation model allows for the relationship between an entire *system* of variables to be tested simultaneously. In the current study, it was hypothesized that fatigue and physical disability would predict psychosocial functioning status. It was also hypothesized that psychosocial functioning deficits in MS would in turn predict depressed mood.

## 1. Method

### 1.1. Participants

The sample participants consisted of 76 MS patients identified from outpatient clinics and the MS Society in the inland Northwestern United States. Diagnosis and disease course were determined by board-certified neurologists using Poser et al.'s (1983) research criteria and disease course criteria outlined by Lublin and Reingold (1996) (see Table 1). Participants were excluded from the study if they: (a) had a history of drug/alcohol abuse or a nervous system disorder other than MS; (b) had severe motor or visual impairment; or (c) could not be evaluated on an outpatient basis at our institution. All participants provided written informed consent and completed the following measures: the SIP, a self-report version of Kurtzke's EDSS, the FIS, and the CMDI. In return for their participation, written and oral feedback was given to the patients regarding their overall intellectual functioning, memory, attention, and mood.

Table 1  
Participant characteristics

<i>n</i>	76
CMDI mood scale	21.88
Age (years)	46.49 (8.21)
Education (years)	14.88 (2.37)
Symptom duration (years)	14.33 (9.96)
Diagnosis duration (years)	7.82 (7.84)
Sex, <i>n</i> (% female)	61/76 (80%)
Diagnostic category	
Clinically definite, <i>n</i> (%)	68/76 (89%)
Laboratory definite, <i>n</i> (%)	4/76 (5%)
Clinically probable, <i>n</i> (%)	3/76 (5%)
Laboratory probable, <i>n</i> (%)	1/76 (1%)
Clinical course	
Relapsing–remitting, <i>n</i> (%)	48/76 (63%)
Secondary progressive, <i>n</i> (%)	19/76 (25%)
Primary progressive, <i>n</i> (%)	7/76 (9%)
Progressive relapsing, <i>n</i> (%)	2/76 (3%)

Unless otherwise specified, values represent means (standard deviation). CMDI=Chicago Multiscale Depression Inventory.

## 1.2. Measures

### 1.2.1. Psychosocial functioning and physical disability

The SIP was considered an appropriate measurement choice for testing the hypothesized model because it is behaviorally based and assesses a variety of functional domains (Bergner, Bobbitt, Carter, & Gilson, 1981). The SIP is a reliable and valid (Carter, Bobbitt, Bergner, & Gilson, 1976) self-report measure of health-related dysfunction that contains 136 statements related to 12 categories of activity (Ambulation, Body Care and Movement, Mobility, Emotional Behavior, Social Interaction, Recreation and Pastimes, Home Management, Eating, Sleep and Rest, Communication, Work, and Alertness Behavior). Patients endorse only those items that describe their current health status with higher scores indicating greater levels of dysfunction in each category of activity. Only six of the SIP categories were used in the current study. Psychosocial and physical functioning constructs that were measured by the SIP include occupational functioning (Work subscale), social functioning (Social Interaction subscale), physical disability (sum of the Mobility, Ambulation, and Body Care and Movement subscales), and recreational functioning (Recreation and Pastimes subscale).

### 1.2.2. Fatigue

Fatigue was measured using the FIS (Fisk et al., 1994). The FIS is a 40-item questionnaire that measures perceived impact of fatigue on quality of life. For each item, the participant is asked to rate the extent to which fatigue has caused problems in relation to each statement over the past month (0 = *no problem* to 4 = *extreme problem*, maximum FIS score = 160). The

FIS can be divided into three subscales that assess the perceived impact of fatigue on cognitive functioning (10 items), physical functioning (10 items), and psychosocial functioning (20 items). Because specific relationships between cognitive dysfunction and depressed mood were not hypothesized in the current study, and to avoid any overlap between the FIS and the psychosocial variables of the SIP, only the physical functioning subscale of the FIS was used to measure fatigue.

### *1.2.3. Depressed mood*

Depressed mood was measured using the mood subscale of the CMDI (Nyenhuis et al., 1998). The CMDI is a measure of depression that was designed for use in MS and other medical populations. It is a 42-item, self-report inventory consisting of three scales measuring mood (e.g., sadness), vegetative (e.g., fatigue), and evaluative (e.g., feelings of uselessness) symptoms. For each item, participants are instructed to circle the one number that best describes the way they have been feeling during the past week, including that day. Circling a 1 indicates that the item describes the patient “not at all,” whereas circling a 5 indicates the item describes the patient “extremely.”

Because of the potential confound involved in including vegetative symptoms of depression when diagnosing depression in MS, following the suggestion of Nyenhuis et al. (1998), and the precedent set with our previous studies on depression in MS (e.g., Arnett, Higginson, Voss, Bender, et al., 1999; Arnett, Higginson, Voss, Wright, et al., 1999), we used the mood subscale (14 items) from Nyenhuis et al.’s CMDI to define depression in the present study.

### *1.2.4. Neurological impairment*

Neurological impairment was determined using a self-report version of Kurtzke’s (1983) EDSS. Ambulation and the ability to carry out day-to-day functioning are assessed. Additionally, eight categories of neurological functioning are evaluated (swallowing, tremor and balance, double vision, slurred speech or difficulty swallowing, numbness, elimination, blurred vision, and memory, calculation and reasoning) using a four-point scale ranging from normal functioning to severe functional impairment. The EDSS was converted to questionnaire form in consultation with a board-certified neurologist, and patients rated themselves on the above categories. The EDSS rating was then made by an experienced neuropsychologist with expertise in MS (P.A.) after he received instruction from a neurologist specializing in MS.

## *1.3. Procedure*

A more complete procedural outline of the current study has been presented elsewhere (Arnett, Higginson, Voss, Wright, et al., 1999). MS patients were sent letters from certified neurologists informing them of the opportunity to participate in a research project. Patients were also recruited through an ad in the Spokane-area MS Society Newsletter. If interested, patients were later called and screened for the exclusionary criteria. Patients who were not excluded and were willing to participate were scheduled for testing.

Participants received a letter and a packet of questionnaires that included the SIP and the EDSS within 1 week prior to testing. The letter instructed the participants to complete and bring the questionnaires to the testing site. On the day of testing, neuropsychological tests were administered along with the CMDI and the FIS. Testing was conducted by three graduate students extensively trained in neuropsychological testing and interviewing techniques. Upon completion of testing, patients were debriefed and, if appropriate, given referrals to psychologists in the area for treatment of depression.

## 2. Results

### 2.1. Preliminary analyses

Pearson Product–Moment Correlation Coefficients for all variables are presented in Table 2. As expected, the EDSS did not significantly correlate with the mood subscale of the CMDI, and therefore was dropped from further analyses. Four of the five variables in the model were significantly correlated with the CMDI mood subscale including SIP-Social Interaction ( $r=.36$ ,  $P<.01$ ), SIP-Recreation and Pastimes ( $r=.42$ ,  $P<.01$ ), SIP-Physical Disability ( $r=.23$ ,  $P<.05$ ), and FIS-Physical Fatigue ( $r=.42$ ,  $P<.01$ ).

### 2.2. Test of the hypothesized model

To compare the hypothesized model to the collected data, structural equation modeling was performed using the EQS computer program (Bentler, 1993). Based on the recommendation to evaluate the overall validity of a model by using multiple criteria (Bentler, 1990; Bentler & Bonett, 1980), three different indices of goodness-of-fit were examined. The first fit index, the chi-square ( $\chi^2$ ) statistic, tests the departure of the specified model's estimated covariance matrix from the actual sample covariance matrix (displayed in Table 3). Contrary

Table 2  
Intercorrelations between depressed mood and primary model variables

	1	2	3	4	5	6	7
(1) EDSS	–	.68*	.41**	.38**	.30**	.29*	.12
(2) SIP-P		–	.52**	.62**	.64**	.49**	.23*
(3) FIS-P			–	.61**	.47**	.27*	.42**
(4) SIP-R&P				–	.66**	.32**	.42**
(5) SIP-SI					–	.30**	.36**
(6) SIP-W						–	.04
(7) CMDI-M							–

$N=76$ . EDSS = Expanded Disability Status Scale; SIP-P = Sickness Impact Profile-Physical Dimension Scale; FIS-P = Fatigue Impact Scale-Physical subscale; SIP-R&P = SIP-Recreation and Pastimes subscale; SIP-SI = SIP-Social Interaction subscale; SIP-W = SIP-Work subscale; CMDI-M = Chicago Multiscale Depression Inventory-Mood subscale.

\*  $P<.05$ .

\*\*  $P<.01$ .

Table 3  
Covariances between primary model variables

	1	2	3	4	5	6
(1) FIS-P	–	.506	.594	.454	.267	.410
(2) SIP-P		–	.623	.648	.494	.235
(3) SIP-R&P			–	.681	.324	.425
(4) SIP-SI				–	.309	.365
(5) SIP-W					–	.217
(6) CMDI-M						–

FIS-P=Fatigue Impact Scale-Physical subscale; SIP-P=Sickness Impact Profile-Physical Dimension Scale; SIP-R&P=SIP-Recreation and Pastimes subscale; SIP-SI=SIP-Social Interaction subscale; SIP-W=SIP-Work subscale; CMDI-M=Chicago Multiscale Depression Inventory-Mood subscale.

to most statistical indices, a nonsignificant  $\chi^2$  is desirable and indicates that the estimated and obtained covariance matrices are similar, and that the proposed model provides a good “fit” to the data. A significant  $\chi^2$  indicates that the model deviates significantly from the data and does not provide a good fit to the data. In other words, the smaller the value of  $\chi^2$  or the larger the  $P$  value ( $P > .05$ ), the better the fit of the model to the data.

Because the  $\chi^2$  value is sensitive to variations in sample size (Bollen, 1989), two other indices of model fit were used. The Bentler–Bonett Normed Fit Index (NFI) is a test that compares a hypothesized model with a corresponding baseline model of uncorrelated or independent variables (Bentler, 1993). The Comparative Fit Index (CFI) was also tested and, according to Bentler (1990), is less sensitive to sample size, making it a more accurate indicator of comparative model fit. NFI and CFI values greater than 0.9 are desirable and indicate good model fit (Bentler, 1993).

Unlike the goodness-of-fit indices, a path coefficient tests the strength of a relationship between two variables while holding all the other variables constant. Path coefficients are represented as one-way arrows in Figs. 2 and 3, whereas a two-way arrow represents the correlation between two variables. Given that many of the variables in the model are highly correlated with one another, the possibility of revising the initial a priori model to provide a better fit to the data seemed plausible. For example, one or more of the psychosocial variables examined might not mediate the relationship between fatigue, physical disability, and mood and therefore can be dropped without adversely affecting overall model fit. Conversely, the addition of a direct path between fatigue and depressed mood may result in an overall better model fit. To examine these possibilities, EQS LaGrange Multiplier (LM) and Wald tests were also conducted to revise the original model in order to evaluate whether adding or dropping paths from the a priori model would result in a better overall fit with the data.

The a priori model with corresponding path coefficients is presented in Fig. 2. The computed  $\chi^2$  of the original model was significant [ $\chi^2(5, N=76)=21.18, P < .05$ ], indicating that the model was not a good fit to the data. Although the other fit indices (NFI=0.87, CFI=0.89) indicate better model fit than the  $\chi^2$ , they were also less than optimal. Consequently, Wald and LM tests were conducted to determine which paths should be added to and/or deleted from the model to improve goodness of fit. The Wald test indicated that the Social Interaction subscale from the SIP did not significantly predict

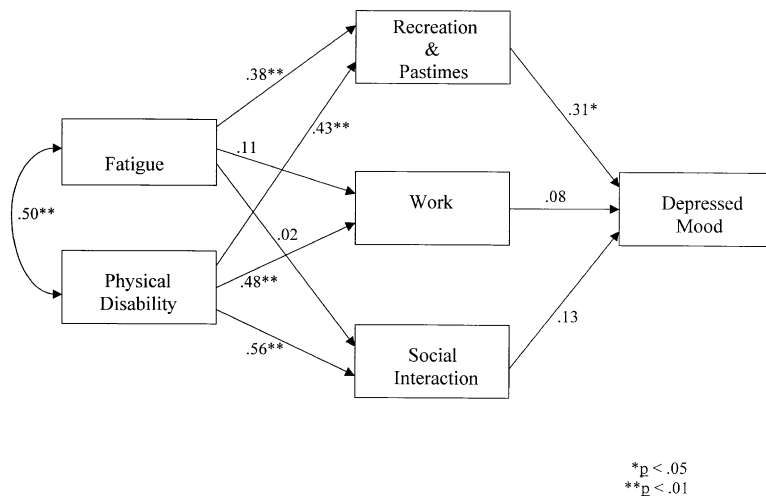


Fig. 2. Path coefficients for the a priori model of depressed mood in MS. \*  $P < .05$ ; \*\*  $P < .01$ .

depressed mood ( $P > .05$ ) and was therefore eliminated from the model. The LM test revealed that a path directly from fatigue to depressed mood would significantly improve model fit.

### 2.3. Test of the revised model

After considering the results of the LM and Wald tests, a revised model was constructed and tested (Fig. 3). All fit indices for the revised model indicate good model fit including the  $\chi^2$  statistic [ $\chi^2(1, N=76)=0.65, P=.42$ ], NFI=0.99, CFI=1.0. Fig. 3 shows that both fatigue and physical disability were significantly and independently predictive of the SIP-Recreation and Pastimes subscale. Recreation and Pastimes in turn significantly predicted depressed mood. Furthermore, fatigue significantly predicted depressed mood independent of the variance explained by Recreation and Pastimes. Therefore, the most parsimonious representation of the data included three of the original six variables in the hypothesized model.

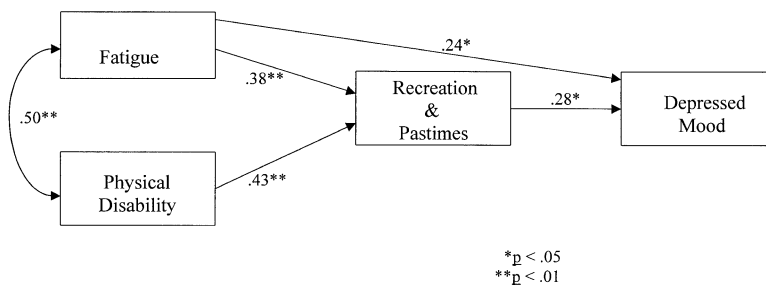


Fig. 3. Path coefficients for the revised model of depressed mood in MS. \*  $P < .05$ ; \*\*  $P < .01$ .

### **3. Discussion**

The purpose of the current study was to test a multivariate model of depressed mood in MS patients. It was hypothesized that physical disability and fatigue would predict psychosocial deficits, which in turn would predict depressed mood. Of the three psychosocial variables measured in the current study (i.e., work, social, and recreational functioning), only the SIP-Recreation and Pastimes variable significantly mediated the relationship between fatigue, physical disability, and depressed mood in MS. Consistent with the hypotheses, the results suggest that fatigue and physical problems may restrict the MS patients' ability to engage in recreational activities, such as enjoying hobbies, going out for entertainment, or participating in athletic activities. This finding is similar to the results of a study by Stenager, Knudsen, and Jensen (1991), who reported that the most severely physically disabled MS patients were the least likely to participate in spare time activities. Taken together, these results suggest that spending time enjoying recreational activities may contribute to positive affect in MS patients.

Also consistent with previous literature, the current study revealed that the EDSS was not correlated with depression. As mentioned earlier, the EDSS measures both disability and impairment, and therefore clear relationships between this instrument and other constructs (e.g., depression) might be confounded. Indeed, a clear relationship was found between depression and physical problems when physical disability alone was assessed using the SIP. This finding suggests that clinicians might want to assess for depressed mood in patients who have ambulation and/or mobility restrictions independent of their other neurological signs.

Similar to the results of other investigators (Fisk et al., 1994; Ritvo et al., 1996), fatigue was found to be significantly predictive of depressed mood in MS. Because fatigue predicted depressed mood independent of physical disability, the association between the fatigue and mood in MS patients is not accounted for by physical disability alone. There are many interpretations of this finding. For example, because fatigue is one of the criteria for Major Depression, our finding might simply be a reflection of the correlation between depressed mood and fatigue in the general population (American Psychiatric Association, 1994). Patten and Metz (2000) suggest that fatigue associated with MS can be distinguished from fatigue related to depression in that MS-related fatigue: (1) is aggravated by heat, (2) is often alleviated by sleep, and (3) lasts for only a few hours compared with the more persistent fatigue associated with depression. Clearly, examining characteristics of fatigue in MS vs. depression, as well as treating fatigue in MS patients are important issues for future research to address.

Important limitations of the current study merit discussion. Because this study was cross-sectional, statements regarding the etiology of depressed mood in MS are necessarily tentative. Similar to the relationship between fatigue and depression, it could be that depressed mood is simply a concomitant, rather than a consequence of recreational dysfunction in MS. In the future, a more precise test of Lewinsohn's model should involve assessing MS patients longitudinally to determine proximal and distal factors responsible for the development of depression in MS.

Generalizability limitations of the present results should also be noted. For example, patients were excluded if they: (1) had a history of drug/alcohol abuse; (2) had severe motor or visual impairment; or (3) could not be evaluated on an outpatient basis at our institution.

Thus, the results of our study might not be applicable to more severe MS cases. Another limitation is that clinical depression per se was not examined in the current report. Depressed mood is not synonymous with major depression as measured by the DSM-IV, thus making it difficult to generalize our results to patients with clinical depression. On the other hand, our reliance on mood could also be considered a strength of the study given that even subclinical depression in MS is predicted by fatigue, physical disability, and decreased involvement in recreational and leisure activities. Another limitation of our study is that, because of small sample size, we were unable to examine possible differential contributors to depression among MS subtypes. Given the differences apparent in the phenomenology of different MS subtypes (Lublin & Reingold, 1996), it is reasonable to speculate that contributors to depression among them might vary.

To summarize, the results of the current study suggest that fatigue and physical disability contribute to depressed mood in MS patients. The current findings also suggest that depression may be at least partially mediated by the patient's inability to participate in recreational activities. These results are potentially clinically relevant because, if a reduction in recreational activities actually causes decrements in mood, then it might be possible to treat depression in MS patients by identifying, and then prescribing, alternate recreational activities that can be enjoyed by patients regardless of physical or fatigue-related difficulties.

## References

- Aikens, J. E., Reinecke, M. A., Pliskin, N. H., Fischer, J. S., Wiebe, J. S., McCracken, L. M., & Taylor, J. L. (1999). Assessing depressive symptoms in multiple sclerosis: is it necessary to omit items from the original Beck Depression Inventory? *Behavioral Medicine*, *22*, 127–142.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association.
- Andrews, G., Tennant, C., Hewson, D. M., & Vaillant, G. E. (1978). Life event stress, social support, coping style, and risk of psychological impairment. *Journal of Nervous and Mental Disease*, *166*, 307–316.
- Arnett, P. A., Higginson, C. H., Voss, W. D., Bender, W. I., Wurst, J. M., & Tippin, J. M. (1999). Depression in multiple sclerosis: relationship to working memory capacity. *Neuropsychology*, *13*, 546–556.
- Arnett, P. A., Higginson, C. H., Voss, W. D., Wright, B., Bender, W. I., & Wurst, J. M. (1999). Depressed mood in multiple sclerosis: relationship to capacity-demanding memory and attentional functioning. *Neuropsychology*, *13*, 434–446.
- Beatty, W. W., Blanco, C. R., Wilbanks, S. L., Paul, R. H., & Hames, K. A. (1995). Demographic, clinical, and cognitive characteristics of multiple sclerosis patients who continue to work. *Journal of Neurologic Rehabilitation*, *9*, 167–173.
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246.
- Bentler, P. M. (1993). *EQS structural equations program manual*. Encino, CA: Multivariate Software.
- Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*, 588–606.
- Bergner, M., Bobbitt, R. A., Carter, W. B., & Gilson, B. S. (1981). The sickness impact profile: development and final revision of the health status measure. *Medical Care*, *19*, 787–805.
- Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.
- Broadhead, W. E., Blazer, D. G., George, L. K., & Tse, C. K. (1990). Depression, disability days, and days lost from work in a prospective epidemiologic survey. *Journal of the American Medical Association*, *264*, 2524–2528.
- Carter, W. B., Bobbitt, R. A., Bergner, M., & Gilson, B. S. (1976). The validation of an interval scaling: the Sickness Impact Profile. *Health Services Research*, *11*, 516–528 (Winter).

- Charcot, J. M. (1877). *Lectures on the diseases of the nervous system delivered at La Salpêtrière*. London: New Sydenham Society.
- Coyne, J. C. (1976). Toward an interactional description of depression. *Psychiatry*, *39*, 28–40.
- Devins, G. M., Edworthy, S. M., Paul, L. C., Mandin, H., Seland, T. P., Klein, G., Costello, C. G., & Shapiro, C. M. (1993). Restless sleep, illness intrusiveness, and depressive symptoms in three chronic illness conditions: rheumatoid arthritis, end-stage renal disease, and multiple sclerosis. *Journal of Psychosomatic Research*, *37* (2), 163–170.
- Feather, N. T., & Barber, J. G. (1983). Depressive reactions and unemployment. *Journal of Abnormal Psychology*, *92*, 185–195.
- Fischer, J. S., Foley, F. W., Aikens, J. E., Ericson, D., Rao, S. M., & Shindell, S. (1994). What do we really know about cognitive dysfunction, affective disorders, and stress in multiple sclerosis? A practitioner's guide. *Journal of Neurological Rehabilitation*, *8*, 151–164.
- Fisk, F. D., Pontefract, A., Ritvo, P. G., Archibald, C. J., & Murray, T. J. (1994). The impact of fatigue on patients with multiple sclerosis. *Canadian Journal of Neurological Science*, *21*, 9–14.
- Gilchrist, A. C., & Creed, F. H. (1994). Depression, cognitive impairment and social stress in multiple sclerosis. *Journal of Psychosomatic Research*, *38*, 193–201.
- Huber, S. J., & Rao, S. M. (1993). Depression in multiple sclerosis. In: S. E. Starkstein, & R. G. Robinson (Eds.), *Depression and neurologic disease* (pp. 84–96). Baltimore, MD: Johns Hopkins Univ. Press.
- Hutchinson, J., & Hutchinson, M. (1995). The functional limitations profile may be a valid, reliable and sensitive measure of disability in multiple sclerosis. *Journal of Neurology*, *242* (10), 650–677.
- Krantz, S. E. (1985). When depressive cognitions reflect negative realities. *Cognitive Therapy and Research*, *9*, 595–610.
- Krupp, L. B., Alvarez, L. A., LaRocca, N. G., & Scheinberg, L. C. (1988). Fatigue in multiple sclerosis. *Archives of Neurology*, *45*, 435–437.
- Kurtzke, J. F. (1983). Rating neurological impairment in multiple sclerosis: an expanded disability status scale (EDSS). *Neurology*, *33*, 1444–1452.
- Lewinsohn, P. M. (1974). A behavioral approach to depression. In: R. J. Friedman, & M. M. Katz (Eds.), *The psychology of depression: contemporary theory and research* (pp. 157–185). New York: Wiley.
- Lewinsohn, P. M., Hoberman, H., Teri, L., & Hautzinger, M. (1985). An integrative theory of depression. In: S. Reiss, & R. R. Bootzin (Eds.), *Theoretical issues in behavior therapy* (pp. 331–359). San Diego, CA: Academic Press.
- Lewinsohn, P. M., Hoberman, H. M., & Rosenbaum, M. (1988). A prospective study of risk factors for unipolar depression. *Journal of Abnormal Psychology*, *97*, 251–264.
- Lublin, F. D., & Reingold, S. C. (1996). Defining the clinical course of multiple sclerosis: results of an international survey. *Neurology*, *46*, 907–911.
- Maybury, C. P., & Brewin, C. R. (1984). Social relationships, knowledge and adjustment to multiple sclerosis. *Journal of Neurology, Neurosurgery and Psychiatry*, *47*, 372–376.
- Minden, S. L., Orav, J., & Reich, P. (1987). Depression in multiple sclerosis. *General Hospital Psychiatry*, *9*, 426–434.
- Minden, S. L., & Schiffer, R. B. (1990). Affective disorders in multiple sclerosis. *Archives of Neurology*, *47*, 98–104.
- Nyenhuis, D. L., Luchetta, T., Yamamoto, C., Terrien, A., Bernardin, L., Rao, S. M., & Garron, D. C. (1998). The development, standardization, and initial validation of the Chicago Multiscale Depression Inventory. *Journal of Personality Assessment*, *70*, 386–401.
- Nyenhuis, D. L., Rao, S. M., Zajecka, J. M., Luchetta, T., Bernardin, L., & Garron, D. C. (1995). Mood disturbance versus other symptoms of depression in multiple sclerosis. *Journal of the International Neuropsychological Society*, *1*, 291–296.
- Patten, S. B., & Metz, L. M. (2000). Fatigue and depression in multiple sclerosis. *Canadian Journal of Psychiatry*, *45*, 84–85.
- Poser, C. M., Paty, D. W., Scheinberg, L., McDonald, L., Davis, F. A., Ebers, G. C., Johnson, K. P., Sibley, W. A., Silberber, D. H., & Tourtellotte, W. W. (1983). New diagnostic criteria for multiple sclerosis: guidelines for research protocols. *Annals of Neurology*, *13*, 227–231.

- Randolph, J. J., Arnett, P. A., Higginson, C. I., & Voss, W. (2000). Neurovegetative symptoms in multiple sclerosis: relationship to depression, fatigue, and physical disability. *Archives of Clinical Neuropsychology*, *15*, 387–398.
- Ritvo, P. G., Fisk, J. D., Archibald, C. J., Murray, T. J., & Field, C. (1996). Psychosocial and neurological predictors of mental health in multiple sclerosis patients. *Journal of Clinical Epidemiology*, *49*, 467–472.
- Safran, J. D. (1990). Towards a refinement of cognitive therapy in light of interpersonal theory: I. Theory. *Clinical Psychology Review*, *10*, 87–105.
- Schiffer, R. B., Caine, E. D., Bamford, K. A., & Levy, S. (1983). Depressive episodes in patients with multiple sclerosis. *American Journal of Psychiatry*, *140*, 1498–1500.
- Stenager, E., Knudsen, L., & Jensen, K. (1991). Multiple sclerosis: the impact of physical impairment and cognitive dysfunction on social and sparetime activities. *Psychotherapy Psychosomatics*, *56*, 123–128.
- Sullivan, H. S. (1953). In: H. S. Perry, & M. L. Gawel (Eds.), *The interpersonal theory of psychiatry*. New York: Norton.
- Surridge, D. (1969). An investigation into some psychiatric aspect of multiple sclerosis. *British Journal of Psychiatry*, *115*, 749–764.
- Vercoulen, J. H. M. M., Hommes, O. R., Swanink, C. M. A., Jongen, P. J. H., Fennis, J. F. M., Galama, J. M. D., van der Meer, J. W. M., & Bleijenberg, G. (1996). The measurement of fatigue in patients with multiple sclerosis. *Archives of Neurology*, *53*, 642–649.
- Vickrey, B. G., Hays, R. D., Harooni, R., Myers, L. W., & Ellison, G. W. (1995). A health-related quality of life measure for multiple sclerosis. *Quality of Life Research*, *4*, 187–206.
- Whitlock, F. A., & Siskind, M. M. (1980). Depression as a major symptom of multiple sclerosis. *Journal of Neurology, Neurosurgery and Psychiatry*, *43*, 861–865.
- Zeiss, A. M., Lewinsohn, P. M., Rohde, P., & Seeley, J. R. (1996). Relationship of physical disease and functional impairment to depression in older people. *Psychology and Aging*, *11*, 572–581.
- Zeldow, P. B., & Pavlou, M. (1988). Physical and psychosocial functioning in multiple sclerosis: descriptions, correlations, and a tentative typology. *British Journal of Medical Psychology*, *61*, 185–195.