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Using Social Cognitive Theory to Identify Key Determinants of Physical Activity In People Living  
with Multiple Sclerosis

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Using Social Cognitive Theory to Identify Key Determinants of Physical Activity in  
People Living with Multiple Sclerosis

by

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B.Sc., St. Francis Xavier University, 2002

THESIS

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## Using Social Cognitive Theory to Explain Physical Activity in People

### Living with Multiple Sclerosis

**Abstract:** Multiple sclerosis is a debilitating neurological disease with few successful symptom alleviating interventions available to the MS population. Preliminary research has shown that PA may aid in alleviating both psychological and physical symptoms; thus, improving overall quality of life. **Objective:** (1) To determine which social cognitive determinants (i.e., barrier efficacy, task efficacy, outcome expectation, social support, modeling, mood, and environment) would predict PA. (2) To determine whether barrier efficacy, task efficacy, and outcome expectation would mediate the social support, modeling, mood, and environment/PA relationships. **Study Design & Participants:** 76 participants (58 female and 18 male) completed a baseline questionnaire concerning social cognitive determinants and a 1-month telephone follow-up concerning PA participation. **Results:** The model accounted for 41% of the variance in PA. Block 1 accounted for 23% of the variance with traffic and modeling of friends making significant contributions to PA. Block 2 of the regression accounted for an additional 18% of variance with barrier efficacy ( $\beta = .25$ ;  $p < .05$ ) and outcome expectation ( $\beta = .21$ ;  $p < .05$ ) being significant predictors of PA. Outcome expectations mediated the modeling-friends/PA relationship. Barrier efficacy partially mediated the traffic/PA relationship. **Conclusion:** PA interventions should aim at increasing barrier efficacy and outcome expectations, and also on important social cognitive variables including barrier efficacy, outcome expectations, social support-friends, modeling-friends and environment (i.e., traffic). The MS patient's PA environment should be safe (i.e., no traffic) and include access to home use PA equipment (i.e., aerobic vide/DVD).

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## **I. INTRODUCTION**

### **Overview**

In 2003, 50 000 Canadians were diagnosed with Multiple Sclerosis (MS) (Canada, 2004). Canada has one of the highest occurrence rates of MS in the world and is the most common neurological disease affecting young Canadians (Canada, 2004). MS is a degenerative, neurological disease that plagues victims with sporadic and chronic, often escalating symptoms that often inhibit mobility, vision, balance, speech, memory, and physical functioning (Canada, 2004; Poser & Brinar, 2002; Solari & Radice, 2001). Furthermore, people afflicted with MS frequently experience a diminished quality of life (e.g., increased depression, anxiety) (Lawler & Hopker, 2001; Schreurs, de Ridder, & Bensing, 2002; Voss et al., 2002)

Fortunately, physical activity (PA) is one intervention that is assisting in alleviating some of these symptoms. Specifically, research examining the effects of PA on MS and other disabled populations has shown that it: (1) decreases anxiety and depression; (2) increases overall quality of life; (3) improves resistance and aerobic capabilities; (4) improves physical functioning; and (5) improves sexual functioning (DeBolt & McCubbin, 2004; Ponichtera-Mulcare, 1992; Sutherland, Anderson, & Stoove, 2001). Despite these benefits, however, research has also shown that people living with MS have significantly lower PA levels compared to the normative population (Mullins, 2001; Stuifbergen & Roberts, 1997). In fact, in a study by Stuifbergen & Roberts, 1997, only 22% of MS patients participated in light/moderate PA and only 19% took part in leisure time activity.

Based on the above statistics, it appears that adherence to PA is an issue for MS patients. Unfortunately, there are no intervention studies to date that have been specifically designed to increase PA in these patients. Before developing such an intervention, however, Baranowski, Anderson, and Carmack (1998) stress that “to provide guidance for the design of effective (physical activity) programs, behavioural science models must be predictive of behaviour and indicate procedures that promote change in behaviour” (p.266). Therefore, a necessary preliminary step for the MS population is to identify key correlates of PA that can provide insight into the development of an efficacious PA intervention. Unfortunately, theory-based studies have not been conducted in the MS population.

Therefore, social cognitive theory was chosen as the theoretical framework to explain PA in this population. The reason this theory was chosen, is that it has been used extensively and successfully to explain PA in numerous non-diseased (McAuley, 1992; Wallace, Buckworth, Kirby, & Sherman, 2000; Winters, Petosa, & Charlton, 2003) and diseased such as cancer, diabetes, fibromyalgia and heart disease) (Allen, 2004; Graves, 2003; Maddison & Prapavessis, 2004; Oliver & Cronan, 2005; Rogers et al., 2004; Rogers et al., 2005) populations. In fact, social cognitive theory has been shown to account for as much as 60% of the variance in PA (Conn, 1998; Conn, Burks, Pomeroy, Ulbrich, & Cochran, 2003; McAuley, 1992, 1993; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003), which is well above the minimum requirement (30%) suggested by Baranowski, Anderson, & Carmack (1998), to base a PA activity intervention on. Therefore, the purpose of this study was to identify the most influential correlates of PA in individuals living with MS from a social cognitive viewpoint. It is intended that the

results from the study will provide the necessary information needed to develop a theoretically based PA intervention aimed at increasing PA in MS patients in the future.

## II. LITERATURE REVIEW

### What is MS?

MS is a degenerative, neurological disease of the brain and spinal cord. It involves progressive destruction of myelin sheaths, the protective tissue surrounding the nerves in the central nervous system. As the protective myelin sheath is destroyed, nerve impulses are interrupted, misinterpreted, or not transmitted at all. Early destruction of the myelin sheath regenerates; over time, however, a scar develops and the nervous tissue is permanently damaged. As more scar tissue develops, more nerve impulses are affected and functional abilities are diminished (Tortora & Grabowski, 1996). Like other immuno-mediated diseases, females are affected more frequently than males (1.4 to 3.1 times as many women than men are affected (Canada, 2004)). Unfortunately, the cause of the disease is unknown and there are no known cures.

### MS Symptoms

*Physical Symptoms:* Each MS patient experiences a different level of neurological dysfunction, typically leading to decreased mobility or even paralysis. Nervous malfunctions may be chronic or sporadic; common symptoms include weakness, numbness, blurred vision, pain, muscular spasm and fatigue, bladder and bowel dysfunction, sexual dysfunction, gait disturbance, difficulty speaking and vertigo (Minden & Frankel, 1992; Sutherland & Anderson, 2001).

*Psychological Symptoms & Quality of Life:* Increased occurrences of fatigue (85% of population) and depression are highly associated in people with MS (Lawler & Hopker, 2001; Schreurs et al., 2002; Voss et al., 2002). Furthermore, people with MS experience a poorer quality of life when compared to the general population (Sutherland

& Anderson, 2001; Sutherland et al., 2001). Specifically, MS patients have been shown to have markedly lower mean scores on all quality of life dimensions including, physical functioning (daily self-care activities to vigorous activity), role functioning (extent to which poor physical and emotional health interfere in daily life), bodily pain (frequency and daily interference), general health (feeling well), vitality (perceived energy), and the extent to which poor health interferes with social activities, role emotional (Nortvedt, Riise, Myhr, & Nyland, 1999).

### **Benefits of PA in MS Patients**

Until recently, people living with MS were told to avoid physical exertion because they often suffer from excessive fatigue and thermosensitivity, both of which get worse with increased PA. Fortunately for the patients, however, researchers have begun to show that PA may in fact be one type of intervention that can be used to alleviate physical and psychological symptoms. Indeed, preliminary studies revealed that people with MS receive some, if not all, of the same benefits as the normative population (DeBolt & McCubbin, 2004; Kasser & Stuart, 2001; Petajan et al., 1996; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Ponichtera-Mulcare, 1992; Stuifbergen & Roberts, 1997; Svensson, Gerdle, & Elert, 1994). In fact, only 8% of people with MS that participated in regular PA reported PA as ineffective (Archibald et al., 1994). Furthermore, most MS patients find exacerbated symptoms diminish within an hour of activity (Petajan & White, 1999).

*PA and Physical Symptoms:* The few studies that have examined the effects of PA on physical symptoms indicate that it improves various physical domains. For example, participants in a 15-week aerobic training program experienced increased aerobic

capacity, increased upper and lower extremity strength, and significant improvement in renal and bowel function (Petajan et al., 1996). Furthermore, an 8-week resistance training program improved muscular power in adults with MS (DeBolt & McCubbin, 2004) whereas muscular endurance training over a 6 and 8 week period improved muscular performance (DeBolt & McCubbin, 2004; Ponichtera-Mulcare, 1992; Svensson et al., 1994). Although these findings are preliminary in nature, they provide support that PA may benefit MS patients' physical symptoms.

*Psychological Symptoms & Quality of Life:* The psychological benefits to individuals with MS have only been recently recognized. Here, one study showed that MS patients who engaged in regular PA experienced improved vigor and psychological well-being (Stuifbergen, Becker, Blozis, Timmerman, & Kullberg, 2003). Another study showed that participation in a 15-week aerobic training program was highly associated with decreased depression and anger and better quality of life compared to the non-exercise group (Gappmaier et al., 1994; Kasser & Stuart, 2001; Petajan et al., 1996; Svensson et al., 1994). Furthermore, Sutherland et al. (2001) examined the influence of a 10-week aerobic aquatic program on quality of life in people with MS. Post-treatment, the intervention group had increased energy, vigor, social and sexual functioning as well as decreased pain and fatigue. Therefore, as with physical symptoms and PA studies, the present research findings are promising from a psychological / quality of life perspective.

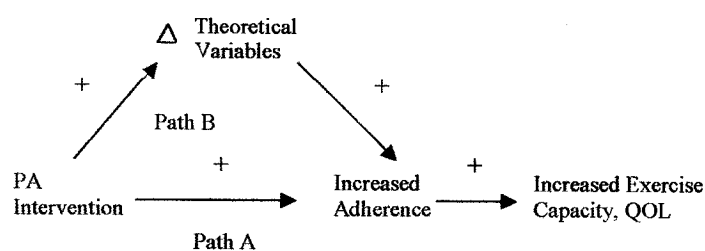
### **Prevalence of PA in MS Patients**

Despite the benefits associated with PA in MS patients, their PA levels are lower compared to the normative population (Petajan & White, 1999; Stuifbergen & Roberts, 1997). Specifically, results in a community-dwelling MS population revealed that only

37% performed stretching exercises 3 times a week; 35% got exercise during daily activities; 22% participated in light/moderate PA; and only 19% took part in leisure time activity (Stuifbergen & Roberts, 1997). Additionally, multiple studies have illustrated that most women with MS do not engage in PA on a daily basis (Stuifbergen et al., 2003; Stuifbergen & Roberts, 1997). In fact, PA is the least participated of all daily activities (Stuifbergen & Roberts, 1997). Additionally, a very small number of women with MS (37%) even intend to engage in PA on a daily basis (Stuifbergen & Roberts, 1997). In general, as the degree of disability increased, the level of activity decreased.

### Need for Theory

Although preliminary findings have shown PA to be beneficial to people with MS, this will only occur if the patients engage in PA. Given that the prevalence of PA is an issue in this population, there is a need to identify physical activity correlates for people with MS, so a PA intervention may be developed to help alleviate the problem. Baranowski et al. (1998), found that PA interventions were most effective when predictors of PA were identified and interventions aimed at altering those predictors were implemented. In other words, a PA intervention should be developed based on a mediational framework (See figure 1). Within this framework, social cognitive theory is one conceptual approach useful for understanding human behaviour that incorporates influential mediating variables that



**Figure 1.** Mediation Model

should be the focus of a PA intervention (i.e., the intervention should not only focus on PA adherence) (Baranowski et al., 1998). For example, using this approach, the MS PA intervention could be designed to increase PA adherence via (1) a PA prescription (i.e., path A), and (2) by increasing the patient's self-efficacy (i.e., their confidence that they can comply with their PA prescription: path B). In doing so, it is hypothesized that a positive change in the patient's self-efficacy (i.e., the theoretical variable in Figure 1) will lead to greater PA adherence and a subsequent increase in exercise capacity, muscular strength, psychological health and overall quality of life (e.g., decreased depression and anxiety).

### **Social Cognitive Theory**

As previously stated, social cognitive theory was the chosen theory to use within this mediational framework as it was the most appropriate model for the population being studied. Through deductive reasoning several other theories were ruled out as they had major constructs that were not applicable to the MS population. For example, a major construct in the theory of planned behavior (TPB) is subjective norm (Carron, 2003). Subjective norm encompasses the perceived social pressures that individuals feel to perform certain behaviors (Carron, 2003). For people living with MS, PA is a relatively new concept and is just being introduced in this population, therefore, previous expectations have not been formed and the concept of subjective norm does not apply to this population. Another model that was eliminated was the transtheoretical model (TTM). A major contribution to this model is the stages of change construct (Carron, 2003). Again, due to the novelty of PA in this population, one would hypothesize that

most individuals are in the pre-contemplation stage. As a result, findings may be skewed and the model would therefore be less effective than social cognitive theory. Social cognitive theory was adapted from social learning theory in an attempt to better understand human behavior (Grusec, 1992). Social cognitive theory is a model to explain the development of skill and regulation of activity. Bandura assumed that individuals are capable of identifying, analyzing and reflecting on behaviours, observational learning, self-regulation and anticipating expected outcomes (Bandura, 1986). He posits that the influence to perform behaviour varies depending on a number of factors known as context. Self-efficacy (i.e., the belief that one has the capability to perform a behaviour) is the primary influence in predicting behaviour, and is determined by past experience, modeling, social support and physiological/mood state.

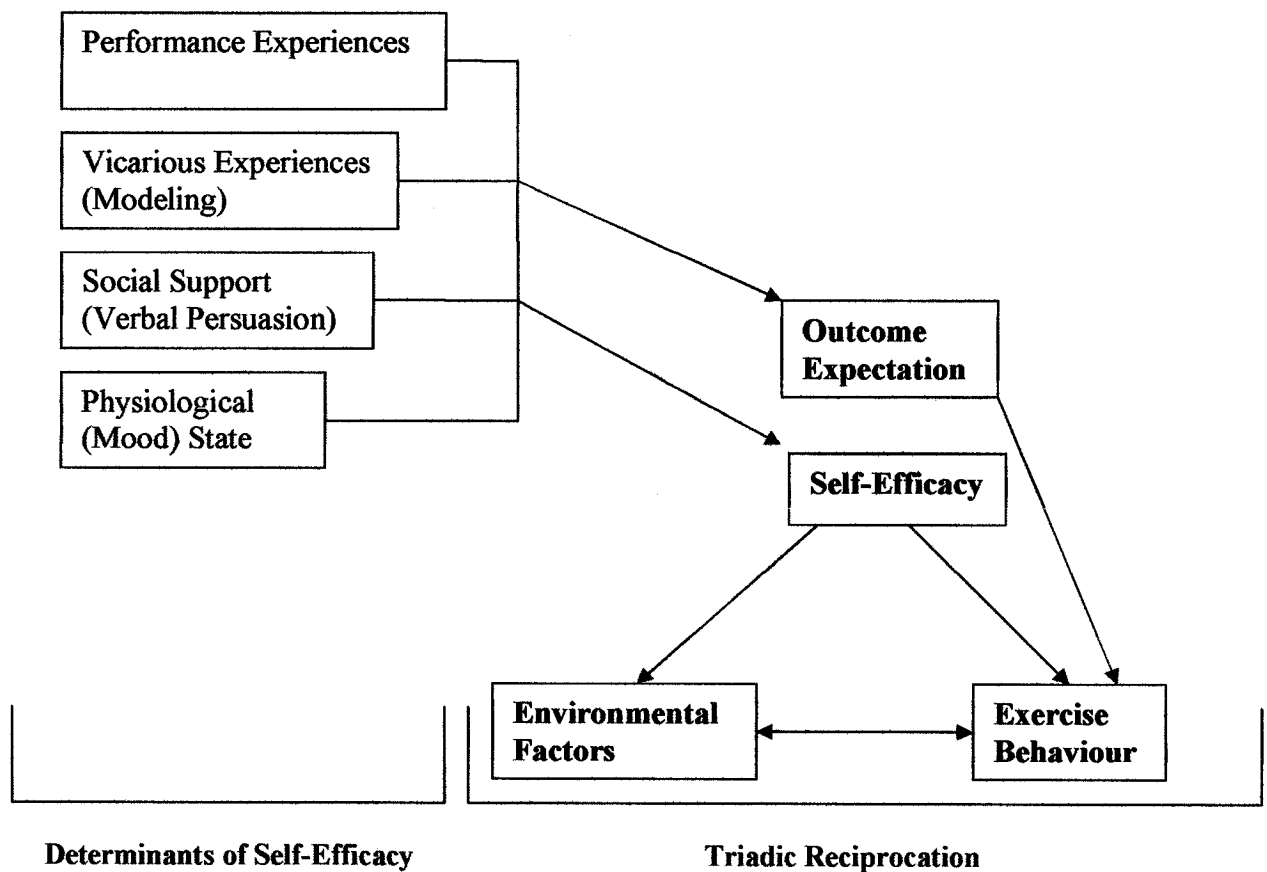


Figure 2. – Adapted from Sources of Self-Efficacy (Bandura 1997)

(Bandura, 1997). An outcome expectation is an individual's belief that performing a behavior will yield specific consequences and are generated from the same sources as self-efficacy and can also influence behavior (Bandura, 1977). Environmental factors, such as facilities, equipment and access also influence behaviour. Reciprocally, behaviour may influence environmental factors and self-efficacy (see figure 2). The theory is described in more detail below.

**Reciprocal Determinism:** Triadic reciprocal causation is the theory that three elements of social cognitive theory (i.e. self-efficacy/outcome expectation, environmental factors and behaviour) do not directly predict each other, but rather all influence one

another (see figure 2). The influence of each variable is not equal and will vary by activity and circumstance (Bandura, 1997). Interactions of the individual with the environment are influenced by cognitions and belief about ability and self-regulation. For example, consider a daily walk an individual with MS may take in his/her neighborhood. Grass walking paths may be perceived as intimidating or unsafe and therefore be considered a negative environment factor; this may cause PA levels and self-efficacy to decrease. After several successful sessions of walking these paths, however, the individual may have increased self-efficacy for this task, may perceive the same areas aesthetically pleasing, and may actually increase their number of walks.

***Self-Efficacy:*** Self-efficacy is the belief that one has the personal capability to carry out a certain behavior (Bandura, 1997). The more self-efficacy an individual has for a certain behaviour, the more likely he/she is to perform that behaviour. Self-efficacy is not a constant trait; it changes over time and in each particular circumstance. An important issue to consider when examining self-efficacy is the difference between task efficacy and barrier efficacy. Task self-efficacy is the confidence in one's ability to perform the elemental aspects of a task (Maddux, 1995). For example, consider an individual living with MS that has limited mobility (uses a cane for mobility) and attends an aerobic aquatic's class. If this individual is confident he/she can perform the exercises in the aquatics class, he/she will have high task efficacy for performing the exercises in the aerobic swimming class. Barrier efficacy, in contrast, is the confidence that one can perform a particular task under challenging conditions (Blanchard, Rodgers, Courneya, Daub, & Knapik, 2002). For example, the individual is confident that he/she can perform the pool exercises even when he/she is tired, has no transportation, etc. Barrier efficacy

has also consistently been shown to predict exercise adherence ( McAuley, 1992; Blanchard, Rodgers, Courneya, Daub, & Black, 2002).

***Outcome Expectations (OE):*** Outcome expectations are one's beliefs that performing a certain behavior will result in specific consequences (Bandura, 1977). For example, an individual may believe that exercising regularly will result in better physical fitness. Together with self-efficacy, outcome expectations increase the likelihood of an individual to perform a task. Although self-efficacy plays a more influential role in behavior (Bandura, 1977; Conn, 1998; Lau-Walker, 2004), outcome expectation can also influence behavior. Outcome expectations change over time and are more or less important or defined depending on the individual or task (Marttila, Laitakari, Nupponen, Miilunpalo, & Paronen, 1998). Individuals consider social, psychological and physiological consequences when creating outcome expectations (Dzewaltowski, 1994) and are especially important in the early stages of behavior change (Marttila et al., 1998).

***Sources of Efficacy/Outcome Expectation:*** According to social cognitive theory, an individual's self-efficacy and outcome expectations are determined by four sources; 1) performance experience (i.e., past behaviour), 2) vicarious performance (i.e., observational learning), 3) verbal persuasion (i.e., social support) & 4) physiological/mood state.

***Performance (Mastery) Experiences:*** The most influential efficacy information is produced through an individual's previous experience. In fact, previous experience with behaviour is the most effective way to predict future outcomes and therefore, form outcome expectations (Bandura, 1986). This influence is fourfold. First, previous performance experience allows an individual to create a pre-existing knowledge base

concerning a behaviour, which determines their personal efficacy (Bandura, 1997). For example, consider the same individual mentioned previously. If the individual has performed the aquatics class successfully in the past, he/she will have higher self-efficacy for that behaviour under similar circumstances in the future; he/she will be confident in his/her ability to complete the class. The influence that each distinct performance provides as well as the self-bias an individual has in the cognitive processing of efficacy information is weakened as experience accumulates (Bandura & Locke, 2003).

Second, previous experience provides an individual with perception of task difficulty and contextual factors (Bandura & Locke, 2003). Past experience with a behaviour allows the individual to better assess the difficulty of the upcoming task based on the difficulty of previous tasks under similar circumstances. These circumstances are the context of the previous behaviour and may include factors such as mood, environmental factors, or barriers. For example, if the individual had previously completed the aquatic's class, despite a negative mood, he/she will more likely believe he/she can again while in a negative mood.

Third, previous experience with behaviour allows an individual to assess the personal effort expenditure required to successfully perform a task. The amount of effort required to perform a behaviour may determine an individual's capability and in turn influence self-efficacy (Bandura, 1997). For example, if an individual completes the class and perceives his/her effort as submaximal, he/she will have increased efficacy for completion of that class again.

Last, past experience allows an individual to selectively self-monitor his/her performances and influences. Previous successes or failures may be attributed to certain

factors and may be controlled in future efforts (Bandura, 1997). For example, if the individual could not complete the class on a certain day and the failure is attributed to warm pool temperature (many individuals with MS experience thermosensitivity), the individual may retain efficacy for the class if that variable is controlled.

These four factors also help the individual to form outcome expectations. Previous knowledge about the task itself, the difficulty, contextual factors and individual effort required to perform the task, as well as possible external influences all help in generating a realistic, more accurate outcome expectation for the individual (Bandura, 1986). For example, an individual participating in the aquatics class for several weeks may expect to be fatigued and have exacerbated symptoms in the hours following the aquatic's session, while an individual attending the class for the first time may not expect any negative reaction. The individual with more past experience has a more realistic, more accurate outcome expectation in this case.

*Modeling (Vicarious Experience or Observational Learning):* Most behaviours do not have an absolute measure of adequacy, therefore, performance outcomes are compared to others (Bandura, 1997). Vicarious experience is the behavior of others (model) that serves as a reference for one's own personal capabilities (Bandura, 1997). This influence on self-efficacy and outcome expectations may be positive or detrimental depending on the performance result. The effectiveness of modeling depends on four factors. First, attribute similarity is the similarity of personal characteristics such as the age and gender between the model and observer. The more comparable the two are, the stronger the influence of the observational learning (Bandura, 1997). For example, if the individual observed another person with MS of similar age and gender participating in

the aquatic's class, efficacy may be potentially increased. Second, the closer the model and observer's capabilities are in a given behaviour, the stronger the influence; this is performance similarity. In the MS population, if the model had similar symptoms and progression of the disease to the observer, there may be a stronger influence on self-efficacy. Third, diversity of modeling influences its effectiveness. For example, observing many people of similar status successfully performing a task can increase self-efficacy. Participating in the aquatic's class with other people with MS may increase the individual's self-efficacy. Finally, the competence of the model may influence modeling effectiveness. Although personal experiences remain a greater influence, highly competent models exert greater influence on the observer than those perceived less competent (Bandura, 1997). Caution must be taken, however, in obtaining models that are too skilled. Individuals who overestimate their confidence prior to attempting a skill and fail may experience detrimental loss to their self-efficacy to acquire that skill (Schunk & Hanson, 1989).

Outcome expectations are influenced by vicarious experience in the same manner as self-efficacy (Bandura, 1986). For example, a person with MS who has witnessed several other competent individuals with MS, with similar capabilities, successfully complete the class may have a more accurate and positive outcome expectation than an individual who has not. Although, not as influential as past personal experience, vicarious experiences may serve as a useful tool in increasing self-efficacy and outcome expectation.

*Verbal Persuasion (Social Support):* Verbal persuasion is providing individuals with feedback expressing faith in their ability to perform a certain behaviour (Bandura,

1997). Verbal persuasion alone has a weak influence on self-efficacy; however, it is a useful tool utilized with other sources of self-efficacy (Bandura, 1997). The effectiveness of verbal persuasion is determined by the framework of the feedback, credibility of the persuader, and appraisal disparity. During the mastery of a skill, feedback may be structured in two ways. Positive feedback focuses on performance gains and is more effective than negative feedback, which concentrates on performance shortfalls. In other words, how self-efficacy is influenced depends on whether an individual is criticized for his/her failures (Bandura, 1986). For example, if the individual in the aquatics class was praised for his/her successes, his/her efficacy would improve; if he/she was criticized for his/her failures, his/her efficacy would decrease. The credibility and knowledgeableness of the persuader also determines the effectiveness of the persuasion. The more knowledge and experience the persuader possesses, the more credible and influential the feedback is to the observer (Bandura, 1986). For example, feedback from an educated health specialist conducting the aquatic's class may have greater impact on self-efficacy than feedback from a peer participant. Finally, the greater the disparities of the appraisal given to the observer from his/her own capability beliefs, the less likely he/she is to be influenced. If there is a very large discrepancy between the observer's and persuader's belief of ability, the influence of the persuader is likely to be lost (Bandura, 1986). For example, if the persuader suggested to the individual performing the class daily instead of twice/week and the individual had no doubt he/she would become too fatigued, the verbal persuasion will not have great influence.

Verbal persuasion also influences the generation of outcome expectations. Similar to self-efficacy, the effectiveness of verbal persuasion on outcome expectations

are determined by the framework of the feedback, credibility of the persuader, and appraisal disparity (Bandura, 1986). Positive or negative outcome expectations may be generated depending on the framework of the feedback. For example, if a participant in the aquatic's class expressed the physical benefits he/she experienced from the class (i.e., full range of motion and maintaining muscle tone) and the great sense of accomplishment he/she gained by participating, other individuals may expect positive outcomes from their participation. In contrast, if the participant focuses on the fatigue and pain experienced as a result of the class, the same individual may form a negative outcome expectation in regards to the same class. The effectiveness of verbal persuasion also depends on appraisal disparity and the credibility of the source (Bandura, 1986). For example, support from another individual with MS with similar levels of disability, which has participated in the class, would have a much greater influence on the generation of outcome expectations than support from a healthy individual that has not participated.

*Physiological Arousal (Mood State):* Individuals rely on physiological information in judging their performance abilities. Physiological arousal may positively or negatively influence self-efficacy or outcome expectation acquisition depending on the perceived source (construal efficacy bias) and level of activation (current mood state) (Bandura, 1989). Perceived source of physiological activation often depends on contextual factors. For example, sweating and an increased heart rate may be perceived as a nervous reaction and seen as negative feedback. However, the same symptoms may be perceived as preparing the body for anticipated activity and seen as positive feedback, thus enhancing personal efficacy. Similarly, level of arousal may be perceived positively or negatively. The intensity of arousal must be comparable to the intensity of the

environmental context in order for self-efficacy or outcome expectation to be enhanced (Bandura, 1986). In the context of the previous example, if the individual in the aquatic's class experienced shortness of breath throughout the class, it might be perceived in two ways. First, if the individual perceived the symptom as a normal indication of PA, the sign will not decrease self-efficacy. Outcome expectation may increase if the individual perceives the symptom as his/her being physically trained. If the symptom is perceived as premature fatigue that is not normal, however, his/her self-efficacy may be decreased and a new, more negative outcome expectation may be formed.

Mood state contributes to assessing personal efficacy as well. As quality of functioning is affected by mood, mood state provides affective information for judgment of personal efficacy. Mood states can bias attention and affect how events are interpreted, cognitively organized, and retrieved from memory (Bandura, 1997). Positive or negative mood can affect which variables individuals retrieve from a situation. A low emotional mood state may cause an individual to focus on failures or negative consequences during behaviour. A positive mood state, in contrast, may influence an individual to focus attention on successes and positive elements of an activity. Mood state also affects how past behaviours are retrieved from memory. People recall events more easily in similar moods as when the event originally occurred (Bandura, 1997). For example, skills performed during an aquatic's class in a pleasant mood state will be recalled more readily in a pleasant mood state. The reverse is also true; aquatic's classes performed during negative mood states will be recalled more readily in negative mood states. The same holds true for outcome expectations. For example, outcome expectations generated in a positive mood state will be more easily recalled in a similar

mood state and vice versa (Bandura, 1986). Intensity of mood also affects self-efficacy and outcome expectations. The more intense the emotion, whether positive or negative, the more influence it will have on self-efficacy or outcome expectation (Bandura, 1997).

### ***Environmental Factors***

Granting research identifying environmental factors is accumulating, researchers agree that, “It is time to devote more investigative attention to policy and physical environmental variables that could lead to solutions to the inactivity epidemic... multiple aspects of the physical environment may influence many people’s PA on a daily basis, but more research is needed to define... environmental barriers” (p.208, Humpel, Owen, & Leslie, 2002; Sallis, Kraft, & Linton, 2002). Environment refers to an individual’s surrounding conditions and influences (Carron, Hausenblaus, & Estabrooks, 2003). Environmental factors include group variables such as class activities, accessibility to facilities and equipment and safe, convenient, aesthetically pleasing places to be physically active (Ball, Bauman, Leslie, & Owen, 2001). A meta-analysis conducted on environmental variables contributing to walking illustrated that aesthetic attributes, convenience and access to facilities and perception of traffic were the most influential factors in adherence to walking programs (Owen, Humpel, Leslie, Bauman, & Sallis, 2004) while Trost, Owen, Bauman, Sallis, and Brown (2002) found that poor weather and lack of facilities were primary environmental associated with PA behaviour.

Environmental factors play an important role in social cognitive theory. They directly influence self-efficacy, outcome expectations and PA behavior and reciprocally are influenced by the same variables (Bandura, 1977). For example, availability of facilities is a common, important environmental factor. An individual living with MS

may live in a neighborhood where there are very few facilities available, and as a result, may feel there is no safe place for her/him to be active. This introduces a barrier for the individual to overcome, thus potentially reducing barrier efficacy. It may also cause doubt as to the individual's ability to participate in PA at all, thus reducing task efficacy and outcome expectations. Physical activity levels may also be reduced due to lack of facilities or other environmental variables.

The opposite, however, is also true. Environmental factors may be influenced by other social-cognitive factors. For example, if several individuals with MS attended the same gym facility, and were observed having the same difficulties with the facility (i.e., wheelchair access), modifications may be made to the environment (i.e., ramp, modified equipment).

### ***Studies using Social Cognitive Theory***

Numerous studies have supported the utilization of social cognitive theory in the prediction of PA behavior. In fact, each component of the model, past experience, modeling, social support, physiological state, and environment can be associated with increased self-efficacy, outcome expectation and PA.

To date, research has consistently shown that task efficacy and barrier efficacy are associated with PA in non-diseased (Everman, Hertz, Petosa, & Suminski, 2004; McAuley & Blissmer, 2000; Motl et al., 2002; Wilcox & Storandt, 1996; Winters et al., 2003) and chronic diseased (Blanchard et al., 2002; Conn, 1998; Maddison & Prapavessis, 2004; McAuley, 1993; McAuley et al., 2003; Oliver & Cronan, 2002) populations. Several studies have also shown outcome expectation to be predictive of PA, especially in older populations (Clark, 1999; Harnirattisai & Johnson, 2005; Resnick,

2001; Resnick et al., 2000). Marttila et al. (1998) found that behavioral change in PA may be more influenced by outcome expectation than many other behaviors. They suggest that PA serves as the ideal platform to emphasize outcome expectations as the benefits of physical activity are so well documented.

This has also been the case for the self-efficacy sources. Many studies have shown that PA is positively associated with social support (Bourdeaudhuij & Sallis, 2001; Everman et al., 2004; Ievers-Landis et al., 2003; Wallace et al., 2000), past behaviour (McAuley, 1992), modeling (McAuley, 1985) and mood (Bozoian, Rejeski, & McAuley, 1994; McAuley, Bane, & Mihalko, 1995) in non-diseased and diseased populations. Granting that self-efficacy has been found to exert much greater influence on PA (Conn, 1998) and has been more widely studied, outcome expectation has been also been shown to be associated with PA (Conn, 1998; Resnick, 2001; Resnick et al., 2000; Rodgers et al., 2002). Finally, research has shown that several environmental variables (aesthetics, safety, accessibility) have been associated with increased PA (Ball et al., 2001; Humpel et al., 2002; Owen et al., 2004). Therefore, it appears that social cognitive theory is a viable framework to use in explaining PA in MS patients. As such, this will be the first study to do so, which will provide invaluable insight into the development of future PA interventions for MS populations.

All social cognitive variables were measured in this study, with the exception of past PA experience. This is due to the fact that past behaviour can not be modified unlike the remaining self-efficacy sources. Nonetheless, it is acknowledged that this is a limitation of the study.

### *Purpose of the Present Study*

Multiple sclerosis is a debilitating neurological disease with few successful symptom alleviating interventions available to the MS population. Preliminary research has shown that PA may aid in alleviating both psychological and physical symptoms; thus, improving overall quality of life. In order to develop an effective intervention, correlates of PA must be identified for the MS population. Social cognitive theory is a useful tool that has been shown to effectively predict PA behaviour. By applying this model to the MS population, key influences on PA may be identified to inform the development of an efficacious PA intervention. The present study attempted to do so by having MS patients complete a social cognitive theory survey, after which they were followed for a 1-month period. Given the preliminary nature of the study, a 1-month time frame was chosen to maximize the variance explained in PA given the importance placed on time in social cognitive theory. Based on social cognitive theory, it was hypothesized that;

- 1) barrier efficacy, task efficacy and outcome expectation would predict PA.
- 2) social support, modeling, mood, and environment would predict PA.
- 3) barrier efficacy, task efficacy, and outcome expectation would mediate the social support, modeling, mood, and environment/PA relationships.

### III. METHODOLOGY

#### PILOT STUDY

A pilot study was conducted prior to the main study in order to generate possible barriers, sources of social support and outcome expectations specific to the MS population (*see Appendix K*).

#### *Participants*

Nine individuals with MS, all members of the Carleton Place support group, comprised the sample. Individuals in attendance were local residents living with MS who formed a group to discuss ongoing MS issues and to give and receive support.

#### *Measures*

*Pilot Study Questionnaire (see Appendix A)*: A brief 6-item questionnaire was administered. Questions were aimed at identifying potential outcome expectations, sources of social support, and possible barriers to PA. The six questions were asked as follows: 1) What do you perceive to be the advantages of PA? 2) What do you perceive to be the disadvantages of PA? 3) Who are the people in your life that provide social support to you? 4) Are there non-supportive people in your life? 5) What prevents you from participating in PA? and 6) What makes it easier for you to participate in PA? All responses were open-ended.

#### *Procedure*

Through personal contacts, the Carleton Place MS support group was approached for participant recruitment. After obtaining permission, I attended a support group meeting prior to beginning the main data collection of the study. The meeting was held May 20, 2004 in a community centre in Carleton Place, ON. The group was given a

verbal briefing of the upcoming study and the purpose of the pilot study. The entire group of nine agreed to complete the extremely brief, six-question pilot study questionnaire aimed at identifying possible outcome expectations, sources of social support and barriers to PA. Participants were given as much time as needed to complete the six open-ended questions. Upon completion of the questionnaire, responses were anonymously collected and the group was thanked for participating. At that time, each individual in the group signed a support letter, encouraging further work in my study and this area of research.

### ***Analysis & Results***

Responses from this questionnaire were not statistically analyzed but rather, served to develop the outcome expectancy measure and modify existing questionnaires to more appropriately query individuals with MS during the baseline assessment. Responses were categorized and frequencies were summarized. The most common, relevant responses were used in the baseline questionnaire.

Participants generated nine possible outcome expectations of participating in physical activity: improved/maintained muscle strength (6 responses), improved mental health (4), decreased energy (4), improved energy (3), alleviated spasticity (2), a gained a sense of accomplishment (2), improvement in overall health (2), improved balance (2), and frustration (1). After combining decreased and increased energy responses, eight, responses were used to generate an outcome expectation scale for the baseline questionnaire.

Participants identified five possible sources of social support: family (7), friends (5), MS support group (3), co-workers (1), and doctors (1). Family and friends were cited as the primary source of social support for these individuals and very few cited

negative/non-supportive influences in their lives. Therefore, Sallis' Social Support & Exercise Survey (Sallis, 1986) would identify relevant sources of social support and did not require modification.

Participants were asked to identify potential barriers to participating in PA. Five potential barriers were identified: fatigue (5), physical functioning (3), pain (2), heat (1) and lack of motivation (1). These barriers were used to generate the barrier efficacy scale for the baseline questionnaire. When participants were asked what aided them in PA participation, the responses were much more personalized and variable; responses were: access to facilities (3), attitude (2), scheduling (2) good health (2), social support from friends (1) and an aesthetically pleasing environment (1). The most common responses were then implemented into the barrier efficacy scale.

## **MAIN STUDY**

### ***Participants***

The average participant was about 50 years of age with approximately 2 children. The average BMI was 26.25 (slightly overweight) and the MS had been diagnosed, on average 11.08 years prior with the majority reporting a relapsing-remitting diagnosis. Sixty-seven percent of participants were married, most were not working (72.3%) and required some kind of aid for mobility (67.1%). About half of the participants (51.3%) had an education below the university level; nonetheless, 48.8% of participants maintained an annual family income of higher than \$60 000. Complete results are displayed in Table 1.

Table 1. - Descriptive Summary of Demographic Information

DEMOGRAPHIC	MEAN/PERCENTAGE	STANDARD DEVIATION
Age	50.58	10.36
# of children	1.85	1.26
# child/home	.79	.990
BMI	26.25	4.49
Years Since Diagnosis	11.08	8.97
Marital Status		
- <i>married</i>	67.1	
- <i>not married</i>	32.8	
Education		
- <i>university graduate or ↑</i>	47.3	
- <i>some university or ↓</i>	51.3	
Annual Family Income		
- <i>≥ \$60 000</i>	48.8	
- <i>&lt; \$60 000</i>	39.5	
Employment Status		
- <i>working</i>	27.6	
- <i>not working</i>	72.3	
MS Diagnosis		
- <i>relapsing-remitting</i>	51.3	
- <i>all others</i>	42.1	
Mobility		
- <i>independent</i>	32.9	
- <i>uses aid all the time</i>	67.1	

### **Measures**

*Task Efficacy Scale*(see Appendix B): This measure (McAuley, 1993) (7 questions) was designed to tap participants' efficacy with respect to continued exercise

participation in prescribed exercise regimens (at least three times per week for 40 min at light/moderate intensity) over incremental week periods for 4 weeks. Participants indicated their degree of confidence for each item on a 0% (no confidence at all) to 100% (complete confidence) scale. For example, I am able to continue to exercise three times per week at light/moderate intensity, for 40+ min without quitting for the next week. The confidence scores are summed and divided by the total number of items giving a possible range of 0-100%. This measure was based on the recommendations put forth by Bandura (1997). Reliability of the scale in this study was 0.99.

*Barrier Efficacy Scale (see Appendix C):* The barrier efficacy scale (McAuley, 1992) is a 13-item scale designed to measure participant's perceived capabilities to engage in PA in the face of commonly identified barriers to participation. A modified version of this scale was used with questions derived from the pilot study. Participants indicated their degree of confidence in overcoming each barrier on a 0% (no confidence at all) to 100% (complete confidence) scale. For example, I believe that I could exercise three times a week for the next four weeks even if: the weather was very bad. The confidence scores were summed and divided by the total number of items giving a possible range of 0-100%. Cronbach's alpha for this measure was 0.92 in the current study.

*Godin Leisure-Time Exercise Questionnaire (see Appendix D):* The Godin is a brief, three question survey used to assess self-reported PA. The questions identify the amount of strenuous, moderate and mild exercise an individual engages in, for at least fifteen minutes at a time, during a typical week. For example, during a typical 7-day period (a week), how many times on the average do you do strenuous exercise (i.e.,

running, basketball, hockey) for more than 15 minutes during your free time? The total leisure score index (LSI) was calculated by adding the frequency of PA in each category. This scale has been shown to be valid and reliable in previous studies (Jacobs, Ainsworth, Hartman, & Leon, 1993).

*Modeling Scale (see Appendix E):* The modeling scale is a 15-item instrument created specifically for this study. Participants indicated the influence of the observation of others being physically active on their own PA levels on a 4-point scale ranging from “strongly disagree” to “strongly agree”. For example, seeing my family being active makes me want to become active. Previous instruments have not been developed as the influence of modeling has not been examined in people living with MS. Responses from each modeling influence (family, friends and others with MS) were averaged to indicate the degree of influence attributed to that group. Due to the novelty of the scale, previous reliability scores were not available; however, Cronbach’s alpha was calculated to be 0.78 for all responses. Reliability for each subscale (modeling-family, modeling-friends and modeling-others) was calculated and Cronbach’s alpha was 0.54, 0.90 and 0.88 respectively. Due to the low reliability found for the modeling-family aggregate, these responses were not used in further analysis.

*Social Support and Exercise Survey (SSES) (see Appendix F):* The SSES (Sallis, 1986) is a 13 item scale measuring social support for PA. Questions examine the role of family and friends on PA participation. Participants indicated the frequency of the support from others by responding to questions on a 5-point scale ranging from “none” to “very often”. For example, during the past four weeks, my family: engaged in PA with me. Responses were scored according to survey protocol (Sallis, 1986). Sallis,

Grossman, Pinski, Patterson, and Nader (1987) reported reliability coefficients of 0.87 and 0.88 for family and friend support respectively. Similar scores were found in this study with reliability coefficients of 0.86 and 0.92 respectively.

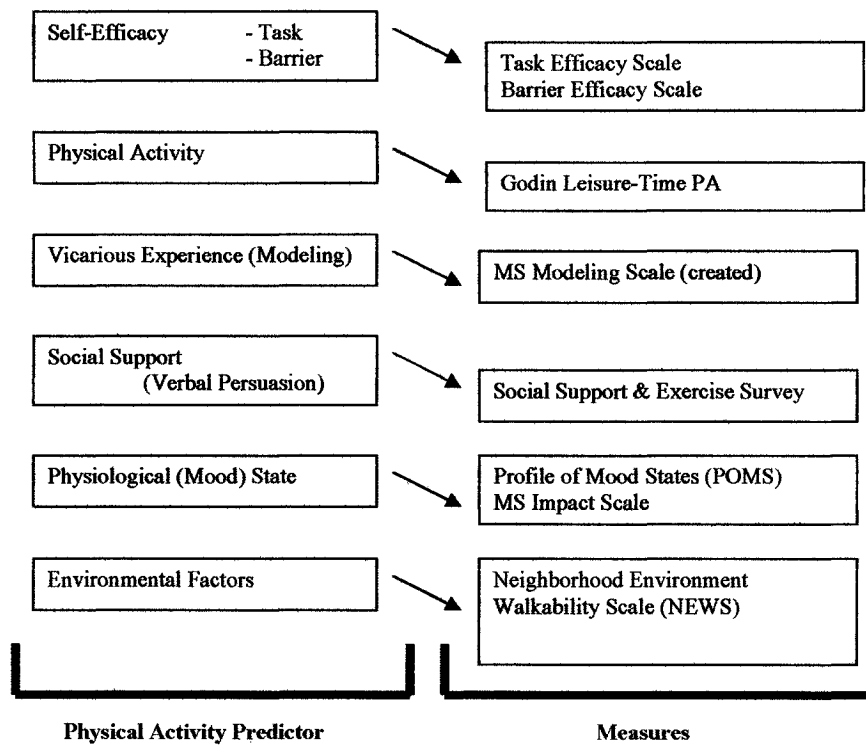
*Profile of Mood States (POMS (see Appendix G):* The POMS (Schacham, 1983) used in the current study was an abbreviated, 18-item version that included 3 subscales (e.g., anxiety, depression, and vigor). Participants were asked to indicate his/her response to various emotional states. A 5-point scale ranging from “not at all” to “extremely” indicated how strongly the participant had experienced each emotion (e.g., sad, grouchy, bushed). For example, during the past four weeks, I have felt: cheerful. This version has been shown to be valid and reliable in previous studies (Pronk, Crouse, & Rohack, 1995). Reliability for the 3 subscales in the current study was 0.91, 0.91, and 0.91 respectively.

*The Multiple Sclerosis Impact Scale (MSIS-29) (see Appendix H):* The MSIS-29 (Hobart, Lamping, Fitzpatrick, Riazi, & Thompson, 2001) is a 29-item (20 physical and 9 psychological) scale measuring the physiological and psychological impact of MS. For purposes of the current study, only the physiological impact items were measured. In essence, the scale indicates to what degree MS has impacted or interfered with the individual’s life. Questions identified the impact of common physical problems associated with MS. For example, in the past four weeks, how much have you been bothered by: problems with your balance. Participants rated the impact (frequency) of various symptoms by means of a 5-point scale ranging from “not at all to “extremely”. Responses were averaged to indicate the degree to which the individual was affected by MS in his/her daily life. The MSIS-29 has been found to be a reliable and valid instrument (Hobart et al., 2001). Reliability was excellent in the current study.

*Neighborhood Environment Walkability Scale (NEWS) (see Appendix I):* The NEWS (Sallis, 2002) is a brief, two section questionnaire that probes participants about their neighborhood (i.e., traffic, aesthetics, and pathways) and facilities. In section one, participants were asked to rate his/her responses on a 4-point scale (strongly disagree to strongly agree) to 12 statements about his/her home environment. For example, many shops, stores, markets or other places to buy things I need are within easy walking distance of my residence. Due to the variability of environmental factors (i.e., traffic, aesthetics, access), responses were not averaged or summed, rather, each response was correlated individually with PA to more precisely determine important environmental factors. Section two assessed the availability and utilization of facilities and equipment to participants. Thirteen commonly used facilities or pieces of equipment were rated for availability and frequency of use. For example, during the next four weeks, will you have access to weight lifting equipment in your residence? Responses for availability were summed to give an indication of access by the individual. This instrument was been found to be reliable and valid (Sallis, 2002) .

*Outcome Expectations (see Appendix J):* The outcome expectancy scale was a derived from the pilot study. Participants were asked to gauge their level of agreement or disagreement on a 7-point scale (strongly disagree to strongly agree). For example, if I engage in 40 minutes of exercise 3 times per week over four weeks, it will: maintain muscle strength and tone. Responses were summed and averaged. Due to the novelty of this measure, previous reliability had not been established. Reliability in this study was ensured.

*Demographics (see Appendix K):* Demographics were measured via self-report and included: age, sex, marital status, number of children, education, family income, height, weight, diagnosis and mobility.



**Figure 3.** Illustration of measures used in study

### ***Procedures***

Participants were recruited in two ways: 1) face to face contact at local MS Society information seminars; 2) at the Carleton Place MS support group (unaffiliated). The first MS society information seminar was April 30, 2005 at the Colonnade Convention Centre where participants attended and received information on living with MS and depression. A table was set up outside the seminar where individuals who were

interested could approach and obtain information about the study. Forty-four participants consented to taking part in the study. The second seminar was June 4, 2005 at the same location. The seminar was on the subject of PA and the MS community. Forty-two participants consented to taking part in the study at this time.

I attended the Carleton Place MS support group meeting on May 20, 2005, where I briefly presented my study (pilot study participants) and recruited any individuals interested in participating.

At each recruitment session, participants were given a verbal briefing and description of the study, after which they were invited to participate in the study. For those who agreed to participate, they were asked to sign an informed consent. They then completed the battery of questionnaires that included; task and barrier efficacy scales, the MS modeling scale, the Social Support and Exercise Survey, Profile of Mood States, the MS Impact Scale, (i.e., physical impact of MS), the Neighborhood Environment Walkability Scale (NEWS), and demographic measures. Due to the length of the baseline assessment, participants completed the survey at home and mailed their responses in postal packages provided. One month following receipt of the baseline questionnaire, the research assistant telephoned each participant to administer the PA questionnaire (i.e., Godin Leisure-Time Exercise Questionnaire). This marked the end of participation in the study. Upon completion, the patients were debriefed, which entailed a conversation regarding the purpose of the study, answering any questions the patients had about the study in general, or their own responses to the questionnaire, and confirmation that the patients could get the results of the study upon completion.

### III. ANALYSIS & RESULTS

#### *Power Analysis*

Using G-power for power estimation with multiple regression ( $ES = .25$ ,  $\alpha = .05$ ,  $\beta = .80$ ) and ten predictors, a sample size of seventy-five participants was required. This analysis was conducted using seventy-six participants.

#### *Sample Recruitment*

All clinically diagnosed individuals with MS ( $\leq 80$  yrs) attending the Ottawa MS Seminar Series or Carleton Place MS support group meeting were eligible to participate. Throughout the 3 month recruitment period, ninety-six (73 women, 23 men) people were initially recruited to participate and given the baseline assessment package (questionnaire and consent form). Forty-four participants were recruited at the first seminar, forty-two participants at the second seminar and ten participants were recruited at the MS support group meeting. However, seventy-eight (62 women, 16 men) participants completed and returned baseline assessments thus, yielding an initial response rate of 81%. Three moved or changed their phone number; 13 people failed to return their baseline questionnaire; one dropped out due to poor English comprehension; and one individual left the study as they were no longer interested in participating. Two participants left the study due to illness. Therefore, the statistical analysis was run with complete data sets for seventy-six individuals.

#### *Variable Distribution*

Prior to the main regression analysis, several preliminary analyses were required. First, all variables were checked for normality. Skewness and kurtosis values were checked for all continuous variables ensuring all values fell in the acceptable range of  $\pm$

1.96 (Triola, Goodman, & Law, 1999). All values were normally distributed with the exception of scores for family participation (1.69, 3.98) and friend participation (2.21, 5.23) from the Social Support and Exercise Survey. Z-scores were calculated for these variables and any values with a corresponding z-score outside the  $\pm 3.29$  range were deleted (Triola et al., 1999). One, “family participation” score, and two, “friend participation” scores were deleted. Skewness and kurtosis were re-checked and scores were found to be normally distributed for “family participation” (1.18, 1.42). Normality scores for “friend participation” were very close to acceptable values (1.78, 2.19) and were used in further analysis.

### ***Demographic Confounders***

Next, several nominal demographic variables were recoded: marital status (0= not married; 1= married), education (0= some university or less; 1=university graduate or more), income (0= \$60 000 or less; 1= \$60 000 or more), employment (0= not working; 1= working), MS diagnosis (0= relapsing-remitting; 1= all others), and mobility (0= independent; 1= use aid at all times). Dichotomizing these demographics was necessary in order to run zero-order correlations with PA to check for potential confounders. Results from these correlations showed that no demographic variable was significantly correlated with PA scores after a Bonferroni correction was made (0.05/9) to avoid making type I error (see Table 2). Thus, there were no confounding variables.

**Table 2.** - Confounding Analysis – Demographics correlated with Physical Activity

DEMOGRAPHIC	Physical Activity	
	Correl	Sig
Age	-.050	.669
Gender	.118	.310
Marital Status	.026	.823
# of children	.148	.203
Children at home	.205	.078
Education	.236	.041
Income	.229	.062
Employment	.071	.541
BMI	-.143	.221
Years since diagnosis	.162	.164

**Note.**  $p < .01$  ( $p < .05/10 = .005$  – Bonferonni Correction)

### *Zero-Order Correlations*

To determine which social cognitive variables should be included in the main regression analysis, zero-order correlations were conducted between each variable and PA. From this analysis, seven variables were found to be significant: task efficacy ( $r = .42$ ;  $p < .01$ ), barrier efficacy ( $r = .44$ ;  $p < .01$ ), outcome expectation ( $r = .35$ ;  $p < .01$ ), social support from friends ( $r = .32$ ;  $p < .01$ ), influence of friends modeling ( $r = .23$ ;  $p < .05$ ), neighbourhood traffic ( $r = .25$ ;  $p < .01$ ), and home aerobic workout video/DVD ( $r = .28$ ;  $p < .01$ ). Therefore, these variables were included in the main regression analysis. See Table 3 for complete results.

**Table 3.** Zero-order correlations – Aggregates with Physical Activity

<i>Social Cognitive Variable</i>	<i>Physical Activity</i>
Anxiety – POMS	.039
Depression – POMS	-.122
Vigor – POMS	.168
Physical Impact – MSIMP	-.030
Psychological Impact – MSIMP	-.146
Social Support – Family	.197
Social Support – Friends	<b>.322**</b>
Modeling – Family	.061
Modeling – Friends	<b>.225*</b>
Modeling – Others with MS	-.052
Task Efficacy	<b>.424**</b>
Barrier Efficacy	<b>.442**</b>
Outcome Expectations	<b>.352**</b>

**Note.** \*\* $p < 0.01$ , \* $p < 0.05$ ; *POMS = Profile of Mood States*; *MSIMP = Multiple Sclerosis Impact Scale*

### ***Regression Analysis***

A hierarchical multiple regression analysis was performed using variables significantly correlated with PA (determined via the zero-order correlations). Four determinants of self-efficacy were used in block one of the regression (traffic, home aerobic video, support-friends and modeling-friends). The three proposed mediating influences of PA (task efficacy, barrier efficacy and outcome expectation) were entered in block two of the regression. The order of blocks was based on proximity to PA (Bandura, 1997).

Overall, the model accounted for 41% of the variance in PA. As can be seen from Table 4, block 1 accounted for 23% of the variance with traffic and modeling of friends making significant contributions to PA. Block 2 of the regression accounted for an additional 18% of variance with barrier efficacy ( $\beta = .250$ ;  $p < .05$ ) and outcome expectation ( $\beta = .211$ ;  $p < .05$ ) being significant predictors of PA. Complete regression results are illustrated in Table 4.

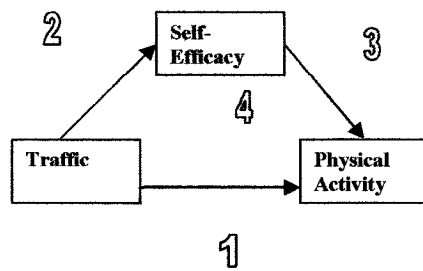
**Table 4.** Multiple regression results for significant predictors and physical activity

	<i>B</i> <sup>1</sup>	<i>B</i> <sup>2</sup>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> change
<b>Block 1</b>				
Difficult/traffic	<b>.267*</b>	<b>.229*</b>		
Aerobic video	.097	-.039		
SS – Friends	.204	.115		
Model – Friends	<b>.252*</b>	<b>.254**</b>	.229	<b>.229**</b>
<b>Block 2</b>				
Task Efficacy		.148		
Barrier Efficacy		<b>.250*</b>		
Outcome Expect.		<b>.211*</b>	.412	<b>.182***</b>

**Note.** \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; *SS* = social support

### **Mediation Analysis**

To determine if barrier efficacy and outcome expectations mediated the relationships between PA and traffic/modeling influence of friends, the Baron and Kenny (1986) procedure was used.



**Figure 4: Mediational Regression Analysis**

There were four steps to this regression (See figure 3). First, PA was regressed onto the predictor variable, in this example, traffic. Second, self-efficacy was regressed onto traffic. Third, PA was regressed onto self-efficacy. Assuming these values were found to be statistically significant, a fourth regression, PA onto traffic & self-efficacy was run in order to determine mediation. In order for mediation to occur, the standardized beta for the traffic/PA relationship in regression 4 needed to be smaller than the traffic/PA beta from regression 1.

Determinants of self-efficacy used were modeling-friends and traffic while SE measures used were barrier efficacy and outcome expectation. Complete results are shown in Table 5.

Table 5. Mediation Analysis Summary – Modeling-friends, barrier efficacy &amp; PA

<i>MODELING (FRIENDS)</i>	<i>BE</i>	<i>PA</i>
Regression #1) MODEL-Friends		.225*
Regression #2) MODEL- Friends	.206	—————→ <i>Stopped</i>
Regression #3) Barrier Efficacy		.442***
Regression #4) MODEL & Barrier Efficacy		.139 .413***

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; BE = barrier efficacy; PA = physical activity

Table 6. Mediation Analysis Summary – Modeling-friends, outcome expectations &amp; PA

<i>MODELING (FRIENDS)</i>	<i>OE</i>	<i>PA</i>
Regression #1) MODEL-Friends		.225*
Regression #2) MODEL-Friends	.349**	
Regression #3) Outcome Expectations		.352**
Regression #4) MODEL & Outcome Expectations		.116 .311**

Partial Mediating  
Effect

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; OE = outcome expectations; PA = physical activity

Table 7. Mediation Analysis Summary – Environment-traffic, barrier efficacy &amp; PA

<i>Environment - TRAFFIC</i>	<i>BE</i>	<i>PA</i>	
Regression #1) TRAFFIC		.253*	} <b>Partial Mediating Effect</b>
Regression #2) TRAFFIC	.303**		
Regression #3) Barrier Efficacy		.442***	
Regression #4) TRAFFIC &		.131	
Barrier Efficacy		.402***	

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; BE = barrier efficacy; PA = physical activity

Table 8. Mediation Analysis Summary – Environment-traffic, outcome expectations &amp; PA

<i>Environment - TRAFFIC</i>	<i>OE</i>	<i>PA</i>	
Regression #1) TRAFFIC		.253*	
Regression #2) TRAFFIC	-.003		→ <i>Stopped</i>
Regression #3) Outcome Expectations		.352**	
Regression #4) TRAFFIC &		.254*	
Outcome Expectations		.352**	

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; OE = outcome expectations; PA = physical activity

A mediating effect by outcome expectation was found on the modeling of friends/PA relationship. The modeling influence of friends significantly predicted PA ( $\beta = .25, p < .05$ ), and the mediating variable; outcome expectation ( $\beta = .21, p < .05$ ). Further, the relationship between modeling-friends and PA, when controlling for outcome expectation was non-significant. Therefore, individuals with a greater influence from the modeling of friends had significantly greater outcome expectations, which led to increased PA levels.

The traffic/PA relationship was also partially mediated by barrier efficacy. Traffic significantly predicted PA ( $\beta = .27, p < .05$ ) and the mediating variable; barrier efficacy ( $\beta = .25, p < .05$ ). The relationship between traffic and PA was non-significant when controlling for barrier efficacy. This indicates that decreased neighborhood traffic led to improved barrier efficacy, which in turn, led to increased PA.

### *Gender Differences*

Several gender differences were observed correlating social-cognitive variables to PA. Among male participants, several strong correlations were found: task efficacy ( $r = .65; p < .01$ ), barrier efficacy ( $r = .66; p < .01$ ), outcome expectation ( $r = .62; p < .01$ ), MS physical impact ( $r = -.52; p < .01$ ). Among female participants slightly different significant relationships were found: task efficacy ( $r = .39; p < .01$ ), barrier efficacy ( $r = .46; p < .01$ ), outcome expectation ( $r = .30; p < .01$ ), social support-friends ( $r = .36; p < .01$ ), traffic ( $r = .35; p < .01$ ).

#### IV. DISCUSSION

Social cognitive theory is a well supported theory that has been shown to explain and predict PA in diseased (Allen, 2004; Graves, 2003; Maddison & Prapavessis, 2004; Oliver & Cronan, 2002, 2005; Rogers et al., 2004; Rogers et al., 2005) and non-diseased populations (Everman et al., 2004; McAuley, 1992; Wallace et al., 2000; Winters et al., 2003). The purpose of this study was to identify the most influential correlates of PA in individuals living with MS. Therefore, this theory was chosen in an attempt to identify important social cognitive correlates in the MS population. Based on this theory, three main hypotheses were derived. The first was to determine if barrier efficacy, task efficacy and outcome expectation would predict PA. The second was to determine if social support, modeling, mood, and the environment predicted PA. Finally, it was hypothesized that barrier efficacy, task efficacy, and outcome expectation would mediate the social support, modeling, mood, and environment/PA relationships.

##### ***Barrier efficacy, task efficacy, outcome expectations and PA***

All three proposed mediating influences of physical activity were found to be significantly associated with PA, however, only barrier efficacy and outcome expectation were found to be predictive of PA in the MS population.

##### ***Barrier Efficacy & PA***

As anticipated, barrier efficacy was predictive of PA in this MS sample; the more barrier efficacy an MS patient had, the more likely he/she was to engage in PA. This is in line with previous studies that found barrier efficacy to be associated with PA in diseased (Allen, 2004; Blanchard, Rodgers, Courneya, Daub, & Knapik, 2002; Maddison & Prapavessis, 2004; Oliver & Cronan, 2002) and non-diseased (Conn, 1998; Everman et

al., 2004; McAuley, 1992, 1993; McAuley et al., 2003; Motl et al., 2002; Winters et al., 2003) populations. Therefore, the results of this study further supported the importance of considering potential barriers when designing new PA interventions in MS patients.

Since the presence of barriers or low barrier efficacy may directly influence a decrease in PA levels, great consideration should be taken in designing PA programs for this population that may pose barriers. This may be particularly important for the MS population given that the mean barrier efficacy score for this sample was an astonishingly low 44%. Health professionals must ensure PA programs for individuals with MS are thoroughly examined for possible barriers to activity so they may be eliminated or appropriate modifications can be made to overcome those barriers.

#### *Task Efficacy & PA*

Contrary to the first hypothesis, task efficacy was not predictive of PA in this MS population, which contradicted previous research in diseased (Allen, 2004; Maddison & Prapavessis, 2004; Oliver & Cronan, 2002) and non-diseased (Conn, 1998; Conn et al., 2003; Everman et al., 2004; McAuley, 1992, 1993; McAuley & Blissmer, 2000; Motl et al., 2002; Rodgers et al., 2002; Winters et al., 2003) samples. However, task efficacy did have a zero-order relationship with PA. It simply disappeared when considered in conjunction with barrier efficacy and outcome expectations in the regression equation.

A possible explanation for this discrepancy across studies was the instrument used to measure task efficacy for this population. Participants were asked to rate their confidence in participating in forty minutes of activity, three days per week, over a one-month time frame. Due to the unpredictable nature of the disease (Poser & Brinar, 2002; Solari & Radice, 2001; Stuifbergen et al., 2003) and severity of disability experienced by

some of the participants, it may be difficult to give accurate responses to this survey. MS symptoms may fluctuate drastically from day to day or week to week, thus, making it difficult for a participant to confidently predict his/her symptoms or physical capabilities over a four week period. Nonetheless, task efficacy may not need to be considered when developing a PA intervention for MS patients.

#### *Outcome Expectations & PA*

A novel finding of the current study was that outcome expectations significantly predicted PA in MS patients, which was consistent with previous studies in non-diseased populations (Clark, 1999; Conn et al., 2003; Harnirattisai & Johnson, 2005; McAuley et al., 1995; Winters et al., 2003). Results from the current study indicated that the MS population had already formed strong, positive outcome expectations about PA. This MS sample agreed with the benefits brought about by PA (scored 5.9 of a possible 7). This indicates that the MS population, although poor at participating in PA, is well educated on the subject of PA.

The significance of this finding in the MS population, along with the support of previously conducted studies, must be taken into account when designing PA programs for the MS population. Since MS patients are already aware of the benefits of PA, health professionals should ensure PA interventions are designed to produce results matching these expectations. Although explaining the benefits of PA and dangers of sedentary lifestyle are important to convey, it may be more effective in this population to demonstrate to participants how the intervention would produce results in line with previously formed outcome expectations. In other words, rather than emphasizing the benefits of PA, which this population already strongly agrees with, focus on forming

strong, positive outcome expectations regarding the intervention. Since outcome expectations are predictive of PA, allowing participants to form positive outcome expectations about the intervention, prior to implementation, may result in greater adherence to the program and result in increased PA levels.

### *Social support, modeling, mood, environment and PA*

The second purpose of the study was to examine the predictive ability of self-efficacy sources (i.e., social support, modeling, mood and environment) on PA.

#### *Social Support*

In this MS sample, social support, specifically the support received from friends, was associated with PA. On the other hand, social support received from family was not predictive of PA for this population, which is somewhat surprising. Given that 67% of participants were married and 82% had children, one might anticipate the amount and influence of social support from family members to be especially prominent in this population.

One possible explanation for the discrepancy in findings with social support (family) could be the weak reliability of the instrument used to measure social support; Cronbach's alpha for the family aggregate of social support was .54 in this study. Therefore it is possible that, if re-tested, the same population may yield different results.

The findings from social support (friends) is consistent with previous findings where social support was found to be associated with PA in a variety of populations (Booth, Owen, Bauman, Clavist, & Leslie, 2000; Everman et al., 2004; Ievers-Landis et al., 2003; Trost et al., 2002), especially women (Trost et al., 2002; Wieslander, Baigi,

Turesson, & Fridlund, 2005). As such, social support from friends should be incorporated into a PA intervention for this population. This could be done by incorporating social support systems into the PA intervention. For example, MS support groups could be encouraged to participate in PA as a group, thus making an otherwise daunting task, an enjoyable, social gathering. Another social support intervention could include a “buddy system” where MS patients with similar capabilities and goals could participate together. The pair could provide a constant source of support to each other and team goals could be set to motivate the individuals. Another possible way to incorporate social support is to implement a telephone counseling system. MS volunteers could contact MS patients in the convenience of their home and still convey important information and support. This may be an affordable, effective and manageable way to provide continuous professional support to MS patients.

### *Modeling*

Vicarious experience or modeling was also found to be predictive of PA in the MS population. However, only the modeling influence of friends was predictive of PA; the influence from family and others with MS were not associated.

To date, the predictive ability of modeling or vicarious experience on PA has not been thoroughly examined. This is somewhat surprising as most other social cognitive sources have been examined in a variety of populations. However, several studies have established that modeling is significantly related to increased self-efficacy (Gould & Weiss, 1981; McAuley, 1985; Starek & McCullagh, 1999). In one original study, McAuley (1985) found modeling to be highly associated with self-efficacy in a sample of female undergraduate students. Students watched other students perform

physical tasks prior to attempting the task themselves. Students, who received vicarious information prior to the task, had higher task-efficacy, as well as faster acquisition of the task. Since research has consistently shown greater self-efficacy leads to increased PA levels (Everman et al., 2004; McAuley, 1992, 1993; Motl et al., 2002; Rodgers et al., 2002), results from this study may suggest that models, especially individuals who are friends, can help increase PA levels in the MS population.

A possible explanation for the discrepancy of results from the modeling influence of family and others with MS may be the lack of a reliable, validated measure examining modeling influences in a behavior change setting. In this study, a modeling scale was developed based on Bandura's four factors affecting vicarious interactions (Bandura, 1986). Strong reliability was found for the modeling influence of friends and other with MS. Unfortunately, weak reliability was found for the section examining the modeling influence of family. This may explain a lack of significance between the family influence and PA, although without previous findings, anticipated outcomes from modeling studies are difficult to determine.

Another possible explanation for the lack of influence from family members may be that the model attributes were too different from the individual with MS. According to Bandura (1997), the effectiveness of a model depends on four factors; two of which are attribute similarity and similar capabilities. The more comparable the observer (i.e., MS patient) and the model (i.e., family member) are, the stronger the influence of the model. Considering most of this sample's family members were able-bodied spouses and children, differences in age and physical capability may have diminished any influence on the MS patient.

Participant's vicarious interactions with others with MS, although reliable, did not predict PA in this study. A possible explanation for this was the number of "not applicable responses" as 32% of the sample did not know any other individuals with MS. If all participants in the sample were recruited from an MS support group, for example, one may anticipate findings to indicate a significant relationship with the modeling influence from others with MS, self-efficacy and PA. Another possible explanation for this result may be that the social support and positive modeling influence received from friends is of much greater importance than from family or others with MS. Participants may not consider the support received from family and others with MS, as they draw most of their support from their friendships.

The ability of modeling (friends) to predict PA in this study suggests it may need to be taken into consideration when designing PA programs, and certainly, future studies should examine the relationships between modeling, self-efficacy and PA in the social cognitive framework. Potential studies could test the effectiveness of a modeling-based PA intervention, or any other intervention including models. Since vicarious experience has not been thoroughly studied in previous research, the implications of this novel finding may have broad future consequences. However, future studies must use and further validate the modeling scale to ensure adequate findings. By creating a standardized, reliable and valid modeling scale, the influence of modeling can be more accurately and easily assessed.

#### *Mood (Physiological arousal)*

Mood, or physiological arousal, was not predictive of PA in this MS sample. This is inconsistent with previous findings where authors found mood to be associated

with moderate and vigorous PA (Everman et al., 2004; Winters et al., 2003) and significantly associated to task-efficacy and barrier-efficacy (Blanchard, Rodgers, Courneya, Daub, & Black, 2002). A possible explanation for this lack of significance is not obvious. Perhaps the instrumentation used to measure mood was not accurate for this population. A modified, abbreviated version of the POMS was used for the purpose of saving time and ensuring the questionnaire was not too long for participants (i.e. the original POMS is 65 items). It is possible that the instrument did not capture mood of participants well enough, as the briefer version did not probe the participants as thoroughly as the extended version.

Another possible explanation for the contrast in results could be due to the nature of the disease. Due to the great difference in severity of symptoms and strong medications, physiological arousal levels of MS patients may have fluctuated drastically from day to day. For example, a hot, humid day may have severely exacerbated an MS patient's symptoms, leaving them fatigued, overheated and generally unwell. A more mild temperature the very next day may have alleviated these symptoms, leaving the same individual feeling energetic and well. In order to capture an accurate depiction of the mood of an individual with MS, physiological arousal levels must be measured repeatedly. By making multiple assessments, researchers are more likely to capture the general mood state of an MS patient, rather than his/her mood on one day.

### *Environment*

Although research continues to accumulate, examining environmental correlates of PA, researchers at large agree a stronger emphasis needs to be placed on the role of the environment on PA (Humpel et al., 2002; Sallis et al., 2002). In this study, the

environment was found to be predictive of PA in individuals with MS. Specifically, perception of traffic and access to a home aerobic video/DVD significantly predicted PA.

Owen et al. (2004) conducted a meta-analysis of healthy adult populations, aimed at determining the most influential environmental attributes on walking. Similar to the current study, they found perception of traffic and availability of home exercise equipment associated with PA. The current findings, therefore, are consistent with (Owen et al., 2004) and several other previous studies suggesting the environment plays an important role in PA behavior (Booth et al., 2000; Humpel, Owen, Iverson, Leslie, & Bauman, 2004; Humpel et al., 2002).

Health professionals, therefore, may want to take environmental variables into account when designing PA programs. Traffic plays a very influential role in the PA behavior in this population; therefore, PA interventions should be sure to utilize a safe, traffic-free environment. Accesses to home aerobic video/DVDs were also predictive of PA. This suggests that individuals with MS are willing to participate in PA if it is safe and convenient for them to do so. This is also consistent with previous research that indicates video interventions that provide a model, may be effective in increasing the likelihood of a behavior (Clark & Ste.Marie, 2002). A PA intervention should make it as safe and easy as possible for individuals with MS to participate.

It is interesting to note that only two environmental variables were predictive of PA in this sample. It was anticipated that several variables would predict PA. One possible explanation for this was the type of equipment used in the survey. The degree of disability experienced by many of the participants would prevent him/her from being able to use standard fitness equipment, thus, having access to it, may have been irrelevant.

For example, since poor balance is an issue for many people with MS, having access to a bicycle is insignificant, as the individual may not have the physical functioning utilize it. Future studies examining access and other environmental issues should ensure all environmental determinants being examined are relevant and usable by the study population.

***Barrier efficacy & outcome expectations mediate the social support, modeling, mood, environment/PA relationship***

The third purpose of the present study was to examine the mediating influence of social cognitive variables on the self-efficacy sources/PA relationship. No previous studies had done so in a MS population.

Results showed that the modeling-friends/PA relationship was partially mediated by outcome expectations. Therefore, health professionals should consider this when designing PA interventions for this population. For example, allowing a MS patient to observe a friend with similar capabilities, successfully complete a PA program, and obtain positive results, may influence the MS patient's outcome expectations regarding PA. By using the modeling influence of friends to form positive outcome expectations, PA levels may increase. Nonetheless, the effect of modeling on increasing PA was only partially explained by the fact that it increased the MS patient's outcome expectations. Therefore, there are likely other variables mediating the modeling-friends/physical activity relationship; future studies should investigate these possibilities.

Barrier efficacy partially mediated the traffic/physical activity relationship. More specifically, traffic does not have a direct effect on PA; rather it decreases the barrier

efficacy of individuals with MS, which results in decreased PA. Motl et al., 2005, also found that barrier efficacy mediated the environment-physical activity relationship. In a sample of adolescent girls, barrier efficacy mediated the effect of equipment accessibility on PA. This finding indicates that PA interventions should attempt to ensure the PA environment is safe and attractive to participants so they may experience increased barrier efficacy, which will lead to increased PA. For example, creating a low traffic environment may alter a participant's perception of access to exercise facilities. By moving an individual's walking route to a less trafficked area, he/she may now feel they have a safe, attractive facility for PA.

### *Gender Differences*

Although gender differences were not part of the initial hypotheses, significant differences were observed for this population and are worth mentioning. The majority of participants were female (n=62) and as a result, the social-cognitive variables that were significantly correlated were the same as the ones reported in the main analysis. These findings were consistent with previous studies identifying important PA determinants in healthy females (Sternfeld, Ainsworth & Quesenberry, 1999; Eyeler, Matson-Koffman, Young, Wilcox, Wilbur, Thompson, Sanderson & Evenson, 2003)

Interesting results were found however, when only male responses were correlated with PA. The presence of traffic and social support from friends were no longer significantly correlated; indicating these factors are not important in the male population. The physical impact of MS was highly correlated with PA, indicating that clinical factors may be playing a role in PA levels for males. Significant correlations with PA were found for task efficacy, barrier efficacy and outcome expectations in the

male population. This is consistent with previous research in healthy populations (Sallis, Hovell & Hofstetter, 1992) however, the strength of the correlations are not. These extremely strong relationships could indicate that only a few main factors influence the male population, and therefore, PA interventions based on these few constructs may be very effective. Regression analyses were non-significant, perhaps due to the low sample size (i.e. 16 males). These gender differences are very preliminary and based on a small sample size; further investigation into the gender differences in the MS population is warranted.

### ***Limitations & Future Directions***

There are several limitations that must be taken into account when considering the results of this study. In any research where a specific theoretical framework is utilized, an argument can be made that other frameworks should have been used. However, results from the study did provide preliminary evidence that social cognitive theory was partially successful (i.e., 41% PA variance) in explaining MS patient's PA levels. Nonetheless, given the novelty of the theoretical research pertaining to PA in this population, replication of the current results is warranted in addition to testing other theoretical frameworks (i.e., the transtheoretical model or self-determination theory).

A second limitation was that one piece of the theoretical framework was absent in this study. Although past PA had been shown to be one of the strongest predictors of future PA participation (Bandura, 1986; McAuley, 1993), it was not assessed in this study. Unlike all other self-efficacy sources, past behavior can not be modified and due to extremely low overall PA levels for the sample, likely due to chronic fatigue, pain and disability (Janardhan & Bakshi, 2002; Voss et al., 2002), PA levels are not likely to

change over time in this population without intervention. Nonetheless, future researchers should be sure to include past PA in their study design, especially when examining the effectiveness of a new PA intervention.

Third, participants were recruited from information seminars and support groups for individuals with MS and also participated in the study on a voluntary basis. This may indicate that the sample of people with MS could be biased in some way; individuals were actively seeking solutions to their MS problems and were motivated enough to volunteer in the study. This may not be representative of the entire MS population. Due to high fatigue and depression rates among individuals with MS (Janardhan & Bakshi, 2002; Voss et al., 2002), many individuals rarely leave their home. This sample may have been physically or mentally healthier than the general MS population, thus skewing results slightly.

Fourth, two original instruments were used in this project, the outcome expectancy scale and the modeling scale. Although both scales were found to be reliable in this study, they had not been previously used, thus leaving room for skepticism concerning their results. Therefore, future studies may utilize these scales to further prove their validity and reliability.

Another possible methodological limitation was in the scale used to measure social support. Participants were asked to identify social support received from family and/or friends. Pilot study responses indicated that one-third (3) of the participants received social support from individuals in their support group. As a result, the social support scale could have queried as to the support received from others with MS. Different findings may result if this source of support was included; future studies should

measure this type of social support as well. Nonetheless, only a few participants were recruited from a support group, and as such, only a few were known to be members of a MS support group. Future studies should aim to identify other possible sources of social support to individuals with MS.

Since this study was, to the best of my knowledge, the first to identify PA correlates in the MS population using social cognitive theory, many subsequent studies may be derived based on these results. Due to the novelty of the study, replication of the current study is warranted. Using a larger sample size and the same theoretical framework to identify PA correlates in MS, may further support the novel findings presented here, as well as identify some other important determinants.

### **Conclusion**

Although previous studies have identified the benefits associated with PA for people living with MS (i.e., maintain muscle strength, decreased depression)(DeBolt & McCubbin, 2004; Ponichtera-Mulcare, 1992; Sutherland & Anderson, 2001), the MS population as a whole, continues to be sedentary (Stuifbergen & Roberts, 1997). Many studies have used social cognitive variables to explain PA behavior. Baranowski et al. (1998) found that the majority of previous studies using a social cognitive model accounted for 30% or less of the variance in PA. The present study showed that traffic and the modeling influence of friends were predictors of PA, while all self-efficacy determinants accounted for 23% of PA behavior. Barrier efficacy and outcome expectation both predicted PA and barrier efficacy, task efficacy, and outcome expectations accounted for 18% of PA variance. Together, all social cognitive variables accounted for 41% of PA in this population. Outcome expectations mediated the

modeling-friends/PA relationship and barrier efficacy mediated the traffic/PA relationship. Based on variables identified in this study, an intervention could be designed; by focusing on key correlates for the MS population (i.e., social support, traffic), its effectiveness should be maximized. The same theoretical framework could be used to test the intervention's effectiveness. Once an effective intervention has been created, it may be implemented in the general population. Individuals with MS looking to increase their PA levels, can utilize the intervention, become more active, and thus, experience the benefits associated with PA.

These findings have many potential implications for PA interventions. When creating a PA intervention for individuals with MS, health professionals should include important sources of self-efficacy and outcome expectations, namely, the modeling influence of friends and social support from friends. The MS patient's PA environment should be safe (i.e., no traffic) and include access to home use PA equipment (i.e., aerobic vide/DVD). Health professionals should also ensure that PA interventions aim at increasing barrier efficacy and outcome expectations for individuals with MS. Since this study showed partial mediating effects, an effective way to do this may be to ensure individuals can participate in PA in low traffic areas, thus increasing barrier efficacy. Activities with friends should be utilized so the modeling influence of friends is maximized; this may increase the outcome expectations of the individual. Future studies should use social cognitive theory with appropriate modifications to further explore important determinants for physical activity in MS.

Despite the findings presented here, limitations such as recruitment process, novel instrumentation, variables measured (i.e., theoretical framework chosen) and more

population specific measures need to be considered. The results of this study leave researchers with many future study possibilities. Reproduction of the present study is warranted due to the novelty of PA in the MS population, and as a result lack of research in this field. Future studies should include past PA measures, ensure a representative MS sample, and further utilize and validate the modeling and outcome expectation scale derived specifically for the MS population. Now that important social cognitive variables for the MS population have been identified, a PA intervention could be generated and tested using a social cognitive framework.

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*Appendix A –*

***Pilot Study Questionnaire***

*We are interested in finding out how you feel about physical activity. Please answer each question as honestly and accurately as possible. There are no right or wrong answers.*

- 1) What do you perceive to be the advantages of physical activity?*
  
- 2) What do you perceive to be the disadvantages of physical activity?*
  
- 3) Who are the people in your life that provide social support to you?*
  
- 4) Are there non-supportive people in your life?*
  
- 5) What prevents you from participating in physical activity?*
  
- 6) What makes it easier for you to participate in physical activity?*

*Appendix B –*

***Task Efficacy Scale***

***Directions:*** The items listed below designed to assess your beliefs in your ability to continue exercising on a three time per week basis at light to moderate intensities, for 40+ per session in the future. Using the scales listed below please indicate how confident you are that you will be able to continue to exercise in the future.

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

**NOT AT ALL  
CONFIDENT**

**MODERATELY  
CONFIDENT**

**HIGHLY  
CONFIDENT**

*For example, if you have complete confidence that you could exercise three times per week at a moderate intensity for 40+ minutes for the next four weeks without quitting, you would circle 100%. However, if you had no confidence at all that you could exercise at your exercise prescription for the next four weeks without quitting, (that is, confident you would not exercise), you would circle 0%.*

*Please remember to answer honestly and accurately. There is no right or wrong answers. Mark your answer by circling a %.*

***PLEASE NOTE:*** Exercise times are accumulated throughout the day. For example, in question one, if you always perform at least 30min of light/moderate activity everyday, you would indicate 100%.

1. I am able to continue to exercise three times per week at light/moderate intensity, for 40+ minutes without quitting for the NEXT WEEK

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

2. I am able to continue to exercise three times per week at light/moderate intensity, for 40+ minutes without quitting for the NEXT TWO WEEKS

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

3. I am able to continue to exercise three times per week at light/moderate intensity, for 40+ minutes without quitting for the NEXT THREE WEEKS

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

4. I am able to continue to exercise three times per week at light/moderate intensity, for 40+ minutes without quitting for the NEXT FOUR WEEKS

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

*Appendix C –*

***Barrier Efficacy Scale***

*Directions: The following items reflect situations that are listed as common reasons for preventing individuals from participating in exercise sessions, or in some cases, dropping out. Please indicate the degree to which you are confident that you could exercise in the event that any of the following circumstances were to occur by circling the appropriate %. Select the response that most closely matches you own, remembering that there are no right or wrong answers.*

**PLEASE NOTE:** Exercise 3 times per week means 40+ min of accumulated activity on three days of the week.

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

**NOT AT ALL  
CONFIDENT**

**MODERATELY  
CONFIDENT**

**HIGHLY  
CONFIDENT**

---

***I BELIEVE THAT I COULD EXERCISE 3 TIMES PER WEEK FOR THE NEXT 4 WEEKS IF:***

*1. The weather was very bad (hot, humid, cold, rainy)*

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

*2. There were no structured programs available.*

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

*3. I was not interested in the activity/program.*

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

*4. I felt pain or discomfort when exercising.*

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

*5. I felt too fatigued to exercise or became too fatigued during exercise.*

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

*6. I had to exercise alone.*

**0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%**

7. *It was not fun or enjoyable.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

8. *It became difficult to get to the exercise location.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

9. *Your body was "not cooperating" that day.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

10. *My schedule conflicted with my exercise session.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

11. *I felt self-conscious about my appearance when I exercised.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

12. *An instructor does not offer me any encouragement.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

13. *I was under personal stress or was feeling depressed that day.*

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%100%

## Appendix D –

### Godin Leisure-Time Exercise Questionnaire

#### Instructions

*In this excerpt from the Godin Leisure-Time Questionnaire, the individual is asked to complete a self-explanatory, brief- four-item query of usual leisure-time exercise habits.*

#### Calculations

*For the first question, weekly frequencies of strenuous, moderate, and light activities are multiplied by nine, five, and three, respectively. Total weekly leisure activity is calculated in arbitrary units by summing the products of the separate components, as shown in the following formula:*

$$\text{Weekly Leisure activity score} = (9X \text{ Strenuous}) + (5X \text{ Moderate}) + (3X \text{ Light})$$

*The second question is used to calculate the frequency of weekly leisure-time activities pursued “long enough to work up a sweat”.*

#### Questionnaire

1. *During a typical 7-day period (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time?*

a) **Strenuous Exercise (heart beats rapidly)** \_\_\_\_\_

*(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)*

b) **Moderate Exercise (not exhausting)** \_\_\_\_\_

*(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)*

c) **Mild Exercise (minimal effort)** \_\_\_\_\_

*(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)*

2. *During a typical 7-day period (a week), in your leisure time, how often do you engage in any regular activity **long enough to work up a sweat** (heart beats rapidly)?*

\_\_\_\_\_ Often

\_\_\_\_\_ Sometimes

\_\_\_\_\_ Never

*Appenedix E –*

***Modeling Scale***

***Directions:*** We would like to find out more about people that may influence you in your physical activity participation. Below is a list of statements. Please indicate your response by circling the answer that best applies to you.

***1. Seeing my family being active makes me want to become active.***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

***2. My family's physical capabilities for physical activity are similar to my own.***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

***3. Many people in my family are regularly active.***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

***4. People in my family are highly competent in physical activity.***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

***5. People in my family have similar personal traits to me (age, gender, height, weight).***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

***6. Seeing my friends being active makes me want to become active.***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

***7. My friend's physical capabilities for physical activity are similar to my own.***

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**8. Many of my friends are regularly active.**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**9. Many of my friends are highly competent in physical activity.**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**10. My friends have similar personal traits to me (age, gender, height, weight).**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**11. Seeing other people I know with MS being active makes me want to become active.**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**12. Other people I know with MS have the same physical capabilities for physical activities are similar to my own.**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**13. Other people I know with MS are regularly active.**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**14. Other people I know with MS are highly competent in physical activity.**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

**15. Other people I know with MS have similar personal traits to me (age, gender, height, weight).**

1                                  2                                  3                                  4                                  8  
*strongly disagree   somewhat disagree   somewhat agree   strongly agree   does not apply*

*Appendix F -*

***Social Support and Exercise Survey***

*Directions: Below is a list of things people might do or say to someone who is trying to exercise regularly. If you are not trying to exercise, then some of the questions may not apply to you, but please read and give an answer to every question.*

*Please rate each question twice. Under family, rate how often anyone living in your household has said or done what is described during the last three months. Under friends, rate how often your friends, acquaintances, or coworkers have said or done what is described during the last three months.*

*Please write one number from the following rating scale in each space:*

<i>none</i>	<i>rarely</i>	<i>a few times</i>	<i>often</i>	<i>very often</i>	<i>does not apply</i>
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>8</i>

*During the past FOUR WEEKS, my family (or members of my household) or friends:*

	<i>Family</i>	<i>Friends</i>
<i>11. Exercised with me.</i>	_____	_____
<i>12. Offered to exercise with me.</i>	_____	_____
<i>13. Gave me helpful reminders to exercise (Are you going to exercise tonight?)</i>	_____	_____
<i>14. Gave me encouragement to stick with my exercise program.</i>	_____	_____
<i>15. Changed their schedule so we could exercise together.</i>	_____	_____
<i>16. Discussed exercise with me.</i>	_____	_____
<i>17. Complained about the time I spend exercising.</i>	_____	_____
<i>18. Criticized me or made fun of me for exercising.</i>	_____	_____

19. *Gave me rewards for exercising  
(bought me something or gave me  
something I like)* \_\_\_\_\_
20. *Planned for exercise on recreational  
outings.* \_\_\_\_\_
21. *Helped plan activities around my  
exercise.* \_\_\_\_\_
22. *Asked me for ideas on how they like  
to exercise.* \_\_\_\_\_
23. *Talked about how much they like to  
exercise.* \_\_\_\_\_

## Appendix G –

**Profile of Mood States****PART ONE**

**Directions:** Below is a list of words that describes feelings people have. Please read each one carefully. Then, circle **one** number corresponding to the adjective phrase that best describes **HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY**. The numbers refer to the following descriptive phrases:

0            1            2            3            4  
 Not at all    A little    Moderately    Quite a bit    Extremely

**During the PAST 4 WEEKS, I have felt...**

	<i>Not at all</i>	<i>A little</i>	<i>Moderately</i>	<i>Quite a bit</i>	<i>Extremely</i>
<b>1. cheerful</b>	0	1	2	3	4
<b>2. restless</b>	0	1	2	3	4
<b>3. hopeless</b>	0	1	2	3	4
<b>4. vigorous</b>	0	1	2	3	4
<b>5. nervous</b>	0	1	2	3	4
<b>6. helpless</b>	0	1	2	3	4
<b>7. full of pep</b>	0	1	2	3	4
<b>8. on-edge</b>	0	1	2	3	4
<b>9. sad</b>	0	1	2	3	4
<b>10. active</b>	0	1	2	3	4
<b>11. tense</b>	0	1	2	3	4
<b>12. worthless</b>	0	1	2	3	4
<b>13. energetic</b>	0	1	2	3	4
<b>14. uneasy</b>	0	1	2	3	4
<b>15. miserable</b>	0	1	2	3	4
<b>16. lively</b>	0	1	2	3	4
<b>17. anxious</b>	0	1	2	3	4
<b>18. discouraged</b>	0	1	2	3	4

## Appendix H –

**Multiple Sclerosis Impact Scale (MSIS-29)**

**Directions:** The following questions ask for your views about the impact of MS on your day-to-day life **DURING THE PAST FOUR WEEKS**. For each statement, please circle **one number that best describes your situation**

---

<i>In the <u>past FOUR weeks</u>, how much has you MS limited your ability to...</i>	<i>Not at all</i>	<i>A little</i>	<i>Moderately</i>	<i>Quite a bit</i>	<i>Extremely</i>
1. Do physically demanding tasks?	1	2	3	4	5
2. Grip things tightly (e.g turning on taps)?	1	2	3	4	5
3. Carry things?	1	2	3	4	5

<i>In the <u>past FOUR weeks</u>, how much have you been Bothered by...</i>	<i>Not at all</i>	<i>A little</i>	<i>Moderately</i>	<i>Quite a bit</i>	<i>Extremely</i>
4. Problems with your balance?	1	2	3	4	5
5. Difficulties moving about indoors?	1	2	3	4	5
6. Being clumsy?	1	2	3	4	5
7. Stiffness?	1	2	3	4	5
8. Heavy arms and/or legs?	1	2	3	4	5
9. Tremor of your arms or legs?	1	2	3	4	5
10. Spasms in your limbs?	1	2	3	4	5
11. Your body not doing what you want it to do?	1	2	3	4	5
12. Having to depend on others to do things for you?	1	2	3	4	5

<i>In the past FOUR weeks, how much have you been Bothered by...</i>	<i>Not at all</i>	<i>A little</i>	<i>Moderately</i>	<i>Quite a bit</i>	<i>Extremely</i>
13. <i>Limitations in your social and leisure activities at home?</i>	1	2	3	4	5
14. <i>Being stuck at home more than you would like to be?</i>	1	2	3	4	5
15. <i>Difficulties using your hands in everyday tasks?</i>	1	2	3	4	5
16. <i>Having to cut down the amount of time you spent on work or other daily activities?</i>	1	2	3	4	5
17. <i>Problems using transport (e.g. car, bus, train, taxi, etc)?</i>	1	2	3	4	5
18. <i>Taking longer to do things?</i>	1	2	3	4	5
19. <i>Difficulty doing things spontaneously (e.g. going out on the spur of the moment)?</i>	1	2	3	4	5
20. <i>Needing to go to the toilet urgently?</i>	1	2	3	4	5
21. <i>Feeling unwell?</i>	1	2	3	4	5
22. <i>Problems sleeping?</i>	1	2	3	4	5
23. <i>Feeling mentally fatigued?</i>	1	2	3	4	5
24. <i>Worries related to your MS?</i>	1	2	3	4	5
25. <i>Feeling anxious or tense?</i>	1	2	3	4	5
26. <i>Feeling irritable, impatient, or short tempered?</i>	1	2	3	4	5
27. <i>Problems concentrating?</i>	1	2	3	4	5
28. <i>Lack of confidence?</i>	1	2	3	4	5
29. <i>Feeling depressed?</i>	1	2	3	4	5

(Hobart et al., 2001)

*Appendix I -***Neighborhood Environment Walkability Scale (Abbrev.)**

**Directions:** Using the scale below, we would like to know what you think about your **current neighborhood**. That is, the neighborhood in which your apartment or house (current residence) is located.

	<i>Strongly Disagree</i>	<i>Somewhat Disagree</i>	<i>Somewhat Agree</i>	<i>Strongly Agree</i>
<b>1. Many shops, stores, markets or other places to buy things I need are within easy walking distance of my residence.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>2. I am within a 5-10 minute walk to a transit stop (bus) from my residence.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>3. There are no sidewalks on most of the streets in my neighborhood.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>4. My neighborhood has several free or low cost facilities, such as parks, walking trails, bike paths, recreation centres, playgrounds, public swimming pools.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>5. The crime rate in my neighborhood makes it unsafe to go on walks <u>at night</u></b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>6. There is so much traffic on the streets that it makes it difficult or unpleasant to walk in my neighborhood.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>7. I see many people being physically active in my neighborhood (e.g. walking, jogging, cycling, sports)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>8. There are many interesting things to look at while walking in my neighborhood.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>9. There are many four-way intersections in my neighborhood</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>10. The sidewalks in my neighborhood are well maintained (paved, few cracks) and not obstructed.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>11. The crime rate in my neighborhood makes it unsafe to walk <u>during the day</u></b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>12. There are many places to go within easy walking distance of my residence</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>

## PART TWO: Home (current residence) Equipment

**Directions:** Using the scale below, we would like to know what you think about your **current environment**. During the **next 4 weeks**, indicate **(1) which items you will have access to** in your apartment complex or house and **(2) whether you will use them**.

Circle Yes or No for each facility in Column 1	<b>Column 1</b>		<b>Column 2</b>	
	<b>Do You Have It?</b>		<b>Will you use it?</b>	
And, if Yes, then circle Yes or No in Column 2				
18) Running shoes	Yes	No	Yes	No
19) Mobility Aid	Yes	No	Yes	No
20) Weight lifting equipment	Yes	No	Yes	No
21) Aerobic workout video or audiotapes	Yes	No	Yes	No
22) Sports equipment (balls, racquets)	Yes	No	Yes	No
23) Cardio equipment (stationary bike, rower, etc)	Yes	No	Yes	No
24) Toning devices (e.g., ankle weights)	Yes	No	Yes	No
25) Step aerobics, slide aerobics equipment	Yes	No	Yes	No
26) Swimming pool	Yes	No	Yes	No
27) Instructed Classes (Tai chi, aerobic)	Yes	No	Yes	No
28) Canoe, row boat, kayak	Yes	No	Yes	No
29) Skis (snow or water)	Yes	No	Yes	No
30) Bicycle	Yes	No	Yes	No

*Appendix J -***Outcome Expectation Scale**

**Directions:** This section of the questionnaire is needed to help determine you perceived benefits of exercise. Several statements below suggest possible benefits. Please indicate the degree to which you are confident that you could achieve these benefits by circling the appropriate number according to the scale below.

1	2	3	4	5	6	7
<i>Strongly Disagree</i>			<i>Unsure</i>	<i>Strongly Agree</i>		

**If I engage in 40 minutes of exercise 3 times per week over the NEXT FOUR WEEKS, it will.....**

1. improve overall mental health	1	2	3	4	5	6	7
2. maintain muscle strength and tone	1	2	3	4	5	6	7
3. relieve muscle spasticity (feel looser)	1	2	3	4	5	6	7
4. make me better/healthy	1	2	3	4	5	6	7
5. give a sense of accomplishment	1	2	3	4	5	6	7
6. improve energy levels	1	2	3	4	5	6	7
7. improve balance	1	2	3	4	5	6	7

## Appendix K -

### Demographics -

**Directions:** This part of the questionnaire is needed to help understand the characteristics of the people participating in this study. For this reason, it is very important information. All information is held in strict confidence.

1. Age \_\_\_\_\_
2. Sex      Male \_\_\_\_\_      Female \_\_\_\_\_
3. Marital Status:    Never Married \_\_\_\_\_    Married \_\_\_\_\_    Common-law \_\_\_\_\_  
    Separated \_\_\_\_\_    Widowed \_\_\_\_\_    Divorced \_\_\_\_\_
4. (a) number of children \_\_\_\_\_      (b) number of children living at home \_\_\_\_\_
5. Education (Please check highest level achieved)
 

Some high school _____	Completed High School _____
Some University/College _____	Completed University/College _____
Some Graduate School _____	Completed Graduate School _____
6. Annual family income:    <\$20,000 \_\_\_\_\_    \$20-\$39,999 \_\_\_\_\_    \$40-\$59,999 \_\_\_\_\_  
    \$60-\$79,999 \_\_\_\_\_    \$80-\$99,999 \_\_\_\_\_    >\$100,000 \_\_\_\_\_
7. Employment Status:    Homemaker \_\_\_\_\_    Retired \_\_\_\_\_    Part-time \_\_\_\_\_  
    Full-time \_\_\_\_\_    Temporarily Unemployed \_\_\_\_\_    Disability Leave \_\_\_\_\_
8. Height and Weight Information:  
     weight in pounds \_\_\_\_\_      or kilograms \_\_\_\_\_  
     height in feet/inches \_\_\_\_\_      or meters/cent \_\_\_\_\_
9. MS Diagnosis:    relapsing-remitting \_\_\_\_\_    secondary progressive \_\_\_\_\_  
    primary progressive \_\_\_\_\_    progressive-relapsing \_\_\_\_\_  
    Years since diagnosis \_\_\_\_\_      or Year diagnosed \_\_\_\_\_
10. Mobility: (Please choose one.)
  - ambulatory (independent of aid) \_\_\_\_\_
  - use aid (e.g. cane, crutches, walker, etc.) some of the time(e.g. long distances) \_\_\_\_\_
  - use aid (e.g. cane, crutches, walker, etc.) all of the time (e.g. short distances) \_\_\_\_\_

- *use of aid (e.g. cane, crutches, walker, etc.) or wheelchair all of the time* \_\_\_\_\_
- *use wheelchair all of the time* \_\_\_\_\_

## *Appendix L – Article*

### **Using Social Cognitive Theory to Identify Key Determinants of Physical Activity in People Living with Multiple Sclerosis**

**Abstract:** Multiple sclerosis is a debilitating neurological disease with few successful symptom alleviating interventions available to the MS population. Preliminary research has shown that PA may aid in alleviating both psychological and physical symptoms; thus, improving overall quality of life. **Objective:** (1) To determine which social cognitive determinants (i.e., barrier efficacy, task efficacy, outcome expectation, social support, modeling, mood, and environment) would predict PA. (2) To determine whether barrier efficacy, task efficacy, and outcome expectation would mediate the social support, modeling, mood, and environment/PA relationships. **Study Design & Participants:** 76 participants (58 female and 18 male) completed a baseline questionnaire concerning social cognitive determinants and a 1-month telephone follow-up concerning PA participation. **Results:** The model accounted for 41% of the variance in PA. Block 1 accounted for 23% of the variance with traffic and modeling of friends making significant contributions to PA. Block 2 of the regression accounted for an additional 18% of variance with barrier efficacy ( $\beta = .25$ ;  $p < .05$ ) and outcome expectation ( $\beta = .21$ ;  $p < .05$ ) being significant predictors of PA. Outcome expectations mediated the modeling-friends/PA relationship. Barrier efficacy partially mediated the traffic/PA relationship. **Conclusion:** PA interventions should aim at increasing barrier efficacy and outcome expectations, and also on important social cognitive variables including barrier efficacy, outcome expectations, social support-friends, modeling-friends and environment (i.e., traffic). The MS patient's PA environment should be safe (i.e., no traffic) and include access to home use PA equipment (i.e., aerobic vide/DVD).

In 2003, 50 000 Canadians were diagnosed with Multiple Sclerosis (MS) (Canada, 2004). Canada has one of the highest occurrence rates of MS in the world and is the most common neurological disease affecting young Canadians (Canada, 2004). MS is a degenerative, neurological disease of the central nervous system that involves progressive destruction of myelin sheaths, the protective tissue surrounding the nerves of neurons in the central nervous system. As the protective myelin sheath is destroyed, nerve impulses are interrupted, misinterpreted, or not transmitted at all (Tortora & Grabowski, 1996). Like other immuno-mediated diseases, females are affected more frequently than males (1.4 to 3.1 times as many women than men are affected (Canada,

2004)). Unfortunately, the cause of the disease is unknown and there are no known cures.

MS plagues victims with sporadic and chronic, often escalating symptoms that often inhibit mobility, vision, balance, speech, memory, and physical functioning (Canada, 2004; Poser & Brinar, 2002; Solari & Radice, 2001). Each MS patient experiences a different level of neurological dysfunction, almost always leading to decreased mobility or even paralysis. Furthermore, people afflicted with MS frequently experience a diminished quality of life (i.e., increased depression, anxiety) (Lawler & Hopker, 2001; Schreurs, de Ridder, & Bensing, 2002; Voss et al., 2002). Specifically, MS patients have been shown to have markedly lower mean scores on all quality of life dimensions including, physical functioning (daily self-care activities to vigorous activity), role functioning (extent to which poor physical and emotional health interfere in daily life), bodily pain (frequency and daily interference), general health (feeling well), vitality (perceived energy), and role-emotional (extent to which poor health interferes with social activities) (Nortvedt, Riise, Myhr, & Nyland, 1999).

Fortunately, PA is one intervention that is assisting in easing some of these symptoms. Until recently, people living with MS were told to avoid physical exertion because they often suffer from excessive fatigue and thermosensitivity, both of which get worse with increased PA. Fortunately for the patients, however, researchers have begun to show that PA may in fact be one type of intervention that can be used to alleviate physical and psychological symptoms. Indeed, preliminary studies revealed that people with MS receive some, if not all, of the same benefits as the normative population (DeBolt & McCubbin, 2004; Kasser & Stuart, 2001; Petajan et al., 1996; Petruzzello,

Landers, Hatfield, Kubitz, & Salazar, 1991; Ponichtera-Mulcare, 1992; Stuifbergen & Roberts, 1997; Svensson, Gerdle, & Elert, 1994). In fact, only 8% of people with MS that participated in regular PA reported PA as ineffective (Archibald et al., 1994). Furthermore, most MS patients find exacerbated symptoms diminish within an hour of activity (Petajan & White, 1999).

The few studies that have examined the effects of PA on physical symptoms indicate that it improves various physical domains. For example, participants of a 15-week aerobic training program experienced increased aerobic capacity, increased upper and lower extremity strength, and significant improvement in renal and bowel function (Petajan et al., 1996). Furthermore, an 8-week resistance training program improved muscular power in adults with MS (DeBolt & McCubbin, 2004), whereas muscular endurance training over a 6 and 8 week period improved muscular performance (DeBolt & McCubbin, 2004; Ponichtera-Mulcare, 1992; Svensson et al., 1994).

The psychological benefits to individuals with MS have only been recently recognized. Here, one study showed that MS patients who engaged in regular PA experienced improved vigor and psychological well-being (Stuifbergen, Becker, Blozis, Timmerman, & Kullberg, 2003). Another study showed that participation in a 15-week aerobic training program was highly associated with decreased depression and anger and better quality of life compared to the non-exercise group (Gappmaier et al., 1994; Kasser & Stuart, 2001; Petajan et al., 1996; Svensson et al., 1994). Therefore, as with physical symptoms and PA studies, the present research findings are promising from a psychological / quality of life perspective.

Despite the above benefits, research has shown that people living with MS have significantly lower PA levels compared to the normative population (Mullins, 2001; Stuifbergen & Roberts, 1997). In fact, only 22% of MS patients participate in light/moderate PA and only 19% take part in leisure time activity (Stuifbergen & Roberts, 1997). Although preliminary findings have shown PA to be beneficial to people with MS, this will only occur if the patients engage in PA. Unfortunately, there are no studies to date that have been specifically designed to increase PA in these patients. Given that the prevalence of PA is an issue in this population, there is a need to identify important PA determinants to more effectively create a PA intervention to help alleviate the problem. Baranowski et al. (1998) found that PA interventions were most effective when predictors of PA were identified and interventions aimed at altering those predictors were implemented. Therefore, a necessary preliminary step for the MS population is to identify key correlates of PA that can provide insight into the development of an efficacious PA intervention.

Unfortunately, theory-based studies have not been conducted in the MS population. Therefore, social cognitive theory was chosen as the theoretical framework to explain PA in the MS population. The reason for this is that the theory has been used extensively and successfully to explain PA in numerous non-diseased (McAuley, 1992; Wallace, Buckworth, Kirby, & Sherman, 2000; Winters, Petosa, & Charlton, 2003) and diseased (i.e., cancer, diabetes, fibromyalgia and heart disease) (Allen, 2004; Graves, 2003; Maddison & Prapavessis, 2004; Oliver & Cronan, 2005; Rogers et al., 2004; Rogers et al., 2005) populations. In fact, social cognitive theory has been shown to account for as much as 60% of the variance in PA (Conn, 1998; Conn, Burks, Pomeroy,

Ulbrich, & Cochran, 2003; McAuley, 1992, 1993; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003), which is well above the minimum requirement (30%) suggested by Baranowski, Anderson, and Carmack (1998), to base a PA activity intervention on.

Social cognitive theory is a model to explain the development of skill and regulation of activity. Bandura assumed that individuals are capable of identifying, analyzing and reflecting on behaviours, observational learning, self-regulation and anticipating expected outcomes (Bandura, 1986). The main constructs in social cognitive theory include barrier efficacy (i.e., the confidence one can perform a task under challenging conditions), task efficacy (i.e., the confidence one can perform the elemental aspects of the task) and outcome expectations (i.e., the belief that performing a certain task will result in certain consequences). Sources of efficacy and outcome expectations, or determinants, include social support, modeling, mood and environment.

Social cognitive theory is a useful tool that has been shown to effectively predict PA behaviour. By applying this model to the MS population, key influences on PA may be identified to inform the development of an efficacious PA intervention. Therefore, the purpose of this study was to identify the most influential determinants of PA in individuals living with MS from a social cognitive viewpoint. It is intended that the results from the study will provide the necessary information needed to develop a theoretically based PA intervention aimed at increasing PA in MS patients in the future.

Based on social cognitive theory, it was hypothesized that;

- 1) barrier efficacy, task efficacy and outcome expectation would predict PA.
- 2) social support, modeling, mood, and environment would predict PA.

3) barrier efficacy, task efficacy, and outcome expectation would mediate the social support, modeling, mood, and environment/PA relationships.

## **Methodology**

### ***Participants***

The average participant was about 50 years of age with approximately 2 children. The average BMI was 26.25 (slightly overweight) and had been diagnosed 11.08 years prior with a relapsing-remitting diagnosis. Sixty-seven percent of participants were married, most were not working (72.3%) and required some kind of aid for mobility (67.1%). About half of the participants (51.3%) had an education below the university level; nonetheless, forty-nine percent of participants maintained an annual family income of higher than \$60 000.

### ***Measures***

*Task Efficacy Scale:* This measure (McAuley, 1993) (7 questions) was designed to tap participants' efficacy with respect to continued exercise participation in prescribed exercise regimens (at least three times per week for 40 min at light/moderate intensity) over incremental week periods for four weeks. Participants indicated their degree of confidence for each item on a 0% (no confidence at all) to 100% (complete confidence) scale. For example, I am able to continue to exercise three times per week at light/moderate intensity, for 40+ min without quitting for the next week. This measure was based on the recommendations put forth by Bandura (1997). Reliability of the scale in this study was 0.99.

*Barrier Efficacy Scale:* The barrier efficacy scale (McAuley, 1992) is a 13-item scale designed to measure participant's perceived capabilities to engage in PA in the face

of commonly identified barriers to participation. A modified version of this scale was used with questions derived from a pilot study. Participants indicated their degree of confidence in overcoming each barrier on a 0% (no confidence at all) to 100% (complete confidence) scale. For example, I believe that I could exercise three times a week for the next four weeks even if the weather was very bad. Cronbach's alpha for this measure was 0.92 in the current study.

*Godin Leisure-Time Exercise Questionnaire:* The Godin is a brief, three question survey used to assess self-reported PA. The questions identify the amount of strenuous, moderate and mild exercise an individual engages in, for at least fifteen minutes at a time, during a typical week. For example, during a typical 7-day period (a week), how many times on the average do you do strenuous exercise (i.e., running, basketball, hockey) for more than 15 minutes during your free time? This scale has been shown to be valid and reliable in previous studies (Jacobs, Ainsworth, Hartman, & Leon, 1993).

*Modeling Scale:* The modeling scale is a 15-item instrument created specifically for this study. Participants indicated the influence of the observation of others being physically active on their own PA levels on a 4-point scale ranging from "strongly disagree" to "strongly agree". For example, seeing my family being active makes me want to become active. Previous instruments have not been developed as the influence of modeling has not been examined in people living with MS. Responses from each modeling influence (family, friends and others with MS) were averaged to indicate the degree of influence attributed to that group. Reliability for each subscale (modeling-family, modeling-friends and modeling-others) was calculated and Cronbach's alpha was

0.54, 0.90 and 0.88 respectively. Due to the low reliability found for the modeling-family aggregate, these responses were not used in further analysis.

*Social Support and Exercise Survey (SSES)*: The SSES (Sallis, 1986) is a 13 item scale measuring social support for PA. Questions examine the role of family and friends on PA participation. Participants indicated the frequency of the support from others by responding to questions on a 5-point scale ranging from “none” to “very often”. For example, during the past four weeks, my family: engaged in PA with me. Responses were scored according to survey protocol (Sallis, 1986). Sallis, Grossman, Pinski, Patterson, and Nader (1987) reported reliability coefficients of 0.87 and 0.88 for family and friend support respectively. Similar scores were found in this study with reliability coefficients of 0.86 and 0.92 respectively.

*Profile of Mood States (POMS)*: The POMS (Schacham, 1992) used in the current study was an abbreviated, 18-item version that included 3 subscales (e.g., anxiety, depression, and vigor). Participants were asked to indicate his/her response to various emotional states. A 5-point scale ranging from “not at all” to “extremely” indicated how strongly the participant had experienced each emotion (e.g., sad, grouchy, bushed). For example, during the past four weeks, I have felt: cheerful. This version has been shown to be valid and reliable in previous studies (Pronk, Crouse, & Rohack, 1995). Reliability for the 3 subscales in the current study was 0.91, 0.91, and 0.91 respectively.

*The Multiple Sclerosis Impact Scale (MSIS-29)*: The MSIS-29 (Hobart, Lamping, Fitzpatrick, Riazi, & Thompson, 2001) is a 29-item (20 physical and 9 psychological) scale measuring the physiological and psychological impact of MS. For purposes of the current study, only the physiological impact items were measured. Questions identified

the impact of common physical problems associated with MS. For example, in the past four weeks, how much have you been bothered by: problems with your balance.

Participants rated the impact (frequency) of various symptoms by means of a 5-point scale ranging from “not at all to “extremely”. The MSIS-29 has been found to be a reliable and valid instrument (Hobart et al., 2001). Reliability was excellent in the current study.

*Neighborhood Environment Walkability Scale (NEWS):* The NEWS (Sallis, 2002) is a brief, two section questionnaire that probes participants about their neighborhood (i.e., traffic, aesthetics, and pathways) and facilities. In section one, participants were asked to rate his/her responses on a 4-point scale (strongly disagree to strongly agree) to 12 statements about his/her home environment. For example, many shops, stores, markets or other places to buy things I need are within easy walking distance of my residence. Section two assessed the availability and utilization of facilities and equipment to participants. Thirteen commonly used facilities or pieces of equipment were rated for availability and frequency of use. For example, during the next four weeks, will you have access to weight lifting equipment in your residence? This instrument was been found to be reliable and valid (Sallis, 2002) .

*Outcome Expectations:* The outcome expectancy scale was a derived from a pilot study. Participants were asked to gauge their level of agreement or disagreement on a 7-point scale (strongly disagree to strongly agree). For example, if I engage in 40 minutes of exercise 3 times per week over four weeks, it will: maintain muscle strength and tone. Responses were summed and averaged. Due to the novelty of this measure, previous reliability had not been established. However, reliability in this study was 0.91.

*Demographics:* Demographics were measured via self-report and included: age, sex, marital status, number of children, education, family income, height, weight, diagnosis and mobility.

### ***Procedures***

Participants were recruited in two ways: 1) face to face contact at local MS Society information seminars; 2) at the Carleton Place MS support group (unaffiliated).

At each recruitment session, participants were given a verbal briefing and description of the study, after which they were invited to participate in the study. For those who agreed to participate, they were asked to sign an informed consent. They then completed the battery of questionnaires. One month following receipt of the baseline questionnaire, the research assistant telephoned each participant to administer the physical activity questionnaires (i.e. Godin Leisure-Time Exercise Questionnaire). This marked the end of participation in the study. Upon completion, the patients were debriefed, which entailed a conversation regarding the purpose of the study, answering any questions the patients had about the study in general, or their own responses to the questionnaire, and confirmation that the patients could get the results of the study upon completion.

### **Results**

#### ***Power Analysis***

Using G-power for power estimation with multiple regression ( $ES = .25$ ,  $\alpha = .05$ ,  $\beta = .80$ ) and ten predictors, a sample size of seventy-five participants was required. This analysis was conducted using seventy-six participants.

#### ***Sample Recruitment***

All clinically diagnosed individuals with MS ( $\leq 80$  yrs) attending the Ottawa MS Seminar Series or Carleton Place MS support group meeting were eligible to participate. Throughout the 3 month recruitment period, ninety-six (73 women, 23 men) people were initially recruited to participate and given the baseline assessment package (questionnaire and consent form). Forty-four and forty-two participants were recruited at the first and second seminars respectively. Ten participants were recruited at the MS support group meeting. Seventy-eight (62 women, 16 men) participants completed and returned baseline assessments thus, yielding an initial response rate of 81%. Three moved or changed their phone number; 13 people failed to return their baseline questionnaire; one dropped out due to poor English comprehension; and one individual left the study as they were no longer interested in participating. Two participants left the study due to illness.

#### ***Variable Distribution***

Prior to the main regression analysis, several preliminary analyses were required. First, all variables were checked for normality. Skewness and kurtosis values were checked for all continuous variables ensuring all values fell in the acceptable range of  $\pm 1.96$  (Triola, Goodman, & Law, 1999). All values were normally distributed with the exception of scores for family participation (1.69, 3.98) and friend participation (2.21, 5.23) from the Social Support and Exercise Survey. Z-scores were calculated for these variables and any values with a corresponding z-score outside the  $\pm 3.29$  range were deleted (Triola et al., 1999). One, “family participation” score, and two, “friend participation” scores were deleted. Skewness and kurtosis were re-checked and scores were found to be normally distributed for “family participation” (1.18, 1.42). Normality

scores for “friend participation” were very close to acceptable values (1.78, 2.19) and were used in subsequent analysis.

### ***Demographic Confounders***

Next, several nominal demographic variables were recoded: marital status (0= not married; 1= married), education (0= some university or less; 1=university graduate or more), income (0= \$60 000 or less; 1= \$60 000 or more), employment (0= not working; 1= working), MS diagnosis (0= relapsing-remitting; 1= all others), and mobility (0= independent; 1= use aid at all times). Dichotomizing these demographics was necessary in order run zero-order correlations with PA to check for potential confounders. Results from these correlations showed that no demographic variable was significantly correlated with PA scores after a Bonferroni correction was made (0.05/9) to avoid making type I error (see Table 2). Thus, there were no confounding variables.

### ***Regression Analysis***

A hierarchical multiple regression analysis was performed using variables significantly correlated with PA (determined via the zero-order correlations: task efficacy ( $r = .42$ ;  $p < .01$ ), barrier efficacy ( $r = .44$ ;  $p < .01$ ), outcome expectation ( $r = .35$ ;  $p < .01$ ), social support from friends ( $r = .32$ ;  $p < .01$ ), influence of friends modeling ( $r = .23$ ;  $p < .05$ ), neighbourhood traffic ( $r = .25$ ;  $p < .01$ ), and home aerobic workout video/DVD ( $r = .28$ ;  $p < .01$ ). Four determinants of self-efficacy were used in block one of the regression (traffic, home aerobic video, support-friends and modeling-friends). The three proposed mediating influences of PA (task efficacy, barrier efficacy and outcome expectation) were entered in block two of the regression. The order of blocks was based on proximity to PA (Bandura, 1997).

Overall, the model accounted for 41% of the variance in PA. As can be seen from Table 4, block 1 accounted for 23% of the variance with traffic and modeling of friends making significant contributions to PA. Block 2 of the regression accounted for an additional 18% of variance with barrier efficacy ( $\beta = .250$ ;  $p < .05$ ) and outcome expectation ( $\beta = .211$ ;  $p < .05$ ) being significant predictors of PA. Complete regression results are illustrated in Table 4.

### *Mediation Analysis*

To determine if barrier efficacy and outcome expectations mediated the relationships between PA and traffic/modeling influence of friends, the Baron and Kenny (1986) procedure was used. There were four steps to this regression. First, PA was regressed onto the predictor variable, in this example, traffic. Second, self-efficacy was regressed onto traffic. Third, PA was regressed onto self-efficacy. Assuming these values were found to be statistically significant, a fourth regression, PA onto traffic & self-efficacy was run in order to determine mediation. In order for mediation to occur, the standardized beta for the traffic/PA relationship in regression 4 needed to be smaller than the traffic/PA beta from regression 1.

Determinants of self-efficacy used were modeling-friends and traffic while SE measures used were barrier efficacy and outcome expectation. Complete results are shown in Tables 5-8. The modeling influence of friends significantly predicted PA ( $\beta = .25$ ,  $p < .05$ ), and the mediating variable; outcome expectation ( $\beta = .21$ ,  $p < .05$ ). Further, the relationship between modeling-friends and PA, when controlling for outcome expectation was non-significant. Therefore, individuals with a greater influence from the

modeling of friends had significantly greater outcome expectations, which led to increased PA levels.

Traffic significantly predicted PA ( $\beta = .27, p < .05$ ) and the mediating variable; barrier efficacy ( $\beta = .25, p < .05$ ). The relationship between traffic and PA was non-significant when controlling for barrier efficacy. This indicates that decreased neighborhood traffic led to improved barrier efficacy, which in turn, led to increased PA.

### **Discussion**

All three proposed mediating influences of physical activity were found to be significantly correlated with PA, however, only barrier efficacy and outcome expectation were found to be predictive of PA in the MS population.

#### ***Barrier Efficacy & PA***

As anticipated, barrier efficacy was predictive of PA in this MS sample; the more barrier efficacy an MS patient had, the more likely he/she was to engage in PA. This is in line with previous studies that found barrier efficacy to be associated with PA in diseased (Allen, 2004; Blanchard, Rodgers, Courneya, Daub, & Knapik, 2002; Maddison & Prapavessis, 2004; Oliver & Cronan, 2002) and non-diseased (Conn, 1998; Everman et al., 2004; McAuley, 1992, 1993; McAuley et al., 2003; Motl et al., 2002; Winters et al., 2003) populations. Therefore, the results of this study further supported the importance of considering potential barriers when designing new PA interventions in MS patients.

Since the presence of barriers or low barrier efficacy may directly influence a decrease in PA levels, great consideration should be taken in designing PA programs for this population that may pose barriers. This may be particularly important for the MS population given that the mean barrier efficacy score for this sample was an astonishingly

low 44%. Health professionals must ensure PA programs for individuals with MS are thoroughly examined for possible barriers to activity so they may be eliminated or appropriate modifications can be made to overcome those barriers.

### ***Task Efficacy & PA***

Contrary to the first hypothesis, task efficacy was not predictive of PA in this MS population, which contradicted previous research in diseased (Allen, 2004; Maddison & Prapavessis, 2004; Oliver & Cronan, 2002) and non-diseased (Conn, 1998; Conn et al., 2003; Everman et al., 2004; McAuley, 1992, 1993; McAuley & Blissmer, 2000; Motl et al., 2002; Rodgers et al., 2002; Winters et al., 2003) samples. However, task efficacy did have a zero-order relationship with PA. It simply disappeared when considered in conjunction with barrier efficacy and outcome expectations in the regression equation.

A possible explanation for this discrepancy across studies was the instrument used to measure task efficacy for this population. Participants were asked to rate their confidence in participating in forty minutes of activity, three days per week, over a one-month time frame. Due to the unpredictable nature of the disease (Poser & Brinar, 2002; Solari & Radice, 2001; Stuijbergen et al., 2003) and severity of disability experienced by some of the participants, it may be difficult to give accurate responses to this survey. MS symptoms may fluctuate drastically from day to day or week to week, thus, making it difficult for a participant to confidently predict his/her symptoms or physical capabilities over a four week period.

### ***Outcome Expectations & PA***

A novel finding of the current study was that outcome expectations significantly predicted PA in MS patients, which was consistent with previous studies in non-diseased

populations (Clark, 1999; Conn et al., 2003; Harnirattisai & Johnson, 2005; McAuley et al., 1995; Winters et al., 2003). Results from the current study indicated that the MS population had already formed strong, positive outcome expectations about PA. This indicates that the MS population, although poor at participating in PA, is well educated on the subject of PA.

Since MS patients are already aware of the benefits of PA, health professionals should ensure PA interventions are designed to produce results matching these expectations. Although explaining the benefits of PA and dangers of sedentary lifestyle are important to convey, it may be more effective in this population to demonstrate to participants how the intervention would produce results in line with previously formed outcome expectations. In other words, rather than emphasizing the benefits of PA, which this population already strongly agrees with, focus on forming strong, positive outcome expectations regarding the intervention. Since outcome expectations are predictive of PA, allowing participants to form positive outcome expectations about the intervention, prior to implementation, may result in greater adherence to the program and result in increased PA levels.

The second purpose of the study was to examine the predictive ability of self-efficacy sources (i.e., social support, modeling, mood and environment) on PA.

### ***Social Support***

In this MS sample, social support, specifically the support received from friends, was predictive of PA. On the other hand, social support received from family was not predictive of PA for this population, which is somewhat surprising. Given that 67% of participants were married and 82% had children, one might anticipate the amount and

influence of social support from family members to be especially prominent in this population.

### *Modeling*

Vicarious experience or modeling was also found to be predictive of PA in the MS population. However, only the modeling influence of friends was predictive of PA; the influence from family and others with MS were not associated.

To date, the predictive ability of modeling or vicarious experience on PA has not been thoroughly examined. This is somewhat surprising as most other social cognitive sources have been examined in a variety of populations. However, several studies have established that modeling is significantly related to increased self-efficacy (Gould & Weiss, 1981; McAuley, 1985; Starek & McCullagh, 1999). In one original study, McAuley (1985) found modeling to be highly associated with self-efficacy in a sample of female undergraduate students. Since research has consistently shown greater self-efficacy leads to increased PA levels (Everman et al., 2004; McAuley, 1992, 1993; Motl et al., 2002; Rodgers et al., 2002), results from this study may suggest that models, especially individuals who are friends, can help increase PA levels in the MS population.

A possible explanation for the lack of influence from family members may be that the model attributes were too different from the individual with MS. According to Bandura (1997), the effectiveness of a model depends on four factors; two of which are attribute similarity and similar capabilities. The more comparable the observer (i.e., MS patient) and the model (i.e., family member) are, the stronger the influence of the model. Considering most of this sample's family members were able-bodied spouses and children, differences in age and physical capability may have diminished any influence

on the MS patient. The ability of modeling (friends) in predicting PA found in this study suggests it may need to be taken into consideration when designing PA programs, and certainly, future studies should examine the relationships between modeling, self-efficacy and PA in the social cognitive framework.

***Mood (Physiological arousal)***

Mood, or physiological arousal, was not predictive of PA in this MS sample. Unfortunately, this is inconsistent with previous findings where authors found mood to be associated with moderate and vigorous PA (Everman et al., 2004; Winters et al., 2003) and significantly associated with task-efficacy and barrier-efficacy (Blanchard, Rodgers, Courneya, Daub, & Black, 2002). A possible explanation for this lack of significance is not obvious. Perhaps the instrumentation used to measure mood was not accurate for this population. A modified, abbreviated version of the POMS was used for the purpose of saving time and ensuring the questionnaire was not too long for participants (i.e. the original POMS is 65 items). It is possible that the instrument did not capture mood of participants well enough, as the briefer version did not probe the participants as thoroughly as the extended version.

Another possible explanation for the contrast in results could be due to the nature of the disease. Due to the great difference in severity of symptoms and strong medications, physiological arousal levels of MS patients may have fluctuated drastically from day to day. For example, a hot, humid day may have severely exacerbated an MS patient's symptoms, leaving them fatigued, overheated and generally unwell. A more mild temperature the very next day may have alleviated these symptoms, leaving the same individual feeling energetic and well. In order to capture an accurate depiction of

the mood of an individual with MS, physiological arousal levels may need to be measured repeatedly. By making multiple assessments, researchers are more likely to capture the general mood state of an MS patient, rather than his/her mood on one day.

### *Environment*

Although research continues to accumulate examining environmental correlates of PA, researchers at large agree a stronger emphasis needs to be placed on the role of the environment on PA (Humpel et al., 2002; Sallis et al., 2002). In this study, the environment was found to be predictive of PA in individuals with MS. Specifically, perception of traffic and access to a home aerobic video/DVD significantly predicted PA.

Owen et al. (2004) conducted a meta-analysis aimed at determining the most influential environmental attributes on walking. Similar to the current study, they found perception of traffic and availability of home exercise equipment was associated with PA.

Health professionals, therefore, may want to take environmental variables into account when designing PA programs. Traffic plays a very influential role in the PA behavior in this population; therefore, PA interventions should be sure to utilize a safe, traffic-free environment. Accesses to home aerobic video/DVDs were also predictive of PA. This suggests that individuals with MS are willing to participate in PA if it is safe and convenient for them to do so. A PA intervention should make it as safe and easy as possible for individuals with MS to participate.

The third objective of the present study was to examine the mediating influence of social cognitive variables on the self-efficacy sources/PA relationship. No previous studies had done so in a MS population.

Results showed that the modeling-friends/PA relationship was partially mediated by outcome expectations. Therefore, health professionals should consider this when designing PA interventions for this population. For example, allowing a MS patient to observe a friend with similar capabilities, successfully complete a PA program, and obtain positive results, may influence the MS patient's outcome expectations regarding PA. By using the modeling influence of friends to form positive outcome expectations, PA levels may increase. Nonetheless, the effect of modeling on increasing PA was only partially explained by the fact that it increased the MS patient's outcome expectations. Therefore, there are likely other variables mediating the modeling-friends/physical activity relationship; future studies should investigate these possibilities.

Barrier efficacy partially mediated the traffic/physical activity relationship which is consistent with Motl et al. (2005). Coupling these findings together indicates that PA interventions should attempt to ensure the PA environment is safe and attractive to participants so they may experience increased barrier efficacy, which will lead to increased PA. For example, creating a low traffic environment may alter a participant's perception of access to exercise facilities. By moving an individual's walking route to a less trafficked area, he/she may now feel they have a safe, attractive facility for PA.

### ***Limitations & Future Directions***

There are several limitations that must be taken into account when considering the results of this study. In any research where a specific theoretical framework is utilized, an argument can be made that other frameworks should have been used. However, results from the study did provide preliminary evidence that social cognitive theory was partially successful (i.e., 41% PA variance) in explaining MS patient's PA levels.

Nonetheless, given the novelty of the theoretical research pertaining to PA in this population, replication of the current results is warranted in addition to testing other theoretical frameworks (i.e., the transtheoretical model or self-determination theory).

A second limitation was that one piece of the theoretical framework was absent in this study. Although past PA had been shown to be one of the strongest predictors of future PA participation (Bandura, 1986; McAuley, 1993), it was not assessed in this study. Unlike all other self-efficacy sources, past behavior can not be modified and due to extremely low overall PA levels for the sample, likely due to chronic fatigue, pain and disability (Janardhan & Bakshi, 2002; Voss et al., 2002), PA levels are not likely to change over time in this population without intervention. Nonetheless, future researchers should be sure to include past PA in their study design, especially when examining the effectiveness of a new PA intervention.

Third, participants were recruited from information seminars and support groups for individuals with MS and also participated in the study on a voluntary basis. This may indicate that the sample of people with MS could be biased in some way; individuals were actively seeking solutions to their MS problems and were motivated enough to volunteer in the study. This may not be representative of the entire MS population. Due to high fatigue and depression rates among individuals with MS (Janardhan & Bakshi, 2002; Voss et al., 2002), many individuals rarely leave their home. This sample may have been physically or mentally healthier than the general MS population, thus skewing results slightly.

Finally, two original instruments were used in this project, the outcome expectancy scale and the modeling scale. Although both scales were found to be reliable

in this study, they had not been previously used, thus leaving room for skepticism concerning their results. Therefore, future studies may utilize these scales to further prove their validity and reliability.

### **Conclusion**

Although previous studies have identified the benefits associated with PA for people living with MS (i.e., maintain muscle strength, decreased depression)(DeBolt & McCubbin, 2004; Ponichtera-Mulcare, 1992; Sutherland & Anderson, 2001), the MS population as a whole, continues to be sedentary (Stuifbergen & Roberts, 1997). Many studies have used social cognitive variables to explain PA behavior. In the current study, two social cognitive determinants, modeling-friends ( $\beta=.25$ ;  $p<.01$ ) and traffic ( $\beta= .23$ ;  $p<.05$ ), significantly predicted PA. Barrier efficacy ( $\beta= .25$ ;  $p<.05$ ) and outcome expectations ( $\beta= .211$ ;  $p<.05$ ) also significantly predicted PA.

Baranowski et al. (1998) found that the majority of previous studies using a social cognitive model accounted for 30% or less of the variance in PA. The present study showed that traffic and the modeling influence of friends were predictors of PA, while all self-efficacy determinants accounted for 23% of PA behavior. Barrier efficacy and outcome expectation both predicted PA and barrier efficacy, task and efficacy and outcome expectations accounted for 18% of PA variance. Together, all social cognitive variables accounted for 41% of PA in this population. Outcome expectations mediated the modeling-friends/PA relationship and barrier efficacy mediated the traffic/PA relationship.

Based on variables identified in this study, an effective intervention could be designed; by focusing on key correlates for the MS population (i.e., social support,

traffic). The same theoretical framework could be used to test the intervention's effectiveness. Once created and tested, it may be implemented in the general population. Individuals with MS looking to increase their PA levels, can utilize the intervention, become more active, and thus, experience the benefits associated with PA.

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Table 1. Descriptive Summary of Demographic Information

DEMOGRAPHIC	MEAN/PERCENTAGE	STANDARD DEVIATION
Age	50.58	10.36
# of children	1.85	1.26
# child/home	.79	.990
BMI	26.25	4.49
Years Since Diagnosis	11.08	8.97
Marital Status		
- <i>married</i>	67.1	
- <i>not married</i>	32.8	
Education		
- <i>university graduate or ↑</i>	47.3	
- <i>some university or ↓</i>	51.3	
Annual Family Income		
- <i>≥ \$60 000</i>	48.8	
- <i>&lt; \$60 000</i>	39.5	
Employment Status		
- <i>working</i>	27.6	
- <i>not working</i>	72.3	
MS Diagnosis		
- <i>relapsing-remitting</i>	51.3	
- <i>all others</i>	42.1	
Mobility		
- <i>independent</i>	32.9	
- <i>uses aid all the time</i>	67.1	

**Table 2.** Confounding Analysis – Demographics correlated with Physical Activity

DEMOGRAPHIC	PHYSICAL ACTIVITY	
	Correl	Sig
Age	-.050	.669
Gender	.118	.310
Marital Status	.026	.823
# of children	.148	.203
Children at home	.205	.078
Education	.236	.041
Income	.229	.062
Employment	.071	.541
BMI	-.143	.221
Years since diagnosis	.162	.164

**Note.**  $p < .01$  ( $p < .05/10 = .005$  – Bonferonni Correction)

**Table 3.** Zero-order correlations – Aggregates with Physical Activity

<i>Social Cognitive Variable</i>	<i>Physical Activity</i>
Anxiety – POMS	.039
Depression – POMS	-.122
Vigor – POMS	.168
Physical Impact – MSIMP	-.030
Psychological Impact – MSIMP	-.146
Social Support – Family	.197
Social Support – Friends	<b>.322**</b>
Modeling – Family	.061
Modeling – Friends	<b>.225*</b>
Modeling – Others with MS	-.052
Task Efficacy	<b>.424**</b>
Barrier Efficacy	<b>.442**</b>
Outcome Expectations	<b>.352**</b>

**Note.** \*\* $p < 0.01$ , \* $p < 0.05$ ; POMS = Profile of Mood States; MSIMP = Multiple Sclerosis Impact Scale

Table 4. Multiple regression results for significant predictors and physical activity

	<i>B</i> <sup>1</sup>	<i>B</i> <sup>2</sup>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> change
<b>Block 1</b>				
Difficult/traffic	.267*	.229*		
Aerobic video	.097	-.039		
SS – Friends	.204	.115		
Model – Friends	.252*	.254**	.229	.229**
<b>Block 2</b>				
Task Efficacy		.148		
Barrier Efficacy		.250*		
Outcome Expect.		.211*	.412	.182***

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; *SS* = social support

Table 5. Mediation Analysis Summary – Modeling-friends, barrier efficacy &amp; PA

<i>MODELING (FRIENDS)</i>	<i>BE</i>	<i>PA</i>
Regression #1) MODEL-Friends		.225*
Regression #2) MODEL- Friends	.206	—————→ <i>Stopped</i>
Regression #3) Barrier Efficacy		.442***
Regression #4) MODEL & Barrier Efficacy		.139 .413***

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; BE = barrier efficacy; PA = physical activity

Table 6. Mediation Analysis Summary – Modeling-friends, outcome expectations &amp; PA

<i>MODELING (FRIENDS)</i>	<i>OE</i>	<i>PA</i>
Regression #1) MODEL-Friends		.225*
Regression #2) MODEL-Friends	.349**	
Regression #3) Outcome Expectations		.352**
Regression #4) MODEL & Outcome Expectations		.116 .311**

Partial Mediating Effect

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; OE = outcome expectations; PA = physical activity

Table 7. Mediation Analysis Summary – Environment-traffic, barrier efficacy &amp; PA

<i>Environment - TRAFFIC</i>	<i>BE</i>	<i>PA</i>	
<b>Regression #1) TRAFFIC</b>		<b>.253*</b>	} <b>Partial Mediating Effect</b>
<b>Regression #2) TRAFFIC</b>	<b>.303**</b>		
<b>Regression #3) Barrier Efficacy</b>		<b>.442***</b>	
<b>Regression #4) TRAFFIC &amp;</b>		<b>.131</b>	
<b>Barrier Efficacy</b>		<b>.402***</b>	

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; BE = barrier efficacy; PA = physical activity

Table 8. Mediation Analysis Summary – Environment-traffic, outcome expectations &amp; PA

<i>Environment - TRAFFIC</i>	<i>OE</i>	<i>PA</i>	
<b>Regression #1) TRAFFIC</b>		<b>.253*</b>	
<b>Regression #2) TRAFFIC</b>	<b>-.003</b>		→ <i>Stopped</i>
<b>Regression #3) Outcome Expectations</b>		<b>.352**</b>	
<b>Regression #4) TRAFFIC &amp;</b>		<b>.254*</b>	
<b>Outcome Expectations</b>		<b>.352**</b>	

Note. \*  $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ ; OE = outcome expectations; PA = physical activity