Examining the role of trait mindfulness and emotion regulation in quality of life in multiple sclerosis

Thesis

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By

Brittney L. Schirda, B.S.
Graduate Program in Psychology
The Ohio State University
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Thesis Committee:
Dr. Ruchika Shaurya Prakash, Advisor
Dr. Amelia Aldao
Dr. Jacqueline Nicholas
Abstract

Dispositional mindfulness demonstrates a positive association with quality of life (QoL). One mechanism by which mindfulness may be associated with better QoL is through an enhancement of emotion regulation abilities. Individuals with multiple sclerosis (MS) experience a plethora of physical, cognitive, and affective impairments, thus reducing overall QoL. The current study examined the relation between mindfulness and QoL, mediated by emotion regulation abilities in individuals with MS. Ninety-five participants with MS completed an online survey incorporating self-report measures of mindfulness, emotion regulation abilities, and QoL. Additionally, although clinical depression was exclusionary, a wide range of depressive symptoms was found in our sample; thus, depression scores were included as a moderator in our mediation model. We found a positive relation between mindfulness and overall QoL, which was partially mediated by emotion regulation. Furthermore, this mediation pathway was significantly moderated by depressive symptoms, such that the effect was stronger in those with greater depressive symptomology. Trait mindfulness may play a role in preserving QoL in individuals with MS. Specifically, mindfulness may impact QoL through the potential pathway of reducing emotion regulation deficits, especially in those with greater depressive symptoms. Future studies should employ a longitudinal study design examining the effects of mindfulness training in individuals with MS on improving QoL through enhancing emotion regulation, utilizing a more nuanced multi-modal approach.
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I dedicate this thesis to my husband, Claudiu Schirda, for the countless hours spent driving to and from Columbus and his belief in this work and me.
Vita

2005…………………………………….Williamsville East High School, Williamsville, NY
2009……………………………B.S. Psychology & Biology, University of Pittsburgh, Pittsburgh, PA

Publications


Honors and Awards

2013-2014 Department of Psychology Teaching Assistantship, The Ohio State University

2012 The Ohio State Social and Behavioral Sciences Fellowship

2012 University Fellowship for Graduate Studies at The Ohio State University

Fields of Study

Major Field: Psychology
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Chapter 1

Introduction

Multiple sclerosis (MS) is a neurodegenerative disease associated with widespread disturbances in the central nervous system (CNS). The disease is characterized by inflammation, demyelination, or deterioration of the myelin sheath; the fatty white substance surrounding and protecting the nerve fibers throughout the brain and spinal cord (Kutzelnigg et al., 2005); axonal dysfunction; and the degradation of gray matter located in the cerebral cortex, as well as in the sub-cortical nuclei (Pirko, Lucchinetti, Sriram, & Bakshi, 2007). Multiple Sclerosis affects an estimated 2.3 million individuals worldwide (National Multiple Sclerosis Society, 2014). This disease affects women and men differentially, with women being two to three times more likely to be diagnosed with MS in comparison to men (Orton et al., 2006). Although MS can affect a broad range of ages, including children, its typical onset occurs in individuals between the ages of 20 and 40 years (Milo & Kahana, 2010). In addition to the associated detriment in the affected individual and caregivers, the disease also is a substantial burden to society. The direct and indirect monetary cost of healthcare related to MS is estimated to be up to $50,000 per patient per year (Adelman, Rane, & Villa, 2013). Around 23% of those costs are considered indirect, which can include increased unemployment rates, reduced vocational productivity, poor job attendance, and alterations to the physical structure of the living and workplace.
The symptomology of MS is highly heterogeneous and often unpredictable, impacting different aspects of functioning in each affected individual. Historically, the most commonly reported deficit within these individuals is that of physical dysfunction, impacting one’s vision, mobility, bowel and urinary systems, and peripheral senses which can involve physical pain, numbness or tingling in the extremities (Martin et al., 2006). Cognitive (Prakash, Snook, Lewis, Motl, & Kramer, 2008) and affective (Siegert & Abernethy, 2005) disturbances have also been found to be associated with MS, with prevalence rates estimated to be up to 70% (Chiaravalloti & DeLuca, 2008) and 50% (Sadovnick et al., 1996) respectively in affected individuals. Similarly to the diverse and idiosyncratic symptoms experienced within the MS population, the course of the disease is also variable. There are currently five recognized distinct sub-types of MS (Lublin & Reingold, 1996), namely relapsing-remitting multiple sclerosis (RRMS), primary progressive multiple sclerosis (PPMS), secondary progressive multiple sclerosis (SPMS), relapsing progressive multiple sclerosis (RPMS), and progressive relapsing multiple sclerosis (PRMS). Those sub-types of MS with a progressive component, such as primary and secondary progressive, involve a steady worsening of neurological dysfunction over time (Lublin & Reingold, 1996). RRMS, the most common sub-type, includes alternating patterns of exacerbations, or acute symptom “flair ups”, and remissions, or periods of time that are free from symptom burden. The other sub-types are an amalgamation of both periods of progressive gradual decline and relapses.

Given these all-encompassing disruptions to physical, cognitive, and emotional well-being, individuals with MS have been shown to experience a substantial reduction in
overall quality of life in comparison to their healthy control counterparts (see Benito-León, Morales, Rivera-Navarro, & Mitchell, 2003 for a review). Studies assessing quality of life in MS have illuminated an overall reduction in quality of life within these individuals, beginning early in the disease process, in comparison to the general healthy population (Fruewald, Loeffler-Stastka, Eher, Saletu, & Baumhacki, 2001) and remarkably above and beyond those with other chronic illnesses, such as in those with inflammatory bowel disease (Rudick, Miller, Clough, Gragg, & Farmer, 1992), rheumatoid arthritis (Rudick et al., 1992), diabetes (Hermann et al., 1996), and epilepsy (Hermann et al., 1996). This reduction has been found to be associated with a lower capacity to work (Flensner, Landtblom, Söderhamn, & Ek, 2013), greater fatigue (Pittion-Vouyovitch et al., 2006), and greater cognitive impairment (Benito-Leon, Morales, & Rivera-Navarro, 2002). Furthermore, perceived quality of life can affect an individual’s adherence to disease modifying medication, as found in a study comparing both mental ($d = .30$) and physical ($d = .22$) self-reported quality of life in adherent and non-adherent individuals (Treadaway et al., 2009). Given that disease modifying medication, which aims to slow progression and reduce rates of relapse, is the primary line of care in individuals with MS, it is crucial that these individuals remain adherent.

Relevantly, a striking proportion of those individuals diagnosed with MS—up to 50% (Sadovnick et al., 1996)—experience depression, which further contributes to their reduced quality of life (Karatepe et al., 2011). In fact, studies have found depressive symptoms in MS to be the strongest predictor of quality of life, exceeding the effect of disability status (Lobentanz et al., 2004). One could speculate that this robust connection
between depressive symptoms and quality of life may stem from an underlying vulnerability of reduced emotion regulation abilities in those with MS.

*Emotion Regulation*

The literature on MS contains evidence supporting the claim that those with MS may exhibit reduced emotion regulation ability, although few studies have examined emotion regulation explicitly. Defined as a set of conscious and unconscious processes, emotion regulatory skills can be utilized by an individual to manage or influence how long, when, and which emotions arise (Gross, 2002). This can include the acceptance and clarity of one’s emotions (Gratz & Roemer, 2004); as well as having a keen awareness of the emotions generated or stimuli evoking them; goals to enhance, maintain, or dampen emotions; and the range of strategies one possesses to carry out these goals (Gross & Jazaieri, 2014). Emotion regulation can affect one’s overt behavioral response, as well as their internal physiological response to a stimulus (Gross, 1998). As described in Gross’ process model of emotion regulation (Gross, 2002), emotion regulation strategies can be implemented prior to the complete activation of an emotional response, which is an antecedent-focused form of emotion regulation, or after an emotional response, defined as response-focused. Further, five specific stages or processes of emotion regulation have been defined in the model: situation selection, situation modification, attentional deployment, cognitive change, and response modulation (Gross, 2002). Difficulties in regulating ones’ emotions can occur at any one of these stages as they are temporally separated. Preliminary evidence, as evinced in a study completed by Phillips and colleagues (2009), shows a significant relation between emotion regulation and quality of
life in MS. Explicitly, greater use of cognitive reappraisal, a putatively adaptive antecedent emotion regulation strategy was associated with higher reported quality of life in individuals with MS.

Additionally, studies investigating coping in MS, a construct related to emotion regulation (Gross & Thompson, 2007), have found individuals with MS utilize greater emotion-based coping strategies, which are associated with poorer quality of life (Montel & Bungener, 2007), rather than problem-based coping (McCabe, McKern, & McDonald, 2004). Furthermore, greater reported positive reappraisal, a positive coping strategy, is related to lower reported depressive symptoms at baseline as well as prospectively overtime, while escape-avoidance, a putatively negative strategy, is associated with higher levels of depressive symptoms in those with MS (Aikens, Fischer, Namey, & Rudick, 1997). Similarly, greater levels of alexithymia (Prochnow et al., 2011), characterized by a lack of identifying and describing emotions, have been found in those with MS. Individuals with MS have also been found to display difficulties in emotion perception, which could potentially affect their ability to react appropriately in a social-emotional context. A study assessing their ability to decipher emotion on both static images of faces and dynamic film clips of people interacting found that individuals with MS performed poorer on this behavioral measure of emotion perception than healthy controls. Importantly, this deficit was correlated with a reduction in both social and psychological quality of life functioning (Phillips et al., 2011).

Corroborating the behavioral evidence supporting reduced emotion regulation ability in MS, preliminary neuroimaging evidence has evinced alterations of the affective
neural circuitry. Specifically, individuals with MS show greater activation in the ventrolateral prefrontal cortex (vPFC) in response to emotional versus neutral stimuli in comparison to healthy adults (Passamonti et al., 2009). This, along with an absence of task-related adaptation in functional connectivity between the PFC regions and amygdala, signifies the presence of potential deficits in the emotional processing circuitry. Thus, the potential vulnerability for emotion regulation deficits as evidenced by a heightened prevalence of psychopathology and other affective disturbances, greater use of poor coping strategies, as well as altered neural circuitry in this population, elucidates the importance of improving emotion regulation in MS.

Taken together, the need for studies investigating potential factors associated with alterations in emotion regulation and preserving and improving overall quality of life in individuals with MS is thus evident given the enduring nature of the illness and current lack of a clear etiology or cure. Mindfulness is a pertinent factor for those with MS, as it has been shown to be efficacious in increasing well-being in a variety of populations, as well as its proposed mechanistic influence on emotion regulation. In this current cross-sectional study, we purported to examine the associations between dispositional mindfulness, quality of life, and emotion regulation abilities in individuals with multiple sclerosis (MS). In addition, while acknowledging the limitations of analyzing mediation in cross-sectional data, we assessed emotional regulation abilities as a potential mediator in the association between dispositional mindfulness and quality of life in MS. This was done as a preliminary attempt to examine the pathway through which mindfulness might be associated with quality of life in those with MS.
Dispositional mindfulness, assessed through self-report measures, is the ability to intentionally attend to the experiences of the present moment with receptive awareness (Brown & Ryan, 2003). Measured as such, dispositional mindfulness has been found to be associated with better quality of life, as well as with overall health and well-being (Keng, Smoski, & Robins, 2011). Researchers have found this association not only in a variety of healthy populations, such as in young adults (Howell, Digdon, Buro, & Sheptycki, 2008) and older adults (de Frias & Whyne, 2014), but also in clinical populations, such as in those with cancer (Bränström, Kvillemo, Brandberg, & Moskowitz, 2010), irritable bowel syndrome (Garland et al., 2012), chronic fatigue syndrome (Surawy, Roberts, & Silver, 2005), and fibromyalgia (Grossman, Tiefenthaler-Gilmer, Raysz, & Kesper, 2007). One of the primary areas of focus within the contemporary study of mindfulness is an examination of the mechanisms through which enhanced mindfulness achieves its prophylactic effects. Several proposed mechanisms have received support, such as increased attention regulation (Schmertz, Anderson, & Robins, 2009), enhanced body awareness (Farb et al., 2010), increased emotion regulation (Goldin & Gross, 2010), and better self-perception (Hollis-Walker & Colosimo, 2011). A growing body of evidence suggests enhanced emotion regulation is at the forefront of these mechanisms (e.g. Arch & Craske, 2006; Coffey, Hartman, & Fredrickson, 2010; Taylor et al., 2011).
Supporting both the notion that trait mindfulness is a meaningful factor in those with MS, and the hypothesis that increased emotional regulation might be an important pathway linking mindfulness to psychological prophylaxis, previous empirical evidence evinces higher levels of trait mindfulness to be associated with an overall reduced perception of emotion regulation difficulty (Hill & Updegraff, 2012; Prakash, Hussain, & Schirda, in review; Roemer et al., 2009). Additionally, trait mindfulness has been linked with reported greater use of putatively adaptive regulation strategies, such as cognitive reappraisal (Jermann et al., 2009), and a reduction in putatively maladaptive strategies, such as suppression (Tamagawa et al., 2013), rumination (Borders, Earleywine, & Jajodia, 2010), brooding, and worry (Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007). Of note, those with greater depressive symptoms report more frequent use of these maladaptive strategies, such as rumination and suppression (see Aldao, Nolen-Hoeksema, & Schweizer, 2010 for a review). More recent literature has investigated the neural correlates of mindfulness (see Chiesa, Serretti, & Jakobsen, 2013 for a review). Explicitly, mindfulness is associated with both the enhancement of top-down regulation ability, which is associated with an increase in neural activation of the prefrontal cortex (PFC) which in turn modulates or reduces the activity of the limbic structures, such as the amygdala (Farb et al., 2007); and the perceptual bottom-up emotion regulation ability (Taylor et al., 2011), which involves the notion of becoming less reactive to the world, neurally expressed by reduced amygdala activation without PFC modulation. Overall, there is considerable support for the interplay between mindfulness and emotion regulation ability (Chambers, Gullone, & Allen, 2009), and thus it is a relevant
relationship to investigate in those with MS, given the potential for their underlying vulnerability in emotion regulation and the mutual relation with improved quality of life.

Preliminary evidence within this population of individuals with MS speaks to the probable protective nature of mindfulness in influencing both emotion regulation and quality of life. In a recent study, Senders & colleagues (2014) found trait mindfulness to be associated with enhanced wellbeing, better coping skills, and decreased psychological distress in those with MS. Additionally, higher levels of trait mindfulness have been found to be associated with higher levels of positive affect and relationship satisfaction in those with MS, as well as lower levels of anxiety symptoms (Pakenham & Samios, 2013). Furthermore, mindfulness training, in the format of an 8-week mindfulness-based stress reduction (MBSR) program utilizing meditation practice and gentle yoga to increase one’s mindfulness skill set, has also been found to improve overall quality of life in individuals with MS. Depressive and anxiety symptoms were also reduced (Grossman et al., 2010).

Summary

MS has a profound impact on overall quality of life, which is especially salient in those with greater affective disturbance. Preliminary evidence in this population including the considerable prevalence of emotional disorders, use of poor coping strategies, and an alteration in the neural circuitry associated with affective regulation, suggests difficulties in emotion regulation. Mindfulness is a promising candidate for maintaining or enhancing quality of life in these individuals, as this relation has been
shown in a variety of other populations. Additionally, there is evidence that mindfulness may achieve its prophylactic effects through influencing emotion regulation ability.

**Specific Aims**

In this study, the primary objective was to conduct a cross-sectional study examining the association between trait mindfulness and quality of life in individuals with MS. The Five Facet Mindfulness Questionnaire (FFMQ) was utilized to assess levels of trait mindfulness and has been used in a variety of populations. Quality of life was measured through the Satisfaction with Life Scale (SWLS) and the World Health Organization Quality of life – brief version (WHOQoL-BREF) in order to capture both a general and health-related report of quality of life. Secondly, we cross-sectionally assessed one potential mechanism of mindfulness on quality of life, perceived emotion regulation ability, which was measured using the Difficulties in Emotion Regulation Scale (DERS). The specific study aims included:

1) Examining the association between trait mindfulness and quality of life in MS. Our hypothesis predicted higher levels of trait mindfulness would be associated with greater reported quality of life.

2) Examining perceived emotion regulation ability as a mediator in the pathway between trait mindfulness and quality of life in those with MS. It was predicted that emotion regulation ability would mediate the relation between mindfulness disposition and quality of life.
Chapter 2

Methods

Study Design and Participant Characteristics

We conducted a cross-sectional study examining the associations between mindfulness, disposition, emotion regulation ability, and quality of life in individuals with MS, as well as the potential mechanistic role emotion regulation ability may play in the association between mindfulness and quality of life. We utilized an *a priori* power analysis to determine the sample size that we would require in the proposed study to detect a significant relationship between emotion regulation and trait mindfulness, as well as between each construct and quality of life. Evidence from previous studies completed in non-clinical patient populations examining the association of emotion regulation and trait mindfulness indicate an effect size (r) of .48 (Roemer et al., 2009), and an estimated effect size between mindfulness and quality of life of (r) .30 (Brown & Ryan, 2003). Utilizing the lower effect size and a .05 alpha significance level (2-tailed test), a sample size of 95 would yield an estimated power sufficiently greater than 0.85 for the statistical test of the correlation between emotion regulation or trait mindfulness and quality of life.

Nighty-five participants with self-reported multiple sclerosis (M age = 44 years, 83% female) were recruited to participate in the online study. Participants were included in the study if they had a self-reported diagnosis of MS, were aged between 18 to 55
years, and were from the United States. Participants were excluded if they reported the presence of any co-morbid neurological disorder or psychiatric disorder and if their recorded IP address had previously been reported as spam producing. In the case that a participant completed multiple surveys, the first survey was recorded.

**Recruitment and Study Procedures**

Individuals with multiple sclerosis were recruited for this study largely through our laboratory’s multiple sclerosis past participant database (35%) and Research Match (44%), a national health volunteer registry that was created by several academic institutions and supported by the U.S. National Institutes of Health as part of the Clinical Translational Science Award (CTSA) program. Online advertisements posted to listservs and support group websites were also utilized. Online platforms have been previously utilized to recruit individuals with MS, based on a self-report diagnosis (Green & Todd, 2008; Hadgkiss et al., 2013; LaRocca, 2011).

All participants who voluntarily chose to participate in the online survey, and met the above-mentioned exclusionary and inclusionary criteria, which was assessed in the first portion of the online survey, were included in the study. After being included in the study, the participants were presented with a set of questions addressing demographic and disease related information, such as type of MS, disease duration, current medications, typical MS-related symptoms and last exacerbation. Next, a series of self-report questionnaires were administered to the participant measuring emotion regulation, mindfulness disposition, depression, disease severity, and general and health-related quality of life. Lastly, the participant was asked to provide likert-scale ratings of their
perceived valance and arousal in response to aversive and neutral images (for an unrelated project). The total time commitment for the participant was between 60 to 90 minutes. The online survey was completed at a computer of the participant’s choice. Participants were compensated with a $5 Amazon gift card, which was sent to their provided email address.

Measurement/Instrumentation

Dispositional Mindfulness

Dispositional mindfulness was measured using the self-report Five Facet Mindfulness Questionnaire (FFMQ). There are 39-items that are each measured using a five-point scale. This scale was created by combining five of the most commonly used mindfulness questionnaires using a factor analysis (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), which produced five unique facets associated with the overarching complex, multifaceted construct of mindfulness disposition. The resulting facets were Observing, Describing, Acting with Awareness, Non-Judgment, and Non-Reactivity. Validity data collected from meditators and non-meditators, suggest the measure is valid to be used within various populations (de Bruin, Topper, Muskens, Bögels, & Kamphuis, 2012). Further, the facets show modest significant correlations with each other, ranging from .13 to .39, which indicates that they are related but not completely overlapping (de Bruin et al., 2012). The Observing facet in the FFMQ examines one’s ability to notice bodily sensations, feelings and emotions, and objects in their environment. Some examples of observing items are “I pay attention to the sounds, such as clocks ticking, birds chirping, or cars passing” and “When I’m walking, I deliberately notice the
sensations of my body moving”. The Describing facet involves one’s ability to use words to label and describe their feelings, emotions, and experiences. Examples of the Describing facet are “Even when I’m feeling terribly upset, I can find a way to put it into words” and “I’m good at finding words to describe my feelings”. Acting with awareness is defined by one’s ability to stay focused and not become distracted, as exemplified by the reverse scoring of these items: “I am easily distracted” and “I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted”. The Non-judgment facet incorporates the concept of being non-judgmental or responding neutrally, the absence of using the labels “good” and “bad”, to one’s thoughts, feelings and emotions. The following are reversed scored examples of the non-judgment facet: “I think some of my emotions are bad or inappropriate and I shouldn’t feel them” and “I tell myself I shouldn’t be feeling the way I’m feeling”. Lastly, the Non-reactivity facet is one’s tendency to pause before reacting and to have greater control over their responses, as can be seen in the following items: “In difficult situations, I can pause without immediately reacting” and “When I have distressing thoughts or images, I just notice them and let them go”. Cronbach’s alpha on the total score, including all facets, for this study equals .929.

Emotion Regulation

Emotion regulation was measured using the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). This self-report measure is a 36-item questionnaire, which uses five-point ratings (1= almost never to 5= almost always) to assess an individual’s perceived rating of their typical difficulties in regulating their
emotions. Gratz and Roemer (2004) utilized a factor analysis to create a multidimensional measure that incorporates many aspects of emotion regulation beyond the control and modulation of emotions and emotional experiences. Using a factor analysis, six separate facets were found: nonacceptance of emotional response, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. The nonacceptance factor assesses one’s difficulty in accepting their emotions and feelings. For example the following items are used to assess nonacceptance: “When I’m upset, I feel guilty for feeling that way” and “When I am upset, I feel like I am weak”. The difficulties engaging in goal-directed behavior facet assesses a deficit in one’s success of regulating emotions affectively to engage in goal-directed behavior such as concentrating or completing work. The following items are used to assess this facet: “When I’m upset, I have difficulty thinking about anything else” and “When I’m upset, I have difficulty focusing on other things”. The impulse control facet measures one’s ability to control their impulses, for example “When I’m upset, I become out of control” and “When I’m upset, I have difficulty controlling my behaviors”. Lack of emotional awareness addresses the concept of having a difficult time paying attention to one’s emotions and feelings. The following are items that are rated inversely in the lack of emotional awareness facet: “I am attentive to my feelings” and “When I’m upset, I acknowledge my emotions”. Emotion regulation strategy use, or whether or not individuals have strategies to aid them in controlling their emotions once they arise, is measured under the limited access to emotion regulation strategy facet. “When I’m upset, I believe that there is nothing I can do to make myself feel better” and “When I’m upset, I
believe that wallowing in it is all I can do” are examples of the limited access to emotion regulation strategy facet. Lastly, lack of emotional clarity addresses one’s difficulties in understanding and identifying their own emotions; item examples are “I am confused about how I feel” and “I have no idea how I am feeling”. Cronbach’s alpha on the total score, including all facets, for this study equals .947.

Quality of Life

Quality of life was assessed using both the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985), which is a one-dimensional global measure of quality of life, and the World Health Organization Quality of Life-BREF (WHOQoL-BREF; WHOQoL Group, 1998) questionnaire, which measures health-related quality of life.

Satisfaction with Life Scale

The SWLS has been found to be a reliable measure of overall life satisfaction, in that research has found it to display high internal consistency with coefficient alphas ranging from .79-.89 (Pavot & Diener, 1993). The scale shows moderate to strong temporal reliability over a wide range of test-retest intervals, spanning from two weeks (r = .83) to four years (r = .54; Pavot & Diener, 1993). This measure shows moderate construct validity, as it exhibits correlation coefficients with other theoretically similar self-report measures ranging from .35 to .83 (Pavot & Diener, 1993). Scores on the SWLS are made up of a sum of five items that are rated using a seven-point scale, where five indicates low satisfaction and 35 signifies high satisfaction. The SWLS is a global
measure of quality of life, and thus it is not disease specific. Research studies utilizing this measure within MS populations have found comparable reliability and validity estimates (Motl, McAuley, Snook, & Gliottoni, 2009). Cronbach’s alpha for this study equals .884.

*World Health Organization Quality of Life-BREF*

The WHOQoL-BREF is a 26-item questionnaire that measures four domains of quality of life, specifically psychological, environmental, physical, and social. This questionnaire was created to be a cross-cultural health-related measure of overall quality of life. The WHOQoL-BREF is the shorter version of the WHOQoL-100 self-report assessment (WHOQoL Group, 1994). Although substantially condensed, the brief version has shown comparable reliability and validity, and also provides nuanced data into the various domains of quality of life (Skevington, Lotfy, & O'Connell, 2004). The measure has shown moderate to strong internal consistency in United States samples (alpha = .69-.87; Skevington et al., 2004). Additionally, the measure has indicated significant discriminant validity, specifically in its ability to decipher quality of life in sick and well samples (Skevington et al., 2004). The construct validity of the four domains has been supported by data from a study that completed a factor analysis to ensure the four domain model is the best fit (Skevington et al., 2004). Finally, a study completed by Wynia and colleagues (2008) highlighted that the WHOQoL-BREF is a better outcome measurement for quality of life in individuals with MS in comparison to another commonly used health-related quality of life measure, the Medical Outcome study Short Form Questionnaire, because it covers a more comprehensive definition of the construct,
beyond the physical aspect, including information about the impact of the environment and other life circumstances. Cronbach’s alpha on the total score, including all domains, for this study equals .933.

Depression

Depression was measured using the 21-item self-report Beck Depression Inventory-II scale (BDI-II Beck, Steer, & Brown, 1996). This measure is one of the most widely used questionnaires assessing depressive symptoms in a variety of populations (Benedict et al., 2005; Bower et al., 2011). Although there is some debate about its use within the MS population, the BDI is one of the most commonly used depression scale in individuals with MS (Goldman Consensus Group, 2005). The debate surrounds the potential overlap of depressive symptoms tested in this questionnaire with the symptoms related to the MS disease course to be a concern. There has been evidence in the MS literature in support of the BDI-II as a valid and reliable measure of depression despite these concerns (Moran & Mohr, 2005). Furthermore, the Goldman Consensus Group (2005) completed a study assessing the employment of this measurement in individuals with MS and reported that it is the optimal approach to screen for depression in patients with MS.

Disease Severity

Disease Severity in this study was assessed using the Expanded Disability Status Scale-SR (EDSS-SR). As described previously, the EDSS is a measure that is widely used to evaluate disability in individuals with MS. This measure encompasses the
effectiveness of eight of the body’s functional systems (FS) by using half point increments, starting with a score of 0, indicating no impairment, to 10, indicating death from MS. The following systems are incorporated in the overall score: pyramidal, cerebellar, brainstem, sensory, bowel and bladder, visual, cerebral and other. This scale can be completed both as a physician administered test and a self-report measure. Given that we administered this scale online, we used the self-report version for the current study. The self-report EDSS has been validated, and further it has been shown to have a strong correlation with the physician administered version of EDSS (r = 0.87; Bowen, Gibbons, Gianas, & Kraft, 2001).

Statistical Analyses

All analyses were performed using SPSS 21.0 (IBM, New York). Composites scores were created for trait mindfulness, emotion regulation ability, and quality of life. Specifically, individual facet scores were averaged for the FFMQ, DERS, and WHOQoL-BREF separately to create a single score for each measure. As can be seen in Table 2 (panels a-c), the individual facets’ scores for these questionnaires were highly correlated justifying the creation of a composite score for these constructs. The DERS composite score was multiplied by -1 so that higher scores reflected higher emotion regulation abilities. Additionally, given the high correlations between the two quality of life measures, the standardized cores of the WHOQoL-BREF and SWLS were merged, by averaging the two measures, to create an overall composite of quality of life that incorporates both domain-specific and general aspects of quality of life. The composite scores for each of the constructs were tested for the presence of outliers, which were defined as any z-score +/- 2.5 SD from the mean. Any score exceeding this threshold was
replaced with a score equivalent to 2.5 $SD$. Normality of data was checked using Kolmogorov-Smirnov test for normality. Bivariate correlations (Pearson’s for normal distributions and Spearman’s rho for non-normal distributions) are presented in Table 2 between the individual facets of each composite variable (panels a-c) and the overall composite variables of interest (panel d).

Next, a simple mediation analysis (Preacher & Hayes, 2008) was employed to test the hypothesis that emotion regulation ability plays a mediating role in the relationship between trait mindfulness and quality of life. In here, we utilized the PROCESS macro for SPSS to apply a bias-corrected non-parametric bootstrapping technique with 5000 resamples to estimate the direct, indirect, and total effects of trait mindfulness on quality of life. Bootstrapping is considered a robust method for determining indirect effects, as it does not make the assumption of a normal sampling distribution (Preacher & Hayes, 2008). Significant indirect and direct effect point estimates were determined based on the criterion that the 95% CI not include zero. The indirect effect in this model is the effect of trait mindfulness on quality of life accounted for by emotion regulation ability, while the direct effect is the effect of mindfulness on quality of life left unexplained by emotion regulation ability. Lastly, the total effect is the sum of the indirect effect and the direct effect.

Although a clinical diagnosis of a psychiatric disorder, such as depression, was an exclusionary criterion, a wide range of depressive symptoms was found utilizing the BDI-II in our sample ($M$ (SD) = 14.3(10.2); Range = 0-43). This finding is consistent with previous studies that have excluded participants with a self-reported psychiatric
diagnosis, but still report a wide range of depressive symptoms (Andrews-Hanna et al., 2013), which suggests that there may be individuals that have gone undiagnosed in our sample. Given this range of depressive symptoms, an exploratory moderated mediation model including a dichotomous depressive symptom variable was conducted. Scores on the BDI-II were separated utilizing a median split, such that the two samples were made of 47 individuals with a score < 13 and 48 with a score ≥ 13. It was hypothesized that depressive symptoms would moderate the strength of the mediated relation between trait mindfulness and quality of life via emotion regulation ability. We tested moderated mediation by assessing for the presence of (a) a moderation of at least one path in the mediation model and (b) a conditional indirect effect meaning the indirect effect must be dependent at different levels of the moderator (Preacher, Rucker, & Hayes, 2007). Specifically, we examined the interaction between trait mindfulness and depressive symptoms in predicting emotion regulation ability; the interaction between depressive symptoms and emotion regulation ability in predicting quality of life; and the interaction between trait mindfulness and depressive symptoms predicting quality of life. If moderated mediation exists, the strength of the relation between trait mindfulness and quality of life through emotion regulation ability would be altered at the two levels of depressive symptoms, high (1) and low (0). We employed Hayes’ index of moderated mediation included in the PROCESS macro for SPSS (Hayes, in review) to test for the presence of moderated mediation. This index tests for a non-zero weight of the moderator in the indirect effect process. In here, a bootstrapping technique with 5000 resamples was used providing a 95% CI; if the CI does not include zero, moderated mediation is indicated.
Chapter 3

Results

Demographics and Bivariate Correlations

Table 1 presents the descriptive statistics, including means, standard deviations, and ranges for the variables of interest. Bivariate correlations among the various sub-facets (panels a-c) of each composite variable are presented in Table 2, as well as between the overall composite variables (panel d). Consistent with our hypotheses, we found evidence for a positive association between dispositional mindfulness and perceived emotion regulation abilities ($\rho = .77$) and quality of life ($r = .63$) in our sample of individuals with MS. Additionally, emotion regulation abilities were also associated with quality of life ($\rho = .59$), such that individuals with higher perceived emotion regulation abilities reported higher quality of life.

Emotion regulation as a mediator in the association between trait mindfulness and quality of life

Given the theoretical framework outlining emotion regulation to be an important pathway linking mindfulness to quality of life, we conducted mediational analyses to test for whether emotion regulation abilities would mediate the association between mindfulness and quality of life. We utilized a simple mediation model with bootstrapping to estimate the direct and indirect effects of mindfulness (Preacher et al., 2007). We
found the total effect of the relation between trait mindfulness and QoL, or the sum of the direct and indirect effects, was equal to a point estimate of .260 (Figure 1). We found that the effect of trait mindfulness on emotion regulation was significant ($B = 4.14$, $SE = .355$, $p < .01$), such that higher levels of trait mindfulness were associated with greater perceived emotion regulation abilities. We also found a significant relation between emotion regulation abilities and QoL ($B = .022$, $SE = .010$, $p = .03$), such that better perceived emotion regulation abilities were associated with better QoL. The indirect effect, assessing the variance explained by emotion regulation abilities in the relation between trait mindfulness and QoL, was significant (point estimate of .089; CI: .019 to .153). This suggests that emotion regulation abilities in individuals with MS mediate the association between trait mindfulness and QoL. The direct effect of mindfulness on QoL remained significant (point estimate of .170; CI: .069 to .272) in this model, indicating that the relationship between trait mindfulness and QoL was only partially mediated by emotion regulation ability (Figure 1). These results indicate emotion regulation ability to be a partial mediator in the relation between trait mindfulness and QoL.

*Depression symptoms as a moderator in the association between trait mindfulness and quality of life via emotion regulation*

Given our finding that emotion regulation significantly partially mediates the relation between trait mindfulness and quality of life, we were able to test the hypothesis that depressive symptoms may play a role in moderating this mediation pathway. We tested the interaction between trait mindfulness and depressive symptoms in predicting emotion regulation ability; the interaction between emotion regulation ability and
depressive symptoms in predicting quality of life; and the interaction between trait mindfulness and depressive symptoms in predicting quality of life.

Of the three interactions tested in the model, the interaction between trait mindfulness and depressive symptoms in predicting emotion regulation was the only significant interaction ($B = 1.91, t = 2.49, p = .01$). The interactions between trait mindfulness and depressive symptoms in predicting QoL ($B = -0.037, t = -0.365, p = .72$) and emotion regulation ability with depressive symptoms predicting QoL ($B = 0.008, t = .361, p = .72$) were not significant. Therefore, depressive symptoms were only included as a moderator in the pathway between trait mindfulness and emotion regulation in the final model, given the significant interaction between trait mindfulness and depressive symptoms in predicting emotion regulation abilities (see Figure 1). In this model, we examined the conditional indirect effect of trait mindfulness on QoL through emotion regulation abilities at the two levels (1, 0) of the moderator. For this, we first examined the 95% CI around the conditional indirect effect at the two levels of the moderator utilizing a bootstrapping method of 5,000 resamples (Preacher & Hayes, 2008). For those with low depressive symptoms (0) the indirect point estimate was .050, with a 95% CI of .013 to .098 and for those with high depressive symptoms (1) the indirect effect point estimate was .091, with a 95% CI of .021 to .160. Therefore, we found that neither CI included zero indicating that for both groups emotion regulation ability significantly partially mediates the relation between trait mindfulness and QoL.

Next, we examined the index of moderated mediation, which was .041, and the 95% CI surrounding the index of moderated mediation (Hayes, in review), which also did not include zero (.009 to .095). Thus, our results showed the conditional indirect effects
were significantly different in each of the two groups. In other words, the indirect effect of trait mindfulness on QoL through emotion regulation ability is stronger in those that have higher depressive symptoms than in those that have low depressive symptoms.
Chapter 4

Discussion

The primary purpose of this study was to investigate the relationship between dispositional mindfulness, emotion regulation, and quality of life in those with MS. Considering the vast implications of a life with MS, it is paramount that the relative paucity of research investigating potential psychological factors influencing quality of life in this population be addressed. In support of our hypothesis, we found higher levels of trait mindfulness to be associated with better quality of life in individuals with MS. Additionally, our findings add to the previous literature in a meaningful way by elucidating enhanced emotion regulation as one valid pathway by which mindfulness affects quality of life in those with MS. Our results indicated that emotion regulation ability partially mediates the association between mindfulness and quality of life. Furthermore, we found that depressive symptoms moderated this mediated pathway, such that the conditional indirect effect of mindfulness on quality of life through emotion regulation was stronger in those with greater depressive symptoms than those with lower reported depressive symptoms.

Our findings substantiate previous evidence demonstrating a significant relation between higher levels of trait mindfulness and better overall health and well-being in
other populations, ranging from older adults (Prakash et al., in review) to cancer patients (Brown & Ryan, 2003), and germane to those with MS, in those with chronic illness (Jedel et al., 2013). While the investigation of mindfulness is in its infancy in individuals with MS, our findings, as well as those of others, provide promising supportive evidence for its role in the overall well-being of this group (Senders et al., 2014). Our study corroborated the results observed by Senders et al. (2014), in which they found higher levels of trait mindfulness to be associated with better quality of life. Our study, replicating and extending the literature, provides corroborating evidence for a positive relation between dispositional mindfulness and quality of life in MS. The direct relation between mindfulness and quality of life, after controlling for emotion regulation ability, remained significant, suggesting further exploration into other ways of operationalizing emotion regulation, as well as the likelihood that there are other relevant factors in the connection between these two constructs. These cross-sectional results thus lend support to the idea that the ability to stay present-focused is associated with a better quality of life in individuals with MS. Contributing to this positive association, there is at least one randomized controlled trial that provided support for increased quality of life after an 8-week mindfulness training program in individuals with MS (Grossman et al., 2010). While this study provided the first evidence for an improvement in quality of life following an intervention, the comparison group was a wait-listed group. Given the findings of this study, as well as our cross-sectional investigation, future research would benefit from evaluating the efficacy of a mindfulness training group, relative to an active control group, matched for duration, and format of group in improving overall quality of life in this population.
Contributing to the essential investigation of the mechanism of mindfulness, our results indicate that increased emotion regulation ability is at least one of the potential pathways by which mindfulness can positively affect quality of life. In dissecting this pathway, there are two relevant associations: first, between mindfulness and emotion regulation, and second, between emotion regulation and quality of life. Previous studies assessing self-report emotion regulation and dispositional mindfulness also have found a significant relationship (e.g. Hill & Updegraff, 2012; Prakash et al., in review; Roemer et al., 2009), however this has never been shown in individuals with MS. These findings suggest that trait mindfulness and perceived emotion regulation abilities are related in a significant way. Future cross-sectional studies could aim to further understand the relation between trait mindfulness and specific emotion regulation strategies, such as cognitive reappraisal and suppression, which have been shown to be associated with trait mindfulness in other populations (e.g. Jermann et al., 2009). Beyond self-report, the literature has assessed emotion regulation by using both behavioral and neuroimaging paradigms, as well as through more naturalistic experience sampling methods. For example, a study completed by Goldin and Gross (2010) in those with social anxiety disorder, showed mindfulness training to be associated with better attentional deployment, a specific type of emotion regulation strategy, as measured in a paradigm asking participants to attend to the breath when viewing relevant aversive stimuli. By utilizing more nuanced measures of laboratory-based emotion regulation, future research can expand upon these self-report findings.

The findings of this study also corroborated past evidence of a relation between emotion regulation and quality of life in individuals with MS. Phillips et al. (2009)
completed the only other study, to our knowledge, investigating the relation between emotion regulation and quality of life in MS. Their study operationalized emotion regulation as the use of particular emotion regulation strategies and revealed that greater use of cognitive reappraisal was associated with better psychological and environmental quality of life, as measured by the WHOQoL-BREF. Our findings expand upon these by combining variance from both the WHOQoL-BREF, as well as the SWLS, which incorporates a more generic definition of quality of life in comparison to the more health-related quality of life of the WHOQoL-BREF. In conjunction, these data support the clear evidence for the critical inclusion of emotional health in literature on quality of life in MS in addition to the already well-studied physical and cognitive limitations.

In our sample, exploratory findings highlighted the important role depressive symptoms may play in the pathway between trait mindfulness and quality of life, via emotion regulation ability. Explicitly, although both groups of individuals showed a significant indirect pathway, the effect size was significantly greater in those with more depressive symptoms. Providing that these exploratory findings are replicated, we speculate these findings implicate mindfulness to be a more important protective factor in those that seem to have higher depressive symptoms. Studies investigating differences in coping strategies in those with higher depressive symptoms, have found lower reported use of positive reappraisal and problem solving, as well as greater escape-avoidance (Aikens et al., 1997). Evidence from a recent longitudinal study found depressive symptoms in individuals with MS to remain relatively static over the course of a four-year period, showing a more chronic trajectory in comparison to the typical, shorter trajectory of depression in the general population (Koch et al., 2014). Thus, research into
the roles trait mindfulness and emotion regulation may play in those with MS may be entirely novel, as this population’s presentation of depression seems to be different than the general depiction of depression. Future studies should aim to investigate the changes in emotion regulation evoked by mindfulness training in those that have higher reported depressive symptoms.

It is important to consider this study in the context of some limitations. First, this study was cross-sectional, thus not lending itself to the rigorous nature of a controlled experiment. While we examined emotional regulation ability as a mediator between dispositional mindfulness and quality of life, the cross-sectional nature of the study prevents us from making any causal inferences. Our results, while cross-sectional, provide an important first step to further examine the possible causal link between mindfulness and quality of life in this population. A randomized controlled trial, comparing mindfulness training, which focuses on building concentrative attention and emotional non-reactivity, to an active control group, which matches the mindfulness training group, especially in terms of it being a forum of social support for the participants, would provide us with the necessary data to make causal claims regarding the efficacy of mindfulness. Additionally, the inclusion of measures of emotional regulation abilities before, during, and after the intervention would allow for a clearer examination of the mediating role of emotional regulation in this pathway.

A second limitation of study was that it was completed entirely online. As such, we were not able to validate the authenticity of the subjects we recruited for our study. That being said, the majority of participants (79%) in this study were past participants or
those coming from national reputable recruitment registry, Research Match. In addition, the participants recruited were highly educated, 67% had at least a college degree, which may limit our ability to generalize to those with less education. Our sample also underrepresented the progressive-type of MS, recent estimates are around 10-15% (Miller & Leary, 2007), and thus our results may not translate to that population. Further, our study used only self-report measures to assess the variables of interest, which may reduce the validity of our findings. Specifically, the observed results could be explained by shared method variance. That is, since data on all measures were collected using self-report, it is possible that the different constructs are correlated because they are all self-report. Future research, employing behavioral tasks to assess emotion regulation abilities, would be critical to replicate and extend the current research.

Conclusions

In this study we found evidence to support the relation between trait mindfulness and quality of life in those with a diagnosis of MS. Further, we have expanded the literature in a novel way by assessing the potential mechanism of mindfulness in this population, elucidating emotion regulation ability as one key variable in this critical link. Thus, we encourage future studies employing a randomized control trial design, with an active control group, to assess the role of mindfulness training on changes in emotion regulation ability and quality of life in those with MS. Additionally, our exploratory findings suggest the investigation of these constructs to be of particular importance in those with greater depressive symptomology.
References


Prakash, R. S., Hussain, M. A., & Schirda, B. (in review). The role of emotion regulation and cognitive control in the association between mindfulness disposition and stress.


### APPENDIX A

**Tables and Figures**

*Table 1 – Demographics and characteristics of the study sample (N=95).*

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Number (%) or Mean (SD), Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (y)</strong></td>
<td>43.72 (8.37), 22-55</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>16 (17%)</td>
</tr>
<tr>
<td>Female</td>
<td>79 (83%)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
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<tr>
<td>High School</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Some College</td>
<td>23 (24%)</td>
</tr>
<tr>
<td>College Graduate</td>
<td>30 (32%)</td>
</tr>
<tr>
<td>Post-College</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Graduate/Professional Degree</td>
<td>26 (27%)</td>
</tr>
<tr>
<td><strong>MS Course</strong></td>
<td></td>
</tr>
<tr>
<td>RRMS</td>
<td>85 (89%)</td>
</tr>
<tr>
<td>SPMS</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>PRMS</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>RPMS</td>
<td>1 (1%)</td>
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<tr>
<td><strong>Disease Duration (y)</strong></td>
<td>10.43 (6.81), 1-28</td>
</tr>
<tr>
<td><strong>EDSS</strong></td>
<td>4.84 (1.53), 0-7.5</td>
</tr>
<tr>
<td><strong>FFMQ</strong></td>
<td>132.78 (22.23), 83-178</td>
</tr>
<tr>
<td><strong>Observing</strong></td>
<td>26.19 (6.21)</td>
</tr>
<tr>
<td><strong>Describing</strong></td>
<td>27.62 (6.63)</td>
</tr>
<tr>
<td><strong>Acting with Awareness</strong></td>
<td>25.55 (6.56)</td>
</tr>
<tr>
<td><strong>Non-judging</strong></td>
<td>29.89 (6.89)</td>
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<tr>
<td><strong>Non-reacting</strong></td>
<td>23.53 (5.25)</td>
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<td><strong>DEROS</strong></td>
<td>75.08 (24.04), 41-141</td>
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<tr>
<td>Nonacceptance</td>
<td>12.40 (5.77)</td>
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<tr>
<td>Goals</td>
<td>13.29 (3.05)</td>
</tr>
<tr>
<td>Impulse</td>
<td>10.96 (5.11)</td>
</tr>
<tr>
<td>Awareness</td>
<td>13.99 (5.14)</td>
</tr>
<tr>
<td>Strategies</td>
<td>14.86 (6.67)</td>
</tr>
<tr>
<td>Clarity</td>
<td>9.58 (4.00)</td>
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<tr>
<td><strong>SWLS</strong></td>
<td>19.78 (7.43), 7-35</td>
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<tr>
<td><strong>WHOQOL-BREF</strong></td>
<td>93.96 (16.92), 53-128</td>
</tr>
<tr>
<td>Total</td>
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<tr>
<td><strong>Overall QoL</strong></td>
<td>6.72 (1.75)</td>
</tr>
<tr>
<td>Physical</td>
<td>24.41 (6.14)</td>
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<tr>
<td>Psychological</td>
<td>20.42 (4.57)</td>
</tr>
<tr>
<td>Social</td>
<td>10.75 (2.64)</td>
</tr>
<tr>
<td>Environmental</td>
<td>31.66 (5.47)</td>
</tr>
<tr>
<td><strong>BDI</strong></td>
<td>14.29 (10.22), 0-43</td>
</tr>
<tr>
<td>&lt; 13</td>
<td>48 (~50%)</td>
</tr>
<tr>
<td>≥ 13</td>
<td>47 (~50%)</td>
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42
Table 2 – Bivariate Correlations Between the Composite Variables and the Individual Facets of Mindfulness Disposition, Emotion Regulation Ability, and Quality of Life.

(a) Quality of Life (QoL)  
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tbody>
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<td>1. Overall QoL</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2. Physical</td>
<td>.72**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. Psychological</td>
<td>.65**</td>
<td>.59**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Social</td>
<td>.41**</td>
<td>.44**</td>
<td>.53**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Environmental</td>
<td>.55**</td>
<td>.51**</td>
<td>.57**</td>
<td>.44**</td>
<td></td>
<td></td>
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<tr>
<td>6. SWLS</td>
<td>.58**</td>
<td>.53**</td>
<td>.57**</td>
<td>.44**</td>
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(b) Difficulties in Emotion Regulation Scale (DERS)  
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<th>3</th>
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<tr>
<td>1. Nonacceptance</td>
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<td>2. Goals</td>
<td>.59**</td>
<td></td>
<td></td>
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<td>3. Impulse</td>
<td>.67**</td>
<td>.63**</td>
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<td>4. Awareness</td>
<td>.52**</td>
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<td>.44**</td>
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<td>5. Strategies</td>
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<td>.81**</td>
<td>.50**</td>
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<td>6. Clarity</td>
<td>.64**</td>
<td>.50**</td>
<td>.67**</td>
<td>.66**</td>
<td>.72**</td>
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(c) Five Facet Mindfulness Questionnaire (FFMQ)  
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<td>1. Observing</td>
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<td>2. Describing</td>
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<td>3. Acting with Awareness</td>
<td>.24*</td>
<td>.53**</td>
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<td>4. Non-judging</td>
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<td>.45**</td>
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<td>5. Non-reacting</td>
<td>.39**</td>
<td>.51**</td>
<td>.33**</td>
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(d) Composite Variables  
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<td>2. DERS</td>
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<tr>
<td>3. QoL</td>
<td>.63**</td>
<td>.59**</td>
<td></td>
<td></td>
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<tr>
<td>4. BDI</td>
<td>-.65**</td>
<td>-.74**</td>
<td>-.70**</td>
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Note: *p < .05, **p < .01
Figure 1 – A) the simple mediation model including the total effect (c) and direct effect (c’)
of trait mindfulness on quality of life, and the indirect (ab) mediated effect of emotion regulation
ability, and B) the exploratory model examining depressive symptoms as a moderator in the
mediated pathway. Note: N = 95. Beta-coefficients are unstandardized with the SE listed in
parentheses. *p<.05, **p<.01