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# **MINDFULNESS AND PHYSICAL ACTIVITY AS MODERATORS OF BEHAVIORAL INHIBITION SENSITIVITY AND PSYCHOLOGICAL DISTRESS**

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# **MINDFULNESS AND PHYSICAL ACTIVITY AS MODERATORS OF BEHAVIORAL INHIBITION SENSITIVITY AND PSYCHOLOGICAL DISTRESS**

A Thesis

Submitted to the Graduate Faculty of the  
Louisiana State University and  
Agricultural and Mechanical College  
in partial fulfillment of the  
requirements for the degree of  
Master of Science

in

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by  
Edward Peter Silber  
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## **ACKNOWLEDGEMENTS**

I would like to begin by thanking my mentor, Dr. Alex Garn, for his unwavering support and guidance. From the very first day that I began my education at LSU, Dr. Garn has allowed me to pursue my interests and has offered incredibly valuable advice that I will carry with me into my next venture. His knowledge is immeasurable, and I consider myself fortunate to have been able to work collaboratively with him. Under the guidance of Dr. Garn, my confidence to be successful in the field of academia has developed immensely and cannot thank him enough for that. I would also like to extend my gratitude to all of my committee members, including Dr. Melinda Solmon, and Dr. Ryan Hulteen. Dr. Solmon has been a wonderful mentor, an inspiring teacher, and a true professional. I truly appreciate the purposeful feedback that was offered and allowing me the opportunity to pursue my education at LSU. Dr. Hulteen has been an incredible mentor to me from the very beginning. I am grateful for his knowledge, communication, and encouragement. Dr. Hulteen has been involved in many of my fondest memories at LSU, and I hope to continue building a professional relationship in the future. Finally, I want to thank my parents, Gail and Peter, and my siblings, Ali, Rachel, and Willie for supporting me through all of my life experiences thus far. I know I will always have your love and encouragement, and for that I am extremely grateful.

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## **ABSTRACT**

Framed in Reinforcement Sensitivity Theory, the current study examined the moderating effects of mindfulness and moderate-to-vigorous physical activity (MVPA) on the relationship between behavioral inhibition system (BIS) sensitivity and psychological distress. Participants ( $N=183$ ) were college students at a large public university in the Southeastern United States. Data were collected using an online survey with self-report questionnaires that demonstrated acceptable reliability. Data analysis utilized multiple linear regression models to test study hypotheses. Findings revealed a significant positive relationship between BIS sensitivity and psychological distress, with mindfulness and MVPA significantly moderating this association. Specifically, increased reports of mindfulness and MVPA related to lower psychological distress for participants with higher than average BIS sensitivity. Mindfulness was especially effective at minimizing psychological distress for these individuals. This study expanded upon current Reinforcement Sensitivity Theory literature by examining the moderating effects of two emotional regulation strategies on BIS sensitivity and psychological distress. Findings from this study suggest that mindfulness and MVPA are unique strategies that buffer the link between BIS sensitivity and psychological distress. Understanding subpopulations of college students with increased risk for psychological distress (i.e., those with high BIS sensitivity) and identifying diverse strategies that effectively lower this risk (i.e., mindfulness; MVPA) can be used to develop targeted interventions that reduce psychopathology and promote mental health. Similarly, mindfulness and MVPA are potentially empowering strategies that college students can learn to adopt, implement, and manage on their own.

## **INTRODUCTION**

Psychological distress is a major public health concern, especially among young adult populations who attend institutions of higher education. Academically, determinants of stress stem from dissatisfaction with class lectures, vastness of academic curriculum, and worry about the future (Chowdhury et al., 2017). Other stressors that contribute to psychological distress for college students include factors related to time-management, money, identity, and social integration (DeRosier et al., 2013). According to the National College Health Assessment, approximately 25% of college students experience feelings of hopelessness, depression, and/or anxiety in any given year (American College Health Association, 2019). Internalizing problems such as anxiety, depression, and somatization are common elements of psychological distress prevalent in college students that lead to disruptions in academic and personal functioning and reduce quality of life (Auerbach et al., 2016). Specifically, female college students typically report higher levels of psychological distress compared to males (Burris et al., 2007). While the causes of internalizing problems are complex and likely stem from a combination of influences, personality factors related to one's temperament appear to play a central role in explaining their variation (Hamill et al., 2015; Maack et al., 2012).

### **Reinforcement Sensitivity Theory**

As presented in Figure 1, the revised Reinforcement Sensitivity Theory (RST; Gray & McNaughton, 2000; Corr, 2008) recognizes three temperament personality components, including the behavioral approach system (BAS), the fight-flight-freeze system (FFFS), and the behavioral inhibition system (BIS). BAS represents the underpinnings of approach motivation, and promotes the attainment of goals, attraction to rewarding stimuli, and positive feelings. FFFS is responsible for avoidance motivation, facilitating escape and survival when faced with

threatening situations by promoting panic and fear. BIS activates when experiencing conflicting stimuli and is responsible for resolving goal conflicts by producing caution and risk assessment (Gray & McNaughton, 2000).

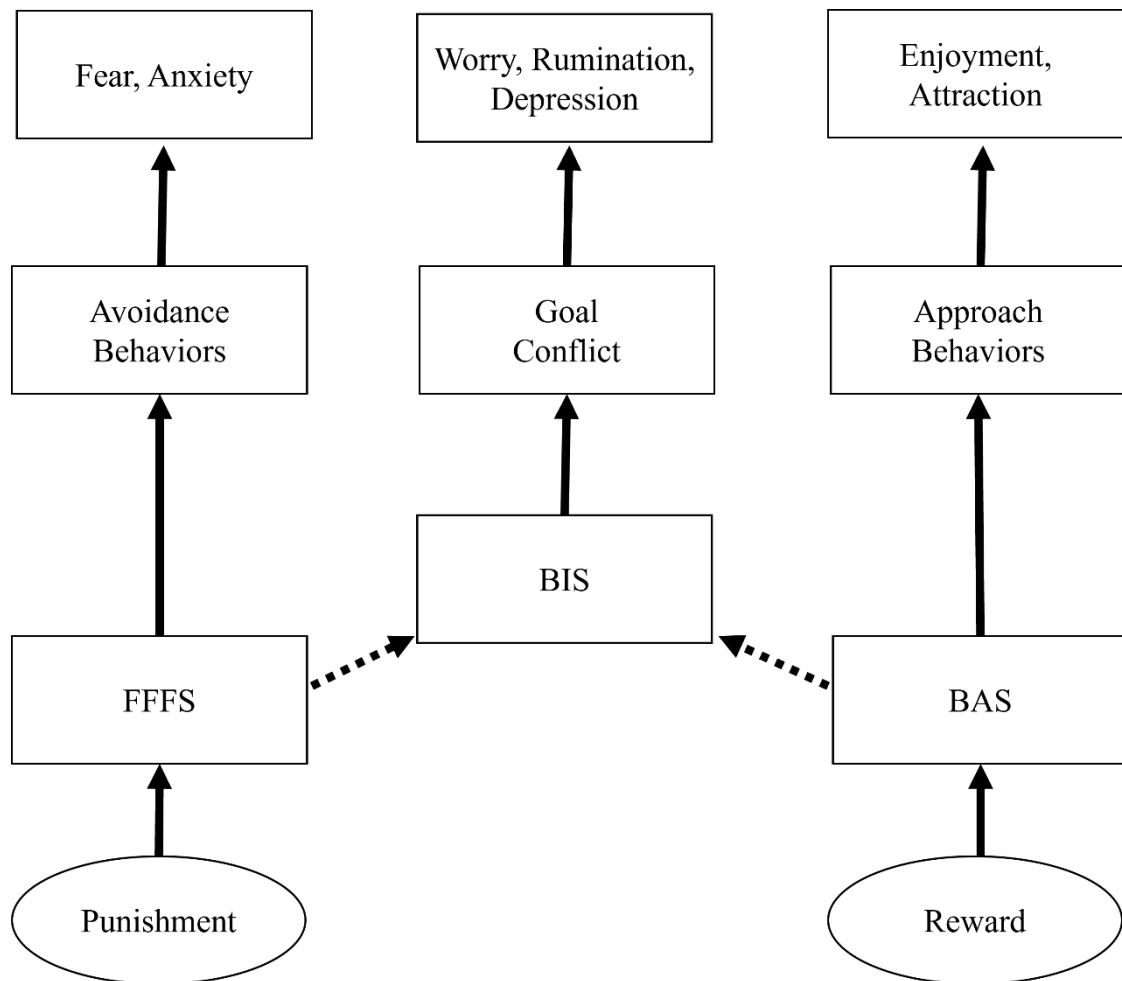


Figure 1. Proposed Revised Reinforcement Sensitivity Theory

The three temperament systems outlined in the revised RST explains how aspects of one's personality work together to optimize environmental adaptation and evolution (Corr, 2008). Specifically, BAS underscores how personality helps attract people to environments that provide rewards. FFFS describes how personality helps people avoid environments containing harmful threats. Finally, BIS demonstrates how personality helps people unpack environmental characteristics that may produce both rewards and threats as well as combinations of rewards or

threats. For example, BAS may direct college students to create and achieve academic goals that lead to future economic rewards. FFFS may prevent college students from engaging in academically harmful behaviors such as skipping classes or cheating on exams. BIS may help facilitate college students' decisions about balancing academic demands with social opportunities. Collectively, BAS, FFFS, and BIS help regulate environmental interactions that affect one's actions, thoughts, and emotions (Corr & McNaughton, 2012).

Sensitivity of the BIS is one specific aspect of temperament with close ties to increased internalizing symptoms (Pickett et al., 2011). Individuals with increased BIS sensitivity generally report dealing with psychological distress on a day-to-day basis. Specific psychopathological disorders associated with BIS sensitivity include depression, bipolar disorder, social anxiety disorder, generalized anxiety disorder, and posttraumatic stress disorder (Pickett et al., 2011; Scholten et al., 2006). BIS sensitivity also can lead to maladaptive internalization symptoms such as rumination, worry, obsessive thoughts about possible danger, and avoidance behaviors (Corr & Cooper, 2016). Contrarily, low levels of BIS are attributed to attention deficit hyperactivity disorder (Barkley, 1997).

Identifying strategies that create buffers between BIS and psychological distress can potentially reduce psychopathology. Mindfulness and physical activity are two strategies that can potentially help mitigate links between BIS sensitivity and psychological distress outcomes. For example, a meta-analysis of mindfulness interventions suggested that mindfulness-based interventions are beneficial for treating internalizing problems (Hofmann et al., 2007). Along the same lines, Xiang et al. (2020) revealed that physically active college students were less likely to report internalization problems such as anxiety. Stonerock et al. (2015) suggested that physical



activity interventions can reduce anxiety symptoms in some cases, but more dose response evidence is needed.

### **BIS and Mindfulness**

The term ‘mindfulness’ refers to one’s ability to bring complete attention to the present moment in an accepting and non-judgmental manner (Baer et al., 2006). Engaging in mindfulness allows individuals to increase their psychological flexibility, which helps reduce maladaptive habits (Segal et al., 2002). Mindfulness practices have been utilized in formal and informal manners. Formally, mindfulness is taught through meditative practices and includes techniques such as body scanning, mindful movements, and yoga. Informally, individuals can practice mindfulness on a day-to-day basis by using skills that gauge body sensations, cognitive patterns, and sensory inputs. Examples of daily behaviors that provide opportunity to engage in mindfulness include brushing teeth, eating, walking, and talking (Kabat-Zinn, 2003). Popular therapeutic options including dialectic behavioral therapy, cognitive behavioral therapy, acceptance and commitment therapy, and relapse prevention for substance abuse, often utilize mindfulness techniques to reduce psychological distress and improve well-being (Baer et al., 2006). A recent study utilizing mindfulness as a means for stress reduction resulted in lower levels of anxiety, depression, and stress (Marchand, 2012). In addition, mindfulness-based interventions for psychiatric disorders were found to be as effective as evidence-based treatments such as cognitive behavioral therapy and antidepressant medications (Goldberg et al., 2017).

Hamill et al. (2015) investigated mindfulness as a moderator in the relationship between BIS sensitivity and psychological distress. In this cross-sectional design, findings showed that heightened BIS sensitivity was associated with greater psychological distress. In addition, the mindfulness technique of acceptance minimized the relationship between BIS sensitivity and

psychological distress. Certain facets of mindfulness, including describing, acting with awareness, non-judging, and non-reactivity also reduced the relationship with BIS sensitivity and psychological distress. According to Baer et al. (2006), ‘describing’ refers to tracking internal experiences with words, ‘acting with awareness’ refers to focusing on current activities and behaviors, ‘nonjudging’ refers to evaluating sensations, thoughts, and emotions, and ‘nonreactivity’ refers to allowing thoughts to enter and leave without rumination. The current study will expand upon findings from Hamill et al. (2015) by exploring global aspects of mindfulness as a means of moderation between BIS sensitivity and psychological distress while also examining moderate to vigorous physical activity (MVPA) as a potential moderator in this relationship.

### **BIS and Physical Activity**

The reported mental health benefits elicited from engaging in a physically active lifestyle is extensive. In a large cross-sectional analysis, it was found that individuals who exercised reported 43% fewer days of psychological distress in the previous month than those who did not exercise. Specifically, the association was strongest for individuals who engaged in physical activity between three to five days per week for 30-60 minutes (Chekroud et al., 2018). Trivedi et al. (2011) also found that MVPA was an effective form of treatment for mild and moderate cases of depression. In addition, a recent study determined that participants reporting at least 30 minutes of MVPA per day were 30% less likely to present symptoms of depression and anxiety (Schuch et al., 2020). Although there is an abundance of literature that supports the benefits of MVPA on mental health, few studies have examined its potential in moderating the relationship between BIS sensitivity and psychological distress.

Baumgartner et al. (2018) found a relationship between physical activity and improvement in cognitive control, a component of the BIS. Cognitive control refers to the ability to manipulate behavior based on the changing environment. In this study, the core processes involved with cognitive control include attentional inhibition (i.e., the ability to ignore distractions and remain focused), working memory (i.e., the ability to record and maintain information during brief periods of time), and cognitive flexibility (the ability to shift attention and regulate response strategies when task demands change). Findings from this study revealed that participants who engaged in more MVPA performed better on cognitive control tests. Specifically, Baumgartner et al. (2018) reported a positive relationship between MVPA and attentional inhibition, suggesting that physically active individuals are better equipped to upregulate their attentional inhibition during conflict conditions. The current study will add to the literature by exploring the moderating function of MVPA in the connection between BIS sensitivity and psychological distress.

### **The Present Study**

The purpose of this study was to investigate the moderating role that mindfulness and MVPA had on the relationship between BIS sensitivity and changes in psychological distress in college students. The following hypotheses were tested:

Hypothesis 1 (H1): BIS sensitivity is positively associated with psychological distress.

Hypothesis 2 (H2): Mindfulness will minimize the relationship between BIS sensitivity and psychological distress.

Hypothesis 3 (H3): MVPA will minimize the relationship between BIS sensitivity and psychological distress.

## **METHODS**

### **Participants**

Undergraduate students ( $N = 183$ , 76% female) from a large public university in the Southeastern United States participated in this study. Ages ranged between 18 to 25 years old with 80% reporting their age as 19 or 20 years old. Most of the sample reported their ethnicity as White/Caucasian (70%) or Black/African-American (15%) while smaller percentages reported their ethnicity as Hispanic (5%), Asian/Asian-American (5%), or Multi-Racial (5%). Most students (86%) were in their second or third year in terms of academic standing.

### **Measures**

All measures appear in Appendix C. Description for BIS sensitivity, mindfulness, MVPA, and psychological distress measures are presented below.

#### **BIS Sensitivity**

To assess individual differences in BIS sensitivity, this study used the BIS items from the short version of the Reinforcement Sensitivity Theory of Personality Questionnaire (RSTPQ-Short) (Vecchione & Corr, 2020). All items were based on the question *How accurately does this statement describe you?* Examples of BIS items included “My behavior is easily interrupted”, and “I often worry about letting down other people”. Participants responded to items using a 4-point Likert scale ranging from “not at all” to “highly”. Scores produced from this measure were studied, and results indicate that RSTPQ-Short represents an efficient, valid, and reliable means of measuring RST constructs.

#### **Mindfulness**

The Mindful Attention Awareness Scale (MAAS) was used to measure participants’ utilization of mindfulness (Brown & Ryan, 2003). The MAAS was constructed to understand the

participants' mindfulness experience in general terms as well as day-to-day events. The MAAS consisted of 15 items, in which responses were reported on a 6-point Likert scale (1=almost always; 6=almost never). Items included, "I find myself doing things without paying attention", and "I rush through activities without being really attentive to them". Participants were informed to indicate answers based on how frequently or infrequently they have experienced each item. Validity of the MAAS in the assessment of mindfulness as a psychological construct has been studied, and validity is confirmed (MacKillop & Anderson, 2007).

### **Physical Activity**

To assess physical activity levels, participants were asked to complete the International Physical Activity Questionnaire Short Form (IPAQ-SF). The IPAQ-SF is a self-reported measure which assesses the frequency of physical activity in the last 7 days. This study used items pertaining to vigorous intensity and moderate intensity. An example item included, "During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling"? This measure has produced valid and reliable scores (Craig et al., 2003).

### **Psychological Distress**

The Brief Symptom Inventory with 18 items (BSI-18) was used to assess psychological distress (Derogatis, 2000). The BSI-18 is comprised of three six-item subscales which included somatic symptoms, depression, and anxiety. Responses were reported on a 4-point Likert scale (0=not at all; 4=nearly every day). Global severity index (GSI) scores were calculated for each participant by summing each subscale scores. Sample somatization items included feelings of faintness or dizziness; sample depression items included feelings of worthlessness and loneliness; and sample anxiety items included feelings of restlessness and fear. Franke and

colleagues (2017) found that the BSI-18 is an instrument that can be used to reliably assess psychological distress.

### **Data Collection**

After obtaining approval from the university institutional review board, the researcher received permission from multiple instructors of undergraduate courses to recruit their students. The researcher briefly met with the students to provide information and context regarding the study. Students received an email after one week with a link to an online survey. Before answering any survey questions, students provided informed consent to participate in the study. Data was acquired using self-report questionnaires, in which participants completed an online survey in November of 2021. This survey took students approximately 10 minutes to complete.

### **Data Analysis**

Data were screened for missing data and statistical assumptions. Coefficient alpha estimates were used to test internal consistency for each study variable. Calculation of descriptive statistics for each study variable included mean, standard deviation, minimum and maximum values. Multiple linear regression analysis was used to test the three main study hypotheses. In this analysis, BIS was the independent variable, mindfulness and MVPA were moderators, and psychological distress was the dependent variable. Understanding that females typically experience psychological distress at higher rates, gender was included as a covariate. To control for further variability, age and ethnicity were also included as covariates. BIS, mindfulness, and MVPA were mean-centered and product scores of BIS x mindfulness and BIS x MVPA represented interaction terms. This produced five predictors including BIS, mindfulness, MVPA, BIS x mindfulness and BIS x MVPA. Alpha level was set at .05. Bias corrected bootstrap 95% confidence intervals (5,000 resamples) determined statistical

significance at an alpha level of .05. Specifically, confidence intervals that do not straddle zero were used to determine statistical significance (Hayes, 2013). Simple slopes tests were used to interpret statistically significant interactions.

## RESULTS

Skewness  $[-0.99 \text{ to } 1.28]$  and kurtosis  $[-0.57 \text{ to } 1.54]$  values suggested data were, in general, normally distributed. Table 1 presents descriptive statistics and coefficient alpha estimates for each variable of interest. Coefficient alpha estimates were above 0.70. Students, on average, reported BIS sensitivity scores and mindfulness scores slightly above the scale midpoint. Participants reported an average of 341.39 minutes of MVPA per week and an average GSI score of 10.47 on a 0-54 scale.

Table 1. Descriptive Statistics for Behavioral Inhibition System (BIS), Mindfulness, Moderate-to-Vigorous Physical Activity (MVPA), and Global Severity Index (GSI) of Psychological Distress.

Statistics	BIS	Mindfulness	MVPA	GSI
Mean (SD) Total	2.59 (.63)	3.74 (.90)	341.39 (288.59)	10.47 (9.69)
Mean (SD) Female	2.64 (.61)	3.66 (.86)	337.48 (288.50)	10.87 (9.79)
Mean (SD) Male	2.47 (.67)	3.94 (.98)	352.02 (291.58)	9.37 (9.41)
Minimum - Maximum	1-4	1-6	0-1200	0-54
Skewness	-0.99	0.21	1.19	1.28
Kurtosis	-0.57	0.03	1.30	1.54
Coefficient Alpha	0.76	0.91	NA	0.93

Note. SD = standard deviation; MVPA measured in minutes per week.

Table 2 represents the bivariate correlation matrix for all variables. Mindfulness and MVPA were negatively associated with BIS sensitivity. Psychological distress was positively associated with BIS sensitivity. Mindfulness and MVPA were not related, however, both mindfulness and MVPA had a negative relationship with psychological distress.

Table 2. Bivariate Correlation Matrix for Behavioral Inhibition System (BIS), Mindfulness, Moderate-to-Vigorous Physical Activity (MVPA), and Global Severity Index (GSI) of Psychological Distress.

	BIS	Mindfulness	MVPA	GSI
BIS	1			
Mindfulness	-0.59**	1		
MVPA	-0.16*	0.13	1	
GSI	0.62**	-0.59**	-0.21**	1

Note. \*  $p < .05$ ; \*\*  $p < .01$ .



A multiple linear regression moderation analysis tested the main hypotheses (Table 3). Age, gender, and ethnicity were included as covariates in the model; however, these variables were not predictors of psychological distress. BIS sensitivity was a positive predictor of psychological distress. MVPA and mindfulness were negative predictors of psychological distress. Statistically significant interaction effects were found between BIS x MVPA and BIS x Mindfulness on psychological distress. The r-square value revealed that 53% of the variance of psychological distress was explained in the regression model.

Table 3. Results from Multiple Linear Regression Moderation Analysis Predicting Global Severity Index (GSI) of Psychological Distress.

Predictors	coeff	se	t	p	95% Boot LCI	95% Boot UCI	$\beta$
BIS	6.03	1.02	5.93	0.01	4.19	7.85	0.39
MVPA	-0.02	0.01	-2.22	0.03	-0.02	-0.01	-0.12
BISxMVPA	-0.01	0.01	-2.14	0.03	-0.02	-0.01	-0.13
Mindfulness	-4.08	0.71	-5.71	0.01	-5.52	-2.60	-0.38
BISxMindfulness	-2.76	0.86	-3.23	0.01	-4.36	-1.21	-0.16
Age	0.17	0.40	0.42	0.67	-0.58	0.91	0.02
Female	0.48	1.19	0.41	0.69	-2.25	2.94	0.02
Ethnicity	0.19	0.40	0.48	0.63	-0.47	0.85	0.03

Note. coeff = unstandardized beta coefficient; se = standard error; 95% Boot LCI = lower bound of 95% bootstrap confidence interval; 95% Boot UCI = upper bound of 95% bootstrap confidence interval; bootstrap estimates based on 5,000 resamples;  $\beta$  = standardized beta coefficient; x represents interaction.

To further analyze the interaction effects, a simple slopes test was conducted (Table 4). Results suggested that GSI scores were highest when individuals reported high BIS sensitivity, low MVPA, and low mindfulness. Contrarily, GSI scores were lowest when individuals reported low BIS sensitivity and high mindfulness. MVPA appeared to play a less meaningful role on psychological distress for participants with low or average BIS scores. However, higher reported levels of MVPA was associated with lower reported psychological distress scores for participants with high BIS (see Table 4 and Figure 2).

Table 4. Simple Slopes Test Values for Global Severity Index (GSI) of Psychological Distress.

	Low BIS	Ave BIS	High BIS
Low MVPA Low Mindfulness	7.61	14.20	20.79
Low MVPA Ave Mindfulness	5.50	10.54	15.57
Low MVPA High Mindfulness	3.40	6.87	10.34
Ave MVPA Low Mindfulness	7.69	13.04	18.39
Ave MVPA Ave Mindfulness	5.59	9.38	13.17
Ave MVPA High Mindfulness	3.49	5.72	7.95
High MVPA Low Mindfulness	7.78	11.89	15.99
High MVPA Ave Mindfulness	5.68	8.23	10.79
High MVPA High Mindfulness	3.58	4.57	5.56

Note. Low = -1 standard deviation below the mean; Ave = mean; High = +1 standard deviation above the mean.

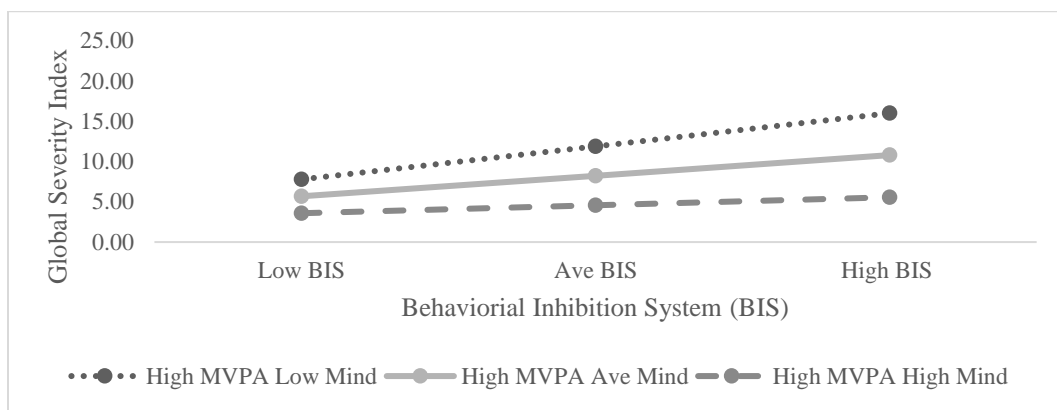
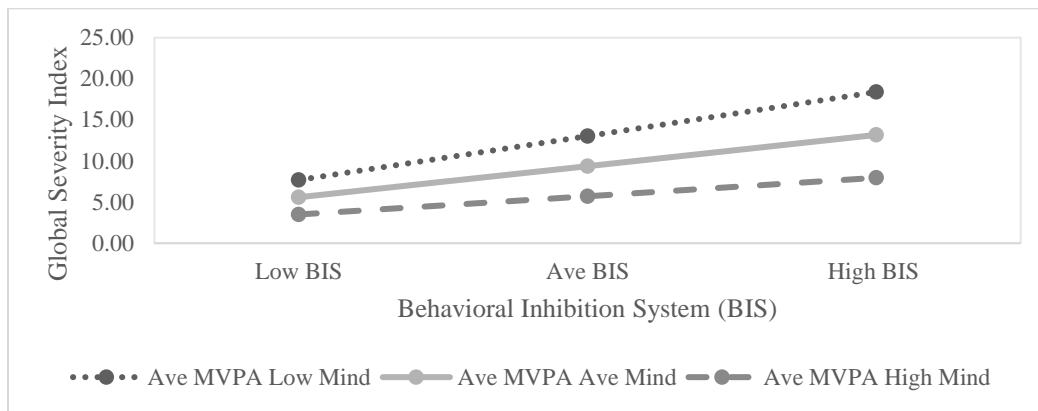
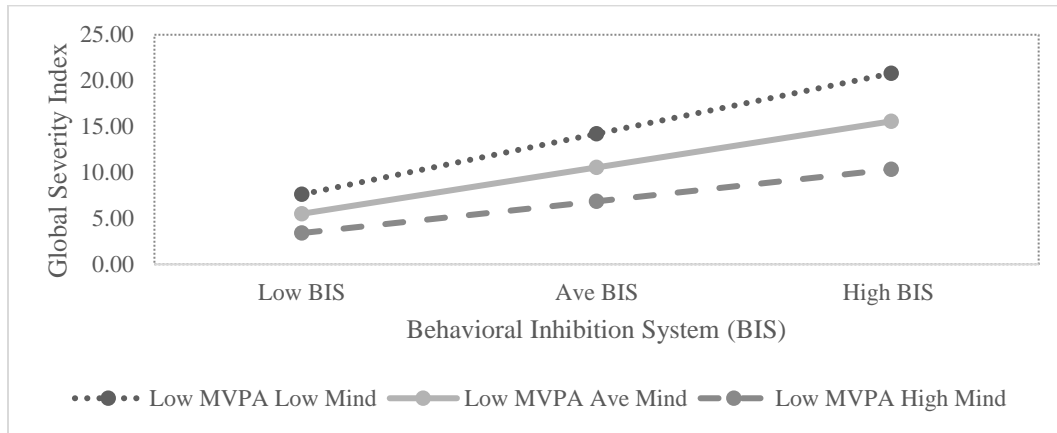


Figure 2. Visual Representation of Simple Slopes Test for Global Severity Index (GSI) of Psychological Distress.

## **DISCUSSION**

With evidence suggesting that college students experience unique stressors that contribute to anxiety, depression, and somatization symptoms, there is a need to obtain a better understanding about the complexity of psychological distress in this population (Auerbach et al., 2016). One factor that influences psychological distress is BIS sensitivity. Under the theoretical framework of RST (Gray & McNaughton, 2000; Corr, 2008), the current study examined the relationship between BIS sensitivity and psychological distress. Due to the functionality of the BIS, psychological distress is likely to occur in individuals with high BIS sensitivity. The BIS is an automatic system that is in place to assess risk and resolve conflict (Gray & McNaughton, 2000). Specifically, dealing with excessive amounts of conflict (i.e., high BIS sensitivity) often leads to maladaptive psychological responses (Corr & Cooper, 2016). Emotional regulation strategies offer individuals opportunities to minimize the negative emotional responses produced from high BIS sensitivity. In the current study, mindfulness and MVPA were evaluated as potential moderators. It was hypothesized that findings would reveal a positive association between BIS sensitivity and psychological distress, but this relationship would be weaker for individuals reporting higher amounts of mindfulness and MVPA.

Mindfulness is an awareness strategy that allows individuals to fully bring their attention to the present moment (Baer et al., 2006). It is closely associated with conflict reappraisal, which refers to one's ability to acknowledge emotional states and respond in a manner that addresses and neutralizes negative emotions. Eftekhari et al. (2009) found that individuals reporting high reappraising characteristics had lower levels of anxiety, PTSD, and depression while those who suppressed negative emotions reported increased symptoms. Because mindfulness is a proactive strategy that shares common elements of reappraisal, it has the potential to minimize the

relationship between BIS sensitivity and psychological distress. Correlational and multiple regression results from this study indicated that BIS sensitivity and psychological distress were negatively associated with mindfulness. Furthermore, mindfulness moderated the relationship between BIS sensitivity and psychological distress. Higher levels of mindfulness appeared to assist college students with high BIS sensitivity deal with psychological distress effectively.

With evidence to suggest that mindfulness is an effective strategy to buffer the relationship between BIS sensitivity and psychological distress, many implications can take place at the university level. First, mindfulness is an emotional regulation strategy that can proactively be taught and practiced. This advantage allows for feasible interventions to be implemented. Previous literature has already highlighted effective mindfulness interventions that target college students. Specifically, Patel et al. (2018) reported that a yoga-based intervention increased scores in mindfulness, cognitive reappraisal, and positive affect. Therapeutically, mindfulness is a fast-growing technique utilized in many evidence-based psychotherapy orientations (Baer et al., 2006). Because mindfulness attempts to diminish maladaptive thinking patterns such as rumination and worry, introducing mindfulness training to individuals with symptoms of anxiety, depression, and somatization may reduce BIS sensitivity.

MVPA has been proven to be an effective strategy to reduce psychological distress. Most recently, engaging in at least 30 minutes of MVPA has been found to reduce symptoms of depression and anxiety by 30% (Schuch et al., 2020). Although the specific mechanisms remain unknown, MVPA likely enhances emotional regulation and emotional health through a combination of biopsychosocial factors (Hopkins et al., 2012). It is important to note that MVPA is not only associated with reductions in psychological distress symptoms, but also higher levels of positive emotions. In simple terms, MVPA produces a general feel good effect (Biddle &

Ekkekakis, 2012). This general feel good effect from MVPA may help minimize the relationship between BIS sensitivity and psychological distress in two major ways. First, it may lead college students with high BIS to make less severe assessments of risk and conflict. MVPA may allow college students to frame stressors as more manageable and less threatening. Second, MVPA may help college students with high BIS sensitivity react more positively to the risk and conflict assessments stemming from BIS activation. The positive feelings associated with MVPA may work to offset the typical negative feelings associated with BIS sensitivity.

Based on the results of this study, college students may benefit from having systematic opportunities to engage in MVPA. Song and Cardinal (2019) have conducted a study to investigate the legitimacy of requiring physical activity courses into the schedules of college students. Results indicate that implementing such a policy allows for amotivated students to be reached. In addition, the use of technology has become an increasingly popular method to deliver interventions. The efficacy of this delivery method has been supported by a recent study indicating that female college students increased their daily step count with the use of a web-based intervention (Ornes & Ransdell, 2007).

Mindfulness had a stronger moderating effect on the relationship between BIS sensitivity and psychological distress than MVPA. Specifically, the model predicted lower psychological distress scores for individuals reporting high BIS sensitivity, high mindfulness and low MVPA when compared to individuals reporting high BIS sensitivity, low mindfulness and high MVPA. These results indicate that although MVPA is an effective strategy to alter the relationship between BIS sensitivity and psychological distress, mindfulness has a stronger moderating effect. However, it is important to note that correlational analyses indicated that MVPA and mindfulness were not related to one another. Considering both strategies were effective

moderators, it is promising that different options can be implemented to reduce anxiety, depression, and somatic symptoms for individuals with high BIS sensitivity. Specifically, if certain college students do not respond to mindfulness training or MVPA interventions, the other strategy can be targeted. This provides health professional on college campuses with multiple options to help mitigate students' psychological distress.

### **Limitations**

Despite findings, the current study is not without limitations. Implementing a correlation, cross sectional design does not allow for causal conclusions to be made. In addition, the subjectivity of self-report measures may have negatively influenced the results of the study. Further highlighting a potential limitation of the study, the short form of the IPAQ was the only measure used to assess MVPA. Furthermore, participants may have inadequately reported levels of MVPA to uphold societal expectations. Given that the sample of participants were recruited from kinesiology courses, some may have over reported levels of MVPA engagement due to their expectations that a kinesiology major should dedicate large amounts of time towards physical activity. Future research could benefit from implementing objective measures of MVPA to account for social desirability influences.

Another limitation came from the participation pool. The study examined a non-clinical, predominantly female, sample of college students. Generalizing results may be difficult given that male participants' outcomes might not have been detected. In addition, all participants were recruited from undergraduate kinesiology courses. Typically, kinesiology majors inherently value health and exercise, which might explain the significant moderating role of MVPA. Given this information, results from this study may not reflect the larger population. Despite

limitations, the current study adequately provides insight into the relationships between BIS sensitivity, mindfulness, MVPA, and psychological distress.

### **Future Directions**

Although every attempt was made to recruit a representative sample, the majority of participants were white females. In order to improve generalizability, it is essential for future studies to investigate samples that represent the whole population. Furthermore, as this study is relatively unique to the field of psychology, there is still a need to study moderating variables that may mitigate psychological distress caused from high BIS sensitivity. Mindfulness and MVPA have proven to be effective strategies to reduce psychological distress, however, it will be important to expand upon these findings by introducing other potential buffering strategies. Potential variables to consider in future research include family support, acceptance, cognitive restructuring, and positive imagery.

In addition, it might be interesting to investigate whether moderation can be exercise specific. Current research supports the premise that exercising for shorter periods of time at light intensities improves mood and self-esteem (Barton & Pretty, 2010). In addition, it is known that aerobic and strength training improve cognitive function and contributes to reducing symptoms of depression (Cassilhas et al., 2007; Hillman, Erickson, & Kramer, 2008; Silveira et al., 2013). However, little is known about which exercises are most favorable to elicit these mental health benefits. A specific area that might be useful to explore is the legitimacy of utilizing mindful exercises to minimize psychological distress. In a review that examined the effectiveness of mindful and non-mindful physical exercises as a means to manage depression, results indicated that 100% of the mindful physical activity interventions produced positive effects on treating depression (Tsang et al., 2008). However, the same study noted that there were significant



limitations on research design and availability of randomized control studies. These limitations did not allow for direct comparison between mindful and non-mindful exercise, suggesting that there was no apparent difference between the two categories (Tsang et al., 2008). Given the limited research in this area, future studies could benefit from investigating the efficacy of mindful physical activity as a moderating variable between BIS sensitivity and psychological distress.

## **Conclusions**

The purpose of this study was to investigate the moderating role of mindfulness and MVPA on the relationship between BIS sensitivity and psychological distress. Findings revealed that both mindfulness and MVPA reduced the relationship, especially in students with high BIS sensitivity. Mindfulness and MVPA are two unique health promotion strategies that can be used to target the mental health of college students. Future studies should focus on college students with high BIS sensitivity for mindfulness and MVPA interventions in order to obtain a better understanding of the causal nature of mindfulness, MVPA, and psychological distress.

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## APPENDIX A. IRB APPROVAL



**TO:** Alex Christopher Garn  
LSUAM | Col of HSE | Kinesiology

**FROM:** Alex Cohen  
Chairman, Institutional Review Board

**DATE:** 01-Oct-2021

**RE:** IRBAM-21-1005

**TITLE:** Psychological Distress in University  
Students: What are the Benefits of  
Mindfulness and Physical Activity?

**SUBMISSION TYPE:** Initial Application

**Review Type:** Exempt

**Risk Factor:** Minimal

**Review Date:** 01-Oct-2021

**Status:** Approved

**Approval Date:** 01-Oct-2021

**Approval Expiration Date:** 30-Sep-2024

**Exempt Category:** 2a

**Requesting Waiver of Informed Consent:** Yes

**Re-review frequency:** Three Years

**Number of subjects approved:** 300

**LSU Proposal Number:**

**By:** Alex Cohen, Chairman

**Continuing approval is CONDITIONAL on:**

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects\*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the

## **APPENDIX B. CONSENT FORM**

1. Study Title: Mindfulness and Physical Activity as Moderators of Behavioral Inhibition Sensitivity and Psychological Distress
2. The purpose of this study is to explore how physical activity and mindfulness moderate the relationship between behavioral inhibition and psychological distress in college students. LSU students 18 years and older will be recruited to participate in the study. Participants will be asked to complete a questionnaire at two time points, separated by four weeks. Each questionnaire will take approximately 10 to 15 minutes with questions focusing on personality, physical activity engagement, mindfulness engagement, and mental health outcomes including anxiety, depression, and somatic symptoms. Participants will also be asked to report basic demographic information including gender, grade level, and race/ethnicity. All answers will remain anonymous
3. Inclusion Criteria: LSU students who are 18 years or older.
4. Exclusion Criteria: LSU students who are under the age of 18 or enrolled in the investigators' courses at the time of data collection.
5. There are no risks involved in participating in this study. If you are currently experiencing severe anxiety and/or emotion distress, please call LSU CARES to talk to a mental health professional. Please contact the IRB office if you have any questions.
6. The following investigator is available for questions about this study, M-F, 8:00 a.m. - 4:30p.m., Mr. Edward Silber, 631-576-6281.
7. Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.
8. Results of the study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.
9. This study has been approved by the LSU IRB. If I have questions about subjects' rights or other concerns, I can contact Alex Cohen, Institutional Review Board, (225) 578-8692, [irb@lsu.edu](mailto:irb@lsu.edu).
10. By continuing this survey, you are giving consent to participate in the study.

## APPENDIX C. QUESTIONNAIRES

Name: \_\_\_\_\_

Age (please write): \_\_\_\_\_ Gender: \_\_\_\_\_ Male \_\_\_\_\_ Female

Grade Classification (Please circle below):

Freshman      Sophomore      Junior      Senior      Grad Student

Ethnicity (Please check the one which you most identify with):

\_\_\_\_\_ Black/African American \_\_\_\_\_ Hispanic/Latino/Mexican American

\_\_\_\_\_ White/Caucasian \_\_\_\_\_ Asian/Asian American

\_\_\_\_\_ American Indian/Alaska Native \_\_\_\_\_ Native Hawaiian/Pacific Islander

\_\_\_\_\_ Multi-Racial Other (please specify) \_\_\_\_\_

### BIS items from Reinforcement Sensitivity Theory of Personality Questionnaire (RSTPQ-Short)

Circle on the number that best answers the question: How accurately does this statement describe you?	
1. I sometimes feel “blue” for no good reason	(Not at all)    1    2    3    4    (Highly)
2. I often worry about letting down other people	(Not at all)    1    2    3    4    (Highly)
3. My behavior is easily interrupted	(Not at all)    1    2    3    4    (Highly)
4. It’s difficult to get some things out of my mind	(Not at all)    1    2    3    4    (Highly)
5. I often wake up with many thoughts running through my head	(Not at all)    1    2    3    4    (Highly)



### The Mindful Attention Awareness Scale (MAAS)

How much do you agree with the following statements?	Almost Never	Very Infrequently	Somewhat Infrequently	Somewhat Frequently	Very Frequently	Almost Always
1. I could be experiencing some emotion and not be conscious of it until some time later	1	2	3	4	5	6
2. I break or spill things because of carelessness, not paying attention, or thinking of something else	1	2	3	4	5	6
3. I find it difficult to stay focused on what's happening in the present	1	2	3	4	5	6
4. I tend to walk quickly to get where I'm going without paying attention	1	2	3	4	5	6
5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention	1	2	3	4	5	6
6. I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
7. It seems I am "running on automatic" without much awareness of what I'm doing	1	2	3	4	5	6
8. I rush through activities without being really attentive to them	1	2	3	4	5	6

(table cont'd.)

How much do you agree with the following statements?	Almost Never	Very Infrequently	Somewhat Infrequently	Somewhat Frequently	Very Frequently	Almost Always
1. I get so focused on the goal I want to achieve that I lose touch with what I am doing right now to get there	1	2	3	4	5	6
2. I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
3. I find myself listening to someone with one ear, doing something else at the same time	1	2	3	4	5	6
4. I drive places on "automatic pilot" and then wonder why I went there.	1	2	3	4	5	6
5. I find myself preoccupied with the future or the past.	1	2	3	4	5	6
6. I find myself doing things without paying attention.	1	2	3	4	5	6
7. I snack without being aware that I'm eating.	1	2	3	4	5	6

### International Physical Activity Questionnaire Short Form (IPAQ-SF)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

\_\_\_\_\_ **days per week**

☐

No vigorous physical activities

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

☐

Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

\_\_\_\_\_ **days per week**

☐

No moderate physical activities

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

☐

Don't know/Not sure

**The Brief Symptom Inventory with 18 items (BSI-18)**

<b>Based on the past two weeks, please indicate to what extent each statement is true for you.</b>	<b>Not at all</b>	<b>Several days</b>	<b>More than half the days</b>	<b>Nearly every day</b>
1. Faintness or dizziness	0	1	2	3
2. Feeling no interest in things	0	1	2	3
3. Nervousness or shakiness inside	0	1	2	3
4. Pains in heart or chest	0	1	2	3
5. Feeling lonely	0	1	2	3
6. Feeling tense or keyed up	0	1	2	3
7. Nausea or upset stomach	0	1	2	3
8. Feeling blue	0	1	2	3
9. Suddenly scared for no reason	0	1	2	3
10. Trouble getting your breath	0	1	2	3
11. Feeling of worthlessness	0	1	2	3
12. Spells of terror or panic	0	1	2	3

(table cont'd.)

Based on the past two weeks, please indicate to what extent each statement is true for you.	Not at all	Several days	More than half the days	Nearly every day
13. Numbness or tingling in parts of your body	0	1	2	3
14. Feeling hopeless about the future	0	1	2	3
15. Feeling so restless you couldn't sit still	0	1	2	3
16. Feeling weak in parts of your body	0	1	2	3
17. Thoughts of ending your life	0	1	2	3
18. Feeling fearful	0	1	2	3

## **VITA**

Edward Peter Silber, a Holbrook, New York native, received his Bachelor of Arts degree from Manhattanville College in May of 2016. To expand upon his interests in physical activity and psychology, he continued his education at Louisiana State University. In August, 2020, Silber accepted a position as a Graduate Assistant in the LSU School of Kinesiology.

Anticipating completion of his master's degree in May of 2022, Edward intends to continue his education as a doctoral student in a Clinical Health Psychology PhD program to pursue a career in research, teaching, and clinical care.