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How Do Dispositional Mindfulness and Statistical Anxiety Affect Student Performance on an Exam?

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HOW DO DISPOSITIONAL MINDFULNESS AND STATISTICAL ANXIETY AFFECT STUDENT PERFORMANCE ON AN EXAM?

MARIO A. DIAZ

46 Pages

The current study investigated if a specific disposition, mindfulness, offers an advantage for undergraduate students' success on statistical exams by decreasing the impact of an academic-related strain, anxiety. Prior research utilizing state mindfulness has found evidence of this performance advantage, but it has yet to be investigated if dispositional mindfulness offers similar results. The current study found that dispositional mindfulness does impact one's anxiety, but that relation does not offer a performance advantage for those with higher levels of mindfulness in comparison to those with lower levels of the disposition. To improve student success, engaging in mindfulness practices appears more beneficial instead of a student organically holding high levels of mindfulness prior to an exam.

KEYWORDS: dispositional mindfulness, statistical anxiety, exam performance, state mindfulness

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MARIO A. DIAZ

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M.A.D

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CHAPTER I: INTRODUCTION

Research demonstrates mindfulness may improve control over one's consciousnesses which in return, can positively affect individuals' functioning and well-being by acting as a buffer against common forms of psychological distress (Brown et al., 2007; Bostock et al., 2019; Chin et al., 2019; Keng et al., 2011; Slutsky et al., 2018). Alone, the current literature review has yielded over 1,000 published academic papers in the past 20 years in a variety of contexts (academic, health, service) with mindfulness elements describing a wide range of benefits for the practitioner. While the rising awareness of mindfulness in society has been cultivated in clinic interventions, smartphone apps and various organizational programs, studies provide contradicting evidence on how mindfulness works (Good et al., 2016; UCLA, 2022). This study proposes that these contradictions can be addressed with the pre-existing notion from Kabat-Zinn (1992) that mindfulness is an inherit human quality. With this perspective, science may find increased autonomy and applicability regarding mindfulness research in a variety of contexts.

Within an academic context, universities spend large amounts of money on mentoring, workshops, and other various tools to improve student success within the classroom. Professors may attempt to equip students with as much knowledge as possible to also improve student success. Ultimately, the student is in control of their own success. While support from the university and knowledge from professors are important influences for a student's success, prior research describes attentional control and emotional regulation as additional important factors that may also affect a student's success (Moore et al., 2020; Bryune et al., 2013). These processes are common themes in mindfulness literature. The classroom offers unique research opportunities, as specific academic courses such as introduction to statistical analysis are more likely to be associated with negative effects that hinder a student's success compared to other

courses (Grays et al., 2017). This current study investigates the relation between one's dispositional mindfulness with statistical anxiety, and the impact that relation has on exam performance. The study uses a correlational design, focused on dispositional mindfulness as opposed to the practice of mindfulness found within experimental research. The purpose of this research is to clarify the parameters of dispositional mindfulness by attempting to replicate and extend outcomes found from mindfulness practices.

Mindfulness

Mindfulness has strong Buddhist origins and has been practiced in eastern cultures for centuries (Brown et al., 2007). Kabat-Zinn (2003) generally defines mindfulness as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (p.145). There have been further conceptualizations of mindfulness after its introduction to the scientific community, which will be explored in the following paragraphs. Ultimately, these conceptions of mindfulness include overlapping elements. First, mindfulness is common among all humans, as such that people vary in the amount of mindfulness based on intersectional identities and other individual differences. Second, mindfulness involves self-regulation and recognition of internal emotions, thoughts, behavioral intentions, and external events. Mindfulness self-regulation must have no true direction of improvement or compression, just the regulation of one's attention to one's current state. Third, mindfulness acts as an unjudging diagnostic check of oneself and external experiences. Similar to a screenshot on a smartphone, mindfulness must act as a capture of one's well-being free of judgment from the self. Fourth, mindfulness requires the practitioner to be present in the moment and pay attention to themselves. While some other meditation methods may include reflections on past events or anticipation of future experiences,

mindfulness requires the practitioner to limit their experiences to the present and only the present. Fifth, entering a mindfulness state may be achieved more frequently by those with higher levels of dispositional mindfulness (Baer et al., 2006; Brown & Ryan, 2003, 2007; Kabat-Zinn, 2005; Kiken at el., 2015). The incorporation of common aspects of mindfulness reveals its independence from other related states and contributes to the explanation of mindfulness as an inherited human disposition.

Mindfulness: Disposition or State?

Mindfulness has been conceptualized as both a state of being and as a disposition in scientific literature. Dispositional mindfulness is the tendency of an individual to be mindful in their everyday life and remains relatively stable over time. State mindfulness refers to the temporary state of being mindful brought upon by practices such as meditation or breathing exercises (Brown & Ryan, 2003; Baer et al., 2006; Hulsheger & Alberts, 2020). Inevitably, mindfulness has the capability to be practiced by everyone and is an inherent human disposition (Kabat-Zinn, 1992). As with a muscle, practitioners can improve their dispositional mindfulness by "exercising" through mindfulness practices like meditation. As practitioners enhance their dispositional mindfulness, it appears that their ability to enter a state of mindfulness at any time becomes more effective (Good et al., 2017; Keng et al., 2011; Kieken et al., 2015;). However, recent research examining the relation between state and dispositional mindfulness has shown inconsistent results (Bravo et al., 2018; Vonderlin et al., 2020). Even without a clear understanding of this relation researchers continue to use mindfulness-based interventions in their research designs (Bakosh et al., 2018; Bostock et al., 2019; Coo & Salanova, 2018; Rogojanski et al., 2011; Shonin et al., 2014). Regardless, both state and dispositional mindfulness appears to be both related and distinct from one another within the parameters of an

ambiguous relation. For instance, even without interventions, dispositional mindfulness not only emerges as stable over time but can also benefit participants similarly as mindfulness interventions (Brown & Ryan, 2003; Hulsheger et al., 2013). Yet, literature investigating dispositional mindfulness is sparse compared to literature utilizing mindfulness.

Common Benefits of Mindfulness

It's no coincidence that mindfulness literature has become more prevalent in recent years due to the rising interest from society. This is due to the benefits that dispositional mindfulness can offer to the public. Keresmaekers and researchers (2018), found that the most frequent uses of mindfulness within scientific literature are through clinical and work-related interventions. More commonly associated with mainstream media and popular culture, mindfulness is found in meditation classes and is available through apps, such as UCLA's (2022) Wellness Sponsored App at no charge. Regardless of delivery method of mindfulness practices, recent research has found that electronic delivery of mindfulness practices can increase one's well-being and decrease various negative emotions (Bostock et al., 2019; Moore et al., 2020). Keng and researchers (2011) and Tomlinson and others (2018) collected an impressive set of mindfulness data within their meta-analysis that describes dispositional mindfulness as a reliable predictor of improving well-being, among many other benefits. More specifically, Brown and Ryan (2003) found that dispositional mindfulness is positively associated with increased self-esteem, pleasant emotions, sense of autonomy, competence, and life/work satisfaction. Additionally, they found negative associations between dispositional mindfulness and depression, and social anxiety, while Baer and researchers (2006) found relations between dispositional mindfulness and decreased emotion regulation, increased experiential avoidance, and other general psychological symptoms. Research also suggests dispositional

mindfulness correlates with short-term memory capacity, autonomic cardiovascular health, and demonstrates immediate changes in the brains of non-experienced practitioners prior to mindfulness practices (Ditto et al., 2006; Lee et al., 2021; Xaio et al., 2019). Experimental research on the immediate effects of brief mindfulness interventions includes improved recovery from negative moods, improved control of emotional responses, in addition to increase of control one's behaviors (Keng et al., 2011). These findings support the notion that both dispositional and state mindfulness have applicability to address various interests in a wide range of contexts through various research lenses and design. In order to advance the effectiveness of each version of mindfulness, researchers must understand the differences and similarities between their associations with other variables of interest.

Dispositional Mindfulness and Statistical Anxiety

Emotional regulation, previously described as a second element of mindfulness, is a core theme of mindfulness literature. Emotional regulation refers to the ability to control and manage one's emotions by recognizing and expressing these emotions in a healthy manner and provides the tools necessary to handle psychopathological symptoms, such as general anxiety. Much of the current literature on mindfulness acknowledges dispositional mindfulness's ability to impact on one's anxiety through emotional regulation (Keng et al., 2011; Keresmaekers et al., 2018; Tomlinson et al., 2017; Zedian et al., 2010).

It's through our own emotional regulation brought upon by dispositional mindfulness, that we are all allowed to develop internal tools such as coping flexibility in order to decrease the negative effects that may allow anxiety to manifest (Jones et al., 2019). Certain underlying mechanisms of anxiety, such as rumination, emotional exhaustion, resource depletion, and stress, are known to impair general performance. These strains have been found in previous research to

have a negative relation with individuals participating in mindfulness interventions and indirectly has improved various forms of performance across contexts (Banks et al., 2015, Fergulio et al., 2021; Good et al., 2016; Hulsherger et al., 2013; Moore et al., 2020; Querstret et al., 2017). The relation between dispositional mindfulness and anxiety is similar in comparison with mindfulness interventions and its impact on anxiety. Though previous research has demonstrated the negative effects of anxiety on academic performance, to our knowledge no published research examines dispositional mindfulness and anxiety specific to statistics classes.

In this study, I am interested in statistical anxiety, which is anxiety that manifests itself in a mathematics classroom context. *"mathematic/statistical anxiety is a person's negative effective reaction towards situations involving numbers, math and mathematic calculations"* (Ashcraft & Moore, 2009, p 197). In the context of higher education, individuals' statistical anxiety has been found to increase during high-stakes tasks (Ashcraft & Moore, 2009; Decaro et al., 2010). Similar to general anxiety, statistical anxiety may result in a variety of undesirable reactions that impede the genuine execution of an individual's statistical skills. Ultimately, this allows statistical anxiety to create emotional barriers between an individual and their true performance capability (Chapell et al., 2005). It has been discovered that dispositional mindfulness acts as a buffer against emotional barriers and decreases emotional reactivity caused by stressors, such as statistical courses (Johnson et al., 2021). Additionally, recent mindfulness research demonstrated favorable outcomes of decreasing statistical anxiety within our targeted population of college students through state mindfulness interventions (David et al., 2022; Fazia et al., 2020; Leppma & Darrhah, 2020; Samuel & Warner, 2019). Dispositional mindfulness, as an important inherent quality, can buffer an individual's statistical anxiety through emotional regulation allowing

cognitive resources to be directed towards other goals. Due to these benefits and findings from previous studies, I propose the following hypothesis:

Hypothesis 1: Dispositional mindfulness will demonstrate a negative relation with statistical anxiety at Time 1.

Dispositional Mindfulness and Exam Performance

Another common core of mindfulness literature consists of increased attentional control, which was described previously as a fourth element of mindfulness. Bear and researchers (2008) define attentional control as noticing or attending to internal and external experiences, such as sensations, cognitions, emotions, sights, sounds, and smells. According to attentional control theory, when confronted with an anxiety-inducing event, such as an exam, one's cognitive resources are diverted from a goal towards negative effects, such as increased rumination and stress levels (Eysenck et al., 2007). Consequently, without adequate attentional control, statistical anxiety may result in affective drop- a decline in a student's performance due to time pressures or high-stake situations such as exams or final projects (Ashcraft & Moore, 2009). Mind wandering may also contribute to affective drop, since it has been negatively associated with fluid intelligence and SAT performance and is characterized by breaks in concentration that divert cognitive resources from attaining a goal (Alberts & Hulsheger, 2015). As explained, attentional control is a crucial aspect of mindfulness that enables one to regulate their own thoughts and actions; it is the opposite of mind wandering and may act as a buffer against affective drop. Response flexibility, an extension of attentional control, may allow those with dispositional mindfulness a "slower reaction" towards situations and which allows for improved decision making and has been shown to have a significant positive relation with dispositional mindfulness (Glomb et al., 2011). Weed and researchers (2021) found attentional control was significantly

associated with overall better course grades within undergraduate introduction math students. It appears that through attentional control, those with higher levels of dispositional mindfulness are afforded greater opportunity to regulate external influences, such as statistical anxiety, hence allowing for greater autonomy within activities that are require high levels of focus.

The significance of academic tasks can also influence the impact of dispositional mindfulness on performance. In an undergraduate sample, affective drop in performance was only observed in high-stakes settings, such as tests, as opposed to low-stakes situations, such as participation quizzes (Bryune et al., 2013). Similar findings were found by Samuel and Warner (2019) among undergraduate STEM students, where mindfulness interventions impacted performance on high-stakes quizzes and exams more effectively than on low-stakes quizzes or assignments. Therefore, because attentional control is a major component of dispositional mindfulness, this notion provides a reliable framework for investigating the relation between dispositional mindfulness and exam performance. Similar to emotional regulation, there is evidence that mindfulness interventions impact both a student's and teacher's performance on various classroom tasks through increasing attentional control (Brunye et al., 2013; McCoy, 2019). As previously described, the Keng et al. (2011) and Tomlinson et al. (2018) meta-analyses found dispositional mindfulness to be a strong predictor of various elements that impact one's well-being. However, most studies in those meta-analyses utilized self-report measures of outcomes to predict these effects of dispositional mindfulness. In this current study, the performance measure is objective as its independent of rater bias. Exam scores are controlled by a student's current statistical abilities at the time of exam 1 and are measured in a high-stake situation. These findings allow us to propose the following hypothesis:

Hypothesis 2: Dispositional mindfulness will demonstrate a positive relation with exam performance at Time 2.

Moderating Effects of Mindfulness

Current research suggests that dispositional mindfulness can moderate the relation between statistical anxiety and exam performance. Research demonstrates that individuals participating in mindfulness interventions perform better on class-related activities than those in control groups as dispositional mindfulness increased for those in the treatment group (Bellinger et al., 2015; Brunye et al., 2013; Leppma & Darrah, 2022; Weed et al., 2021). Correspondingly, dispositional mindfulness indirectly improves performance by decreasing adverse outcomes such as perceived stress, rumination, thought suppression, anxiety, and stress (Imtiaz et al., 2018; Johnson et al., 2021; Pallozzi et al., 2017; Rogojanski et al., 2011). I propose that these mechanisms may buffer participants' statistical anxiety, which should allow those with higher levels of dispositional mindfulness to utilize their statistical knowledge and skills without internal interference, which could then lead to affective drop of exam scores. Dispositional mindfulness's moderation ability has impacted outcomes such as life satisfaction, engagement, and student success by increasing school self-concept, academic efficacy, and self-regulation (Coo & Salanova, 2018; Dust et al., 2021; Heckenberg et al., 2019; Imtiaz et al., 2018; Pallozzi et al., 2017). The maintenance of our emotional regulation and attentional control may explain why some students are able to perform more effectively than those without these mechanics in high stake situations vs low stake situations. This study proposed that the phenomenon of dispositional mindfulness and its bivariate relations found in past research does not provide a comprehensive explanation.

Hypothesis 3: Statistical anxiety at Time 1 will have a stronger negative relation with exam performance at Time 2 for individuals high in dispositional mindfulness than those low in dispositional mindfulness.

CHAPTER II: METHOD

Participants

To be eligible for the current study, participants (N = 183) must have been at least 18 years of age and enrolled in one of two introductory statistical analysis courses at a large Midwestern university during spring semester of 2023. I did not conduct a formal power analysis but rather collected as many participants as possible enrolled in these courses. Participation in the study was voluntary, and participants were compensated in the form of extra credit for their overall course grades. Alternative extra credit options were offered for those who did not participate in our study. This study was approved by the university's IRB.

Design

I conducted a two-stage cross-lagged study to investigate the relations between statistical anxiety, dispositional mindfulness, and exam performance. At time 1 (T1), I collected participants' demographic information, statistical anxiety, and dispositional mindfulness levels via paper-pencil surveys. At time 2 (T2), participants completed exam 1 through the university's online educational interface. I used exam 1 grades as the exam performance variable.

Procedure

During the first two weeks of the semester, statistical instructors informed students of an opportunity to take part in this current study during scheduled laboratory time. As the study date approached, statistical instructors posted an announcement on their course websites to remind participants of the research opportunity. An e-mail with the same reminder information was also sent to each student in the course simultaneous to the posted announcement. To reduce demand effects, instructors and teaching assistants who taught specific sections were not present in the

laboratory during T1's data collection period. Instead, participants entered the computer laboratory and were greeted by an unfamiliar research assistant. Participants were offered a writing utensil, a packet containing statistical anxiety and mindfulness questionnaires, and a demographic survey. Participants were instructed by the research assistant to return the packet once completed. Participants were then allowed to leave. At T2, participants entered the computer laboratory and were given 50 minutes to complete exam 1 through the university's online educational platform. Once participants concluded their exam or time ran out, participants vacated the laboratory. Within the research packet collected at T1, participants provided their unique ID number for the research team to compensate participants with extra credit and to match exam 1 scores for the intended participant. Participants were then debriefed at the following scheduled course meeting time following T2.

Measures

Dispositional Mindfulness. The Five Facet Mindfulness Questionnaire-15 (Baer et al., 2012) is a 15 item self-report questionnaire that measures dispositional mindfulness through multi-facets of interrelated components of mindfulness; observing, describing, acting with awareness, nonjudging of inner experience, nonreactivity to inner experience. FFMQ-15 is an abbreviated version of Baer et al. (2006) FFMQ-39, which originally included 39 items. This modified version of the FFMQ-39 was developed to alleviate participant burden in research trials as its factor structure is supported by previous validation studies. For example, confirmatory factor analysis found that FFMQ-15's aggregated DM score was significantly negatively correlated with psychological inflexibility and rumination (well-documented relation in prior research) and significantly positively correlated with distress tolerance (theoretically should be positively correlated). Convergent validity demonstrated large correlations between FFMQ-15

and FFMQ-39 total scores, indicating both versions capture similar mindfulness constructs and are sensitive to research manipulation (Gu et al., 2016; Kim et al., 2021). Similar to FFMQ-39, FFMQ-15 includes items such as ("I'm good at finding words to describe my feelings"; "I pay attention to sensations, such as the wind in my hair or sun on my face") rated on a Likert scale of one ("never or very rarely true") to five ("very often or always true").

To produce a moderator variable, I calculated an overall dispositional mindfulness score for each participant by summing the responses in the subscales and dividing them by the number of items in that subscale. Subscale scores were summed to produce an overall mindfulness score for each participant. I did not have any a priori hypotheses about mindfulness subscales so I chose to calculate an average dispositional mindfulness score for each participant. Higher overall scores indicate higher levels of dispositional mindfulness. For this current study, FFMQ-15's internal consistency was adequate (Cronbach's $\alpha = .73$) and consistent with previous research (Beshai et al., 2022; Kim et al., 2021; Ortet et al., 2020; Seritan et al., 2022). Refer to Appendix A for the distribution of FFMQ-15 scores.

Statistical Anxiety. The Statistical Anxiety Rating Scale or STARS (Cruise et al., 1985) is a 51 item self-report questionnaire that measures statistical anxiety through six subscales; worth of statistics, interpretation anxiety, test and class anxiety, computational self-concept, fear of asking for help and fear of statistics teachers. Hanna and researchers (2008) found favorable convergent validity of STARS with other popular mathematics anxiety scales, providing strong support for STARS through confirmatory factor analysis in a UK sample of psychology students. Additionally, Chew et al. (2018) found STARS favorable divergent validity with two positive affect scales, indicating that STARS is sensitive to research manipulation regardless of sample characteristics. STARS include items such as ("I feel statistics is a waste",

and “I am never going to use statistics so why should I have to take it?”). Participants indicated how much anxiety they experience in situations for the first 23 items on a Likert scale from one (no anxiety) to five (strong anxiety) and their level of agreement from one (strongly agree) to five (strongly disagree) on the remaining items. Every subscale captured a different aspect of statistical anxiety, with higher scores on a subscale indicating higher levels of statistical anxiety. To produce the predictor variable, an overall statistical anxiety score for each participant was calculated by summing the responses in the subscales and dividing them by the number of items in that subscale. Subscale scores were then summed to produce an overall statistical anxiety score. For this current study, STARS internal consistency was favorable (Cronbach’s $\alpha = .95$) and consistent with previous research utilizing STARS (Chew et al., 2018; Hanna et al., 2008; Paechter et al., 2017). Refer to Appendix B for the distribution of STARS scores.

Exam Performance. Exam 1 scores are utilized as the dependent variable for the primary analysis. Exams scores were measured as a continuous variable (e.g., 75%, 85%) instead of an ordinal variable (e.g., A’s, F’s). Exams were graded automatically through the university’s online educational software and the results were made available both to participants and the research team the following day. Questions on the exams may have varied slightly between the two introductory statistics courses, however, the topics tested and exam structure are nearly identical between course instructors. Regardless, exam 1 scores for both course instructors were standardized individually into two Z-scores variables. These Z-scores were then combined and transformed into a final dependent variable for the primary analysis. Refer to Appendix C for the distribution of exam 1 scores.

CHAPTER III: RESULTS

Primary Analysis

Participants *(N* = 183) reported their gender as female (*n* = 123), male (*n* = 56), or non-binary (*n* = 4), and an average age of 19.58 years (*SD* = 1.69). Regarding race, 73.2% participants identified as “White”, 10.4% participants identified as “Black”, 9.3% participants identified as “Hispanic”, 6.6% participants identified as “Asian”, and 0.5% participants identified as “Pacific Islander”. Regarding class ranking, 36.1% of participants were freshmen, 40.4% of participants were sophomores, 18.6% of participants were juniors, 4.4% of participants were seniors, and 0.5% of participants were graduate students. Of these participants, 89% had no prior experience with statistical analysis courses.

Examining Instructor Differences and Prior Statistical Experience on Exam Scores

An examination of instructor type (A/B) and a participant’s prior experience in statistical courses (experienced/non-experienced) was conducted to see whether they have an effect on exam performance. An independent samples t-test demonstrated a non-significant difference between course instructor A (*M* = 42.69, *SD* = 4.60) and B (*M* = 43.96, *SD* = 5.21) on exam 1 grades $t(176) = -1.60$, $p = .111$, $d = -.25$. The variance was equal for participants across statistical sections, $F(1,176) = 1.83$, $p = .178$. Refer to Appendix E for illustration purposes. An additional independent samples t-test demonstrated a non-significant difference between participants having prior statistical experience (*M* = 42.45, *SD* = 5.50) and not having prior statistical experience (*M* = 43.66, *SD* = 4.97) on exam 1 grades $t(176) = -1.01$, $p = .313$, $d = -.24$. The variance was equal for participants regarding statistical experience $F(1,176) = 0.01$, $p = .934$. Refer to Appendix F for illustration purposes. These results suggest that instructor and

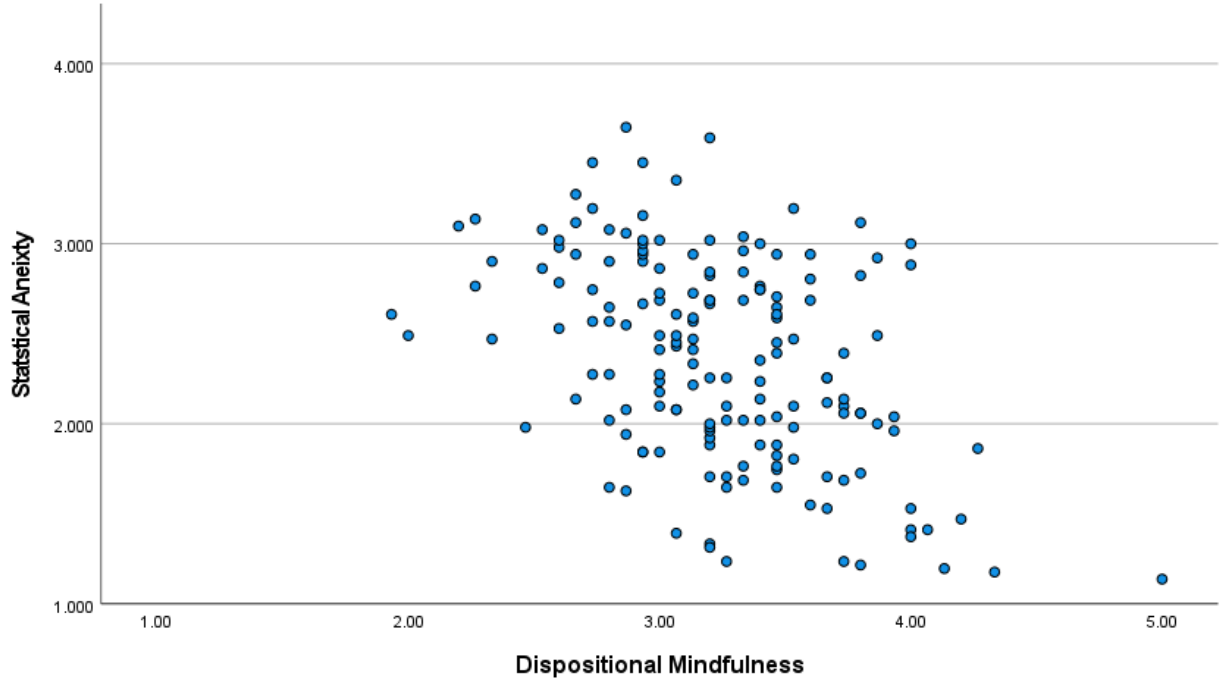
previous statistical course experience did not affect exam performance, and therefore, were not included in the primary analysis.

Correlations

I predicted a negative correlation between dispositional mindfulness and statistical anxiety at T1. For H_1, I predicted that dispositional mindfulness would demonstrate a negative relation with statistical anxiety at T1. Results demonstrated support for that idea as there was a significant negative relation found at T1; $r(164) = -.46$, $p < .001$. Refer to Figure 1 for a scatterplot illustration of this relation. For H_2, I predicted that dispositional mindfulness would demonstrate a positive relation with exam performance at T2. Results did not support H_2, as there was no statistically significant relation between exam 1 scores and dispositional mindfulness at T1; $r(168) = .10$, $p = .093$. Refer to Figure 2 for a scatterplot of this relation. Higher levels of dispositional mindfulness were not related to higher statistical exam performance on exam one for participants. Refer to Table 1 for descriptive statistics and correlations for all primary analysis variables.

Figure 1

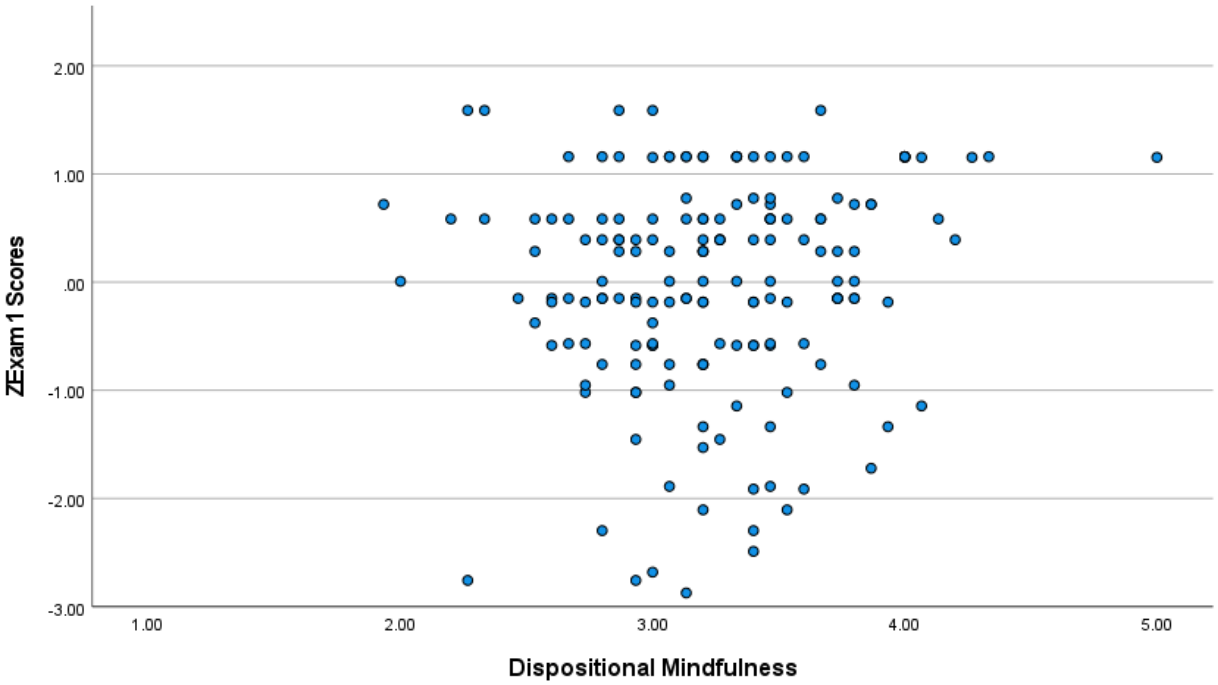
Scatterplot Illustrating the Relation Between STARS and FFMQ-15.



Note. H_1 was supported by a statistically significant negative relation between statistical anxiety and dispositional mindfulness at T1; $r(164) = -.46$, $p < .001$.

Figure 2

Scatterplot Illustrating the Relation Between Standardized Exam 1 scores and FFMQ-15



Note. H_2 was not supported as there was not a significant relation found between exam 1 scores and dispositional mindfulness at T1; $r(168) = .10$, $p = .093$.

Table 1

Descriptive Statistics and Correlations for Study Variables

Variable	*n*	*M*	*Min*	*Max*	*SD*	*1*	*2*	*3*
1. Dispositional mindfulness	175	3.23	1.93	5.00	0.47	-	-	-
2. Statistical anxiety	173	2.34	1.14	3.65	0.58	-.46**	-	-
3. Exam 1 scores	178	43.52	29.00	50.00	5.03	.10	-.21*	-

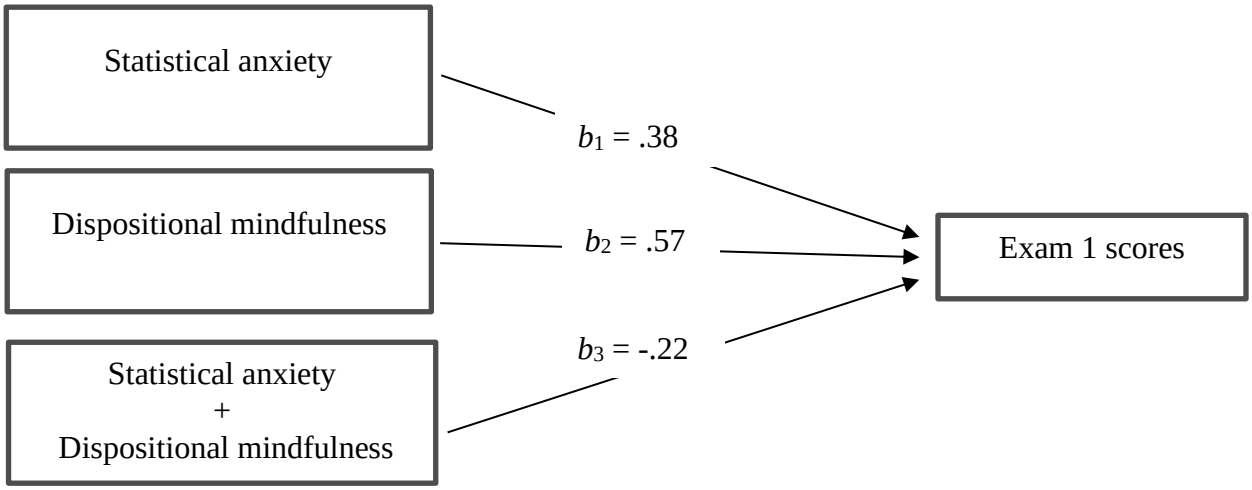
Note. Exam 1 scores displayed are raw scores. Correlation is significant at the .01 level (1-tailed), * $p < .01$, ** $p < .001$.

Moderation Analysis with Hayes PROCESS

I examined H_3 using Hayes PROCESS model 1 (Hayes, 2013), a moderation analysis was performed with statistical anxiety (SA) as the predictor, exam 1 scores as the criterion variable, and dispositional mindfulness (DM) as the moderator. Results demonstrated that there was a nonsignificant main effect found between statistical anxiety and exam 1 scores, (b = .38, CI [-1.31, 2.07], t = .45, p = .656), a nonsignificant main effect of dispositional mindfulness on exam 1 scores (b = .57, CI [-.628, 1.77], t = .94, p = .348) (Figure 3). The interaction term between statistical anxiety and dispositional mindfulness did not explain a significant increase in variance in exam 1 scores, ΔR^2 = .005, $F(1, 158) = 0.78$, p = .379. The unstandardized simple slope for participants who had one *SD* below the mean of dispositional mindfulness was 2.76, the unstandardized simple slope for participants with a mean dispositional mindfulness was 3.24, and the unstandardized simple slope for participants one *SD* above the mean of dispositional mindfulness was 3.71. Hence, H_3 was not supported. Refer to Appendix D for the standardized residual histogram.

Figure 3

Unstandardized Regression Coefficients for the Relation Between Statistical Anxiety and Exam 1 Scores as Moderated by Dispositional Mindfulness



Note. There was a nonsignificant main effect found between statistical anxiety and exam 1 scores, (b = .38, p = .656), a nonsignificant main effect of dispositional mindfulness on exam 1 scores (b = .57, p = .348) and a nonsignificant interaction by dispositional mindfulness and statistical anxiety on exam 1 scores, (b = -.22, p = .379).

Exploratory Analysis

Emotional regulation and attentional control are subscale dimensions of the FFMQ-15 that should be positively related to improved exam performance as eluded to in the literature review. Results did not find a significant positive relation between attentional control and exam 1 scores, instead, a negative relation was found $r(176)$ = -.13, p = .042. Additionally, there was no significant positive relation between emotional regulation and exam 1 scores $r(174)$ = -.03, p = .320. Refer to Table 2 for descriptive statistics and correlations for all exploratory variables.

Table 2

Descriptive Statistics and Correlations for Exploratory Variables

Variable	n	M	SD	1	2	3	4	5	6	7
1. Attentional control	178	2.77	0.58	-	-	-	-	-	-	-
2. Describing	182	2.51	0.71	.07	-	-	-	-	-	-
3. Acting with	181	2.33	0.57	.08	.38**	-	-	-	-	-
4. Non-judgement	181	2.52	0.75	.01	.34**	.37**	-	-	-	-
5. Emotional regulation	180	2.48	0.61	-.03	.21*	.14	.02	-	-	-
6. Statistical anxiety	173	2.34	0.58	-.04	-.36**	-.27**	-.40**	-.18*	-	-
7. Exam 1 scores	178	43.52	5.03	-.13	.15	.09	.12	-.03	-.21*	-

Note. Exam 1 scores displayed are raw scores. Correlation is significant at the .01 level (1-tailed), * $p < .05$, ** $p < .001$.

CHAPTER IV: DISCUSSION

Implications and Future Directions

To my knowledge, this is the only study that has provided correlational evidence that dispositional mindfulness is associated with lower levels of statistical anxiety; although, previous literature and meta-analyses have provided correlational evidence of dispositional mindfulness's relations with other similar negative effects, such as general and social anxiety (Baer et al., 2006; Brown & Ryan, 2003; Keng et al., 2011; Tomlinson et al., 2018). Additionally, H_1 findings are similar with previous experimental research utilizing mindfulness interventions that have reduced statistical anxiety and other forms anxiety within student populations (David et al., 2022; Samuel & Warner, 2019). The current study has provided sufficient evidence that supports the idea of the relation existing organically in higher education contexts. Since previous meta-analyses and research have also confirmed similar relations between various forms of anxiety and dispositional mindfulness, the significant findings of H_1 adds to the validity and generalizability of the general relation through replication (Keng et al., 2011; Tomlinson et al., 2018). Understanding the relations between students' dispositions and higher education strains allows future researchers confidence when crafting methods to ultimately increase student success. Future researchers may find similar relations between dispositional mindfulness and other common stressors and strains found in higher education. Although researchers should not limit their focus to only higher education populations, but across all educational levels to examine demographic differences or similarities. Outside the realm of education, employee populations that involve tasks or responsibilities that invoke statistical anxiety should also be investigated.

This current study aimed to address the conflicting evidence of disposition and state mindfulness, specifically through exam performance in an academic context. The lack of a positive relation between dispositional mindfulness and exam performance (T2) was not anticipated. Even though I did not hypothesize that statistical anxiety would be significantly negatively related to exam performance, I found a such a correlation (Table 1), which is consistent with previous research that has found various forms of anxiety are associated with lower levels of performance in both academic and organizational contexts (Banks et al., 2015; Good et al., 2016; Moore et al., 2020). Although dispositional mindfulness is not initially related to exam performance as participants' performance data was collected early in the semester, it could be that as participants obtain statistical-related knowledge and skills throughout the course, participants' dispositional mindfulness may be significantly related to exam performance later in the semester instead of earlier. The previous notion would support previous state mindfulness findings, studies of which are commonly conducted throughout the semester. Accounting for H_1 and H_2 findings, it appears that dispositional mindfulness is not organically related to objective performance outcomes but is significantly related to a strain that could affect performance. These results address the similarities and differences between disposition and state mindfulness. To increase clarification within this line of research, future researchers could collect performance data multiple times and measure student performance with alternative methods. For example, dispositional mindfulness could be positively related to subjective performance such as in presentations that involve statistical communication. This type of performance would require a measure of behavior, such as professor ratings, instead of exam 1 scores as the current study utilized (Good et al., 2015).

H_3 failed to provide evidence that those with higher levels of dispositional mindfulness will indirectly benefit their exam performance by lowering of levels statistical anxiety. Besides study length, the current study did not impact performance as found in previous research with similar study designs (Bruyne et al., 2013; Samuel & Warner, 2019; Weed et al., 2021). The lack of evidence found in the current study highlighted a difference between dispositional and state mindfulness research. The difference being that being mindful and utilizing mindfulness in our everyday experiences result in different outcomes. Referencing attentional control theory, which explains that when individuals encounter an anxiety-inducing experience, such as the case for exam 1, cognitive resources are diverted toward negative effects (Eysenck et al., 2007). Now consider that my exploratory analysis demonstrated a near significant relation between attentional control and exam 1 scores (Table 2). It could be possible that attentional control needs mindfulness interventions to teach practitioners techniques to indirectly improve their grades. The current exploratory results suggest that attentional control could harm participants' exam performance. Essentially if mindfulness tools are not properly managed, such as response flexibility, these mechanisms could be consuming cognitive resources simultaneously in a similar manner as statistical anxiety (Glomb et al., 2011). This could explain why we see high levels of dispositional mindfulness not producing similar outcomes as research using mindfulness interventions but still being highly related to a strain that is known to affect student performance (Brunye et al., 2013; McCoy, 2019). Therefore, universities promotion of other health and wellness dimensions such as improving better sleep habits, may be more impactful for improving classroom success than the promotion of dispositional mindfulness knowledge within higher education populations.

An additional takeaway from this current research provided me the idea that dispositional mindfulness appears to be more related to improved internal experiences instead of external outcomes. Instead of moderating the relation between state anxiety with exam performance, a significant moderation may occur with another internal variable, students' motivation. As I did in the current study, defining high levels of objective performance with "A, B or C" may actually be subjective from the students' perspective. A student's perspective of their own high performance could simply be achieving a grade that will prevent them failing the course, instead of exceeding the average score among their peers. Technically, this could be considered daily mindful behavior if the student meets certain requirements. First, the student must recognize their own internal emotions, thoughts, behavioral intentions, and goals through self-regulation. As discussed in the introduction when defining mindfulness, self-regulation must have no true direction (Kabat-Zinn, 2005). Therefore, if a student regulates and aligns their thoughts and behaviors to achieve a passing grade, then mindfulness has helped them achieve that goal. Second, mindfulness is free of judgment reflection of the self and requires the user to be present in the moment. This ties in with the previous point of being motivated to obtain a passing grade. These components that define dispositional mindfulness could be used to justify why some participants with high levels of dispositional mindfulness could simply not be motivated to achieve higher scores on exam 1. Additionally, since exam 1scores were collected near the beginning of the semester, there is still time for students to achieve a passing grade before final grades are posted. It could be that students may perceive exams near the end of the semester, where opportunities to improve course grades are slim, as more important, and thus our variables of interest may produce different results.

Future researchers should incorporate several study variations to examine if dispositional mindfulness can indirectly improve exam performance. Including multiple performance, and statical anxiety collection timepoints over the entirety of the semester with both high-stakes tasks (such as exams) and low-stakes tasks (such as quizzes) instead of single high stakes task at the beginning of the semester appears promising. This variation will allow researchers to examine how dispositional mindfulness may fluctuate throughout the semester, and for replication purposes regarding the weight of each task. Additionally, collecting motivation prior to performance timepoints could address if this variable was confounding results in the current study. Future researchers may also wish to define performance through alternative methods. Presentations which require subjective performance measures (professor ratings) and allowing students to define performance through ranking may provide favorable results. Although. future researchers should be mindful of the burden brought upon participants when considering alternative measurement options and study design variations. Altogether the current study provides knowledge of the relation between dispositional and state mindfulness. Dispositional mindfulness appears to be related to internal but not external experiences, as state mindfulness practices have found significant findings with both internal and external experiences. Additionally, the results add validity to previous state mindfulness findings that demonstrate inexperienced individuals in mindfulness can improve their academic performance with mindfulness practices and expertise, as in the current study that those with high dispositional mindfulness are not repping the same benefits.

Limitations

Regarding the limitations of the current study, self-report measures will always serve as an area of concern, especially with the low (though still acceptable) reliability of FFMQ-15 in

the current study. If a more reliable measure was used for dispositional mindfulness, I may have seen the magnitudes of the reported correlations increase to significant thresholds. However, the decision to go with the FFMQ-15 was crafted due to the availability of other statistical anxiety measures within the current research design and to alleviate the burden on participants. Additionally, the context on which the study was conducted restricted the opportunity for the research design to incorporate the use of behavioral measures of mindfulness, such in breath-counting tasks (Levinson et al., 2014). During the stages of research proposal, I alluded to potentially using multiple exam scores for data analysis instead of just the one performance measure, exam 1. However, the current study was limited to one measure of exam performance. Multiple performance measures could describe the relations between the study variables more clearly, therefore, the time restraints prior to students' exams were a factor in the creation of our research timeline. Traditionally, exam 1 encompasses universal concepts students may have learned about throughout their academic career even without prior enrollment in a statistical analysis course. Therefore, exam 1 may be perceived as easier than the other exams, due to the foundational knowledge that needs to be established before moving onto more complex topics and not bring upon as much statistical anxiety as exam 2 or 3.

Statistical anxiety is a state anxiety, which is a temporary feeling brought upon by a stressor in an individual's environment and is a temporary emotional state (Ashcraft & Moore, 2009). Previous research suggests that one's statistical anxiety levels are highest shortly before a high-stakes task (Bryune et al., 2013). Considering statistical anxiety in the current study was captured a week prior to exam 1, participants' statistical anxiety could have changed from T1 and T2. However, our research design could not directly interfere with participants performance due to ethical purposes, as collection of participant's statistical anxiety minutes before exam 1

could've affected their performance. Additionally, dispositional mindfulness and mindfulness practices have become increasingly popular in society (Good et al., 2016). I did not assess participants' prior experience with mindfulness practices within the demographics survey, so it is possible that some participants may have had exposure to mindfulness previously which could have affected the results. Also, attention checks were not included within demographics surveys, which could have reduced the number of outliers during primary analysis.

Conclusion

The purpose of this research was to investigate the relation between dispositional mindfulness and state mindfulness by attempting to replicate outcomes found by previous experimental research. Additionally, to improve and support mindfulness interventions implementation within universities, evidence providing the notion that dispositional mindfulness does not produce similar outcomes on academic performance is provided. I found evidence that further establishes the parameters of the relation between dispositional and state mindfulness research, such as that dispositional mindfulness does not impact student success but is organically relate to statistical anxiety, a known strain that could affect student performance. The current results suggest that higher levels of dispositional mindfulness do not impact exam performance as mindfulness interventions do within an academic context (Bryune et al., 2013; McCoy, 2019; Samuel & Warner, 2019). Hence, it appears state mindfulness is more vital to student success as prior research has found that state mindfulness practices, such as focused breathing techniques, moderated course grades of individuals with high levels of math anxiety (Bruyne et al, 2013). The current research did provide evidence that dispositional mindfulness is an inherit disposition that is related to strains that could impact outcomes. Narrowing down what those outcomes are could provide future researchers with even more knowledge to improve

mindfulness interventions and the interactions of dispositional mindfulness with various performance factors.

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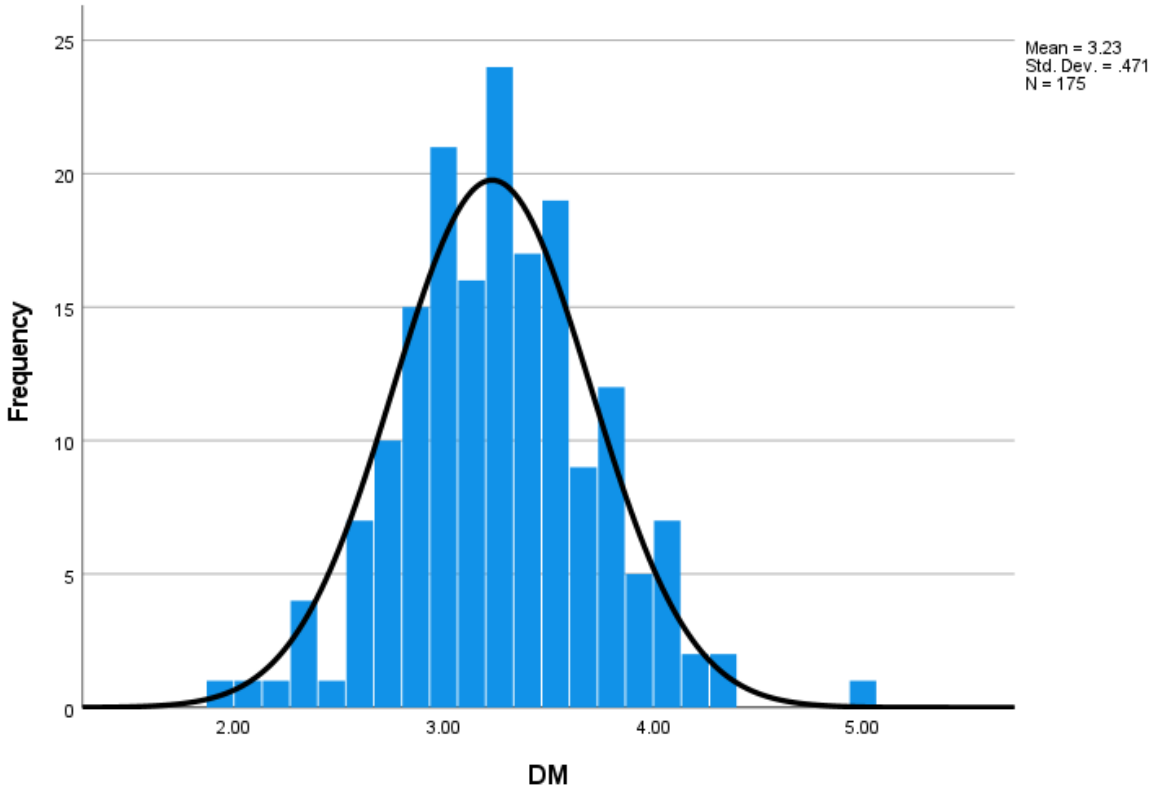
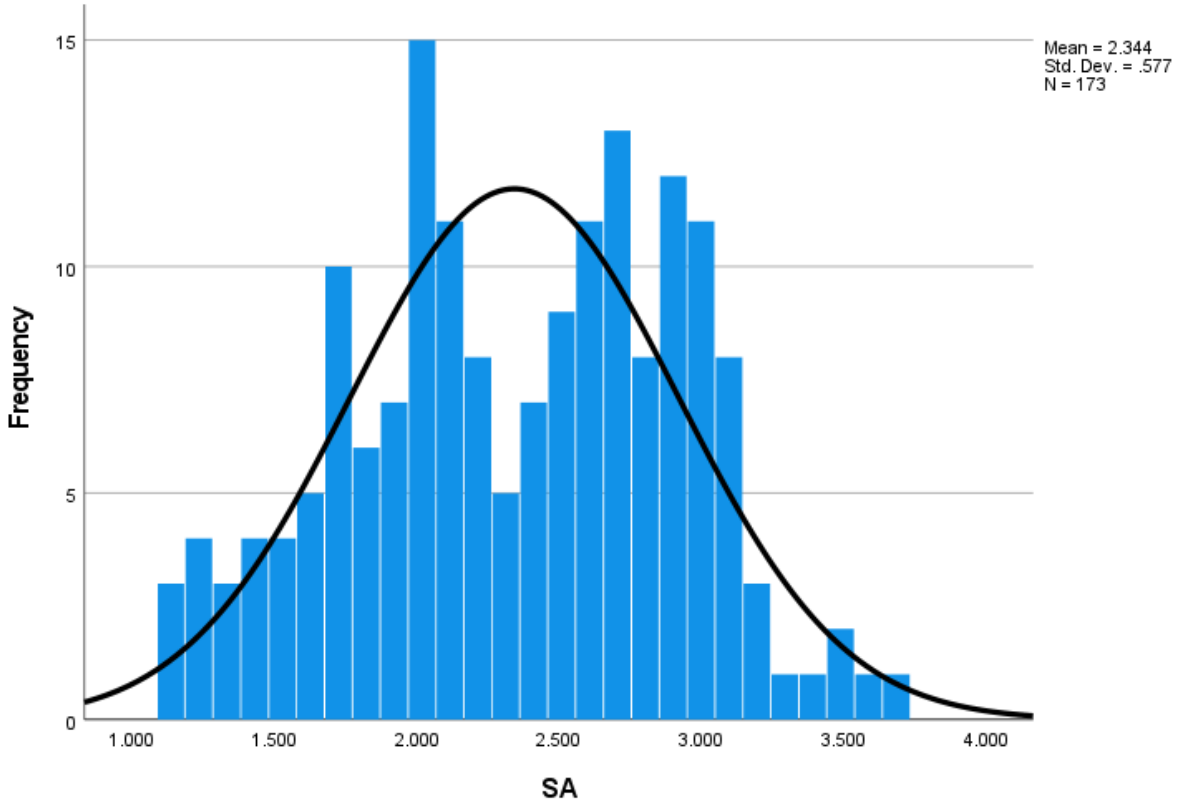
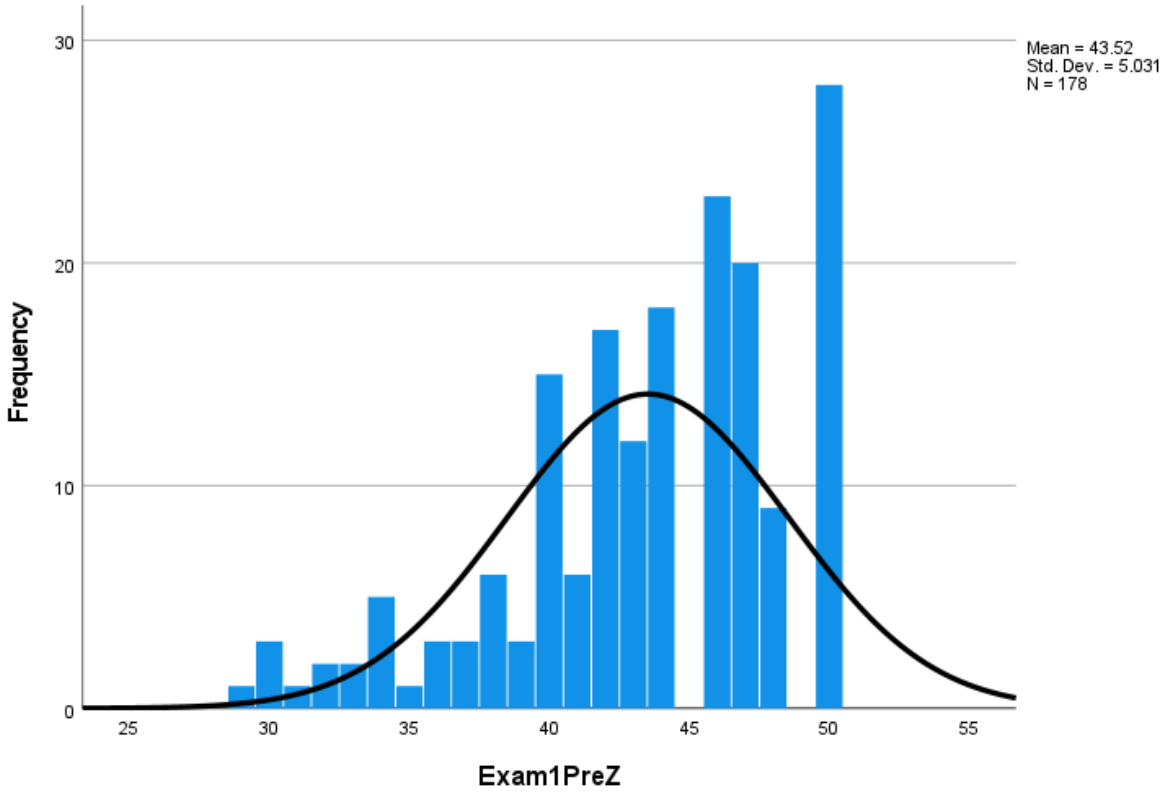
APPENDIX A: HISTOGRAM FOR DISPOSTIONAL MINDFULNESS SCORES



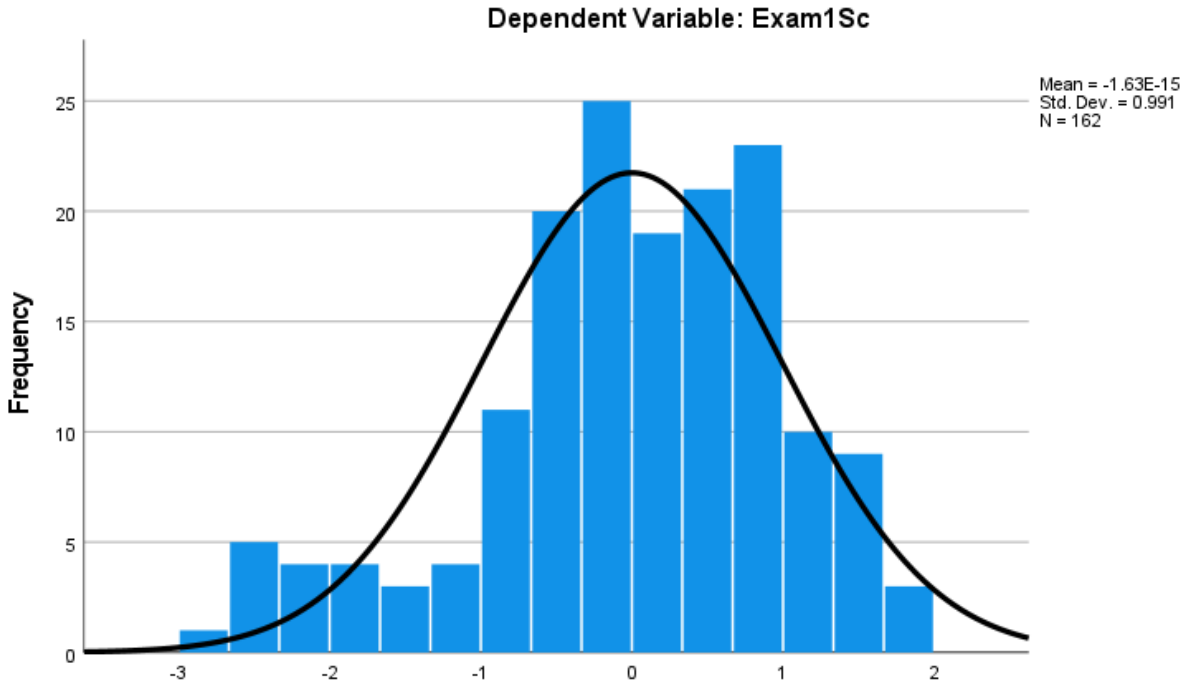
APPENDIX B: HISTOGRAM FOR STATISTICAL ANXIETY SCORES



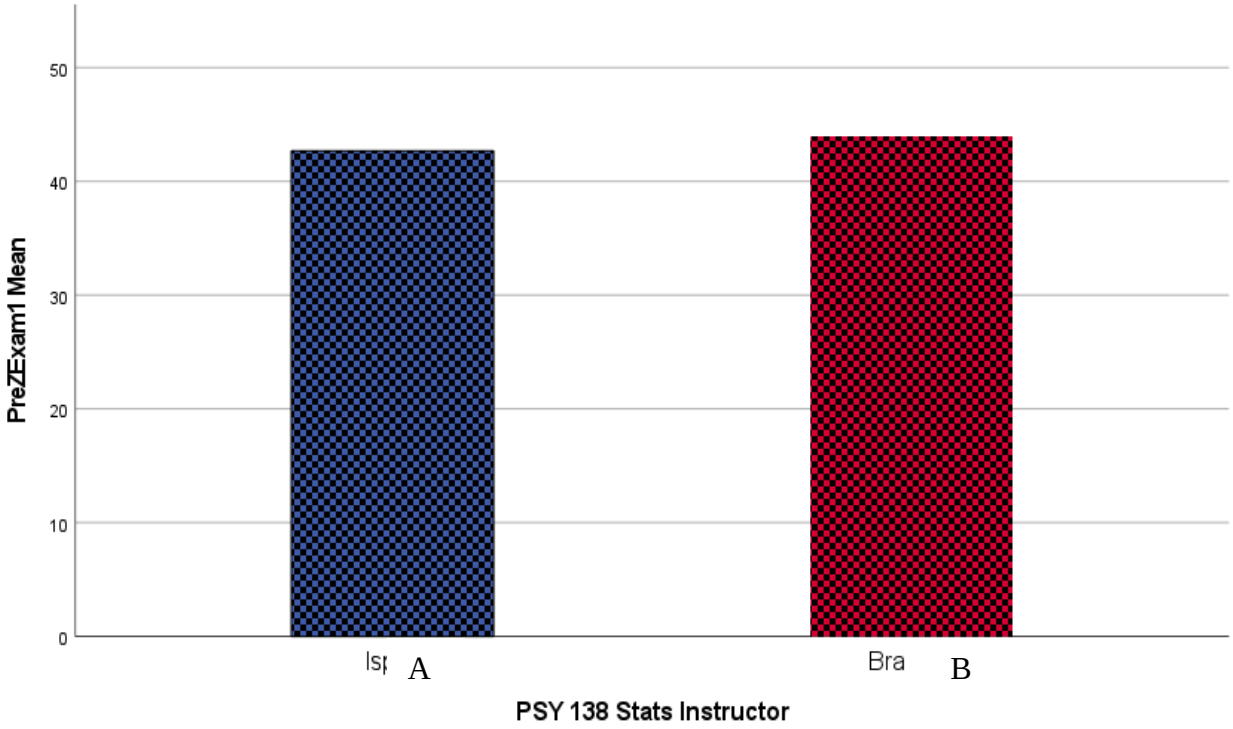
APPENDIX C: HISTOGRAM FOR UNSTANDARDIZED EXAM 1 SCORES



APPENDIX D: REGRESSION STANDARDIZED RESIDUAL HISTOGRAM FOR H_3

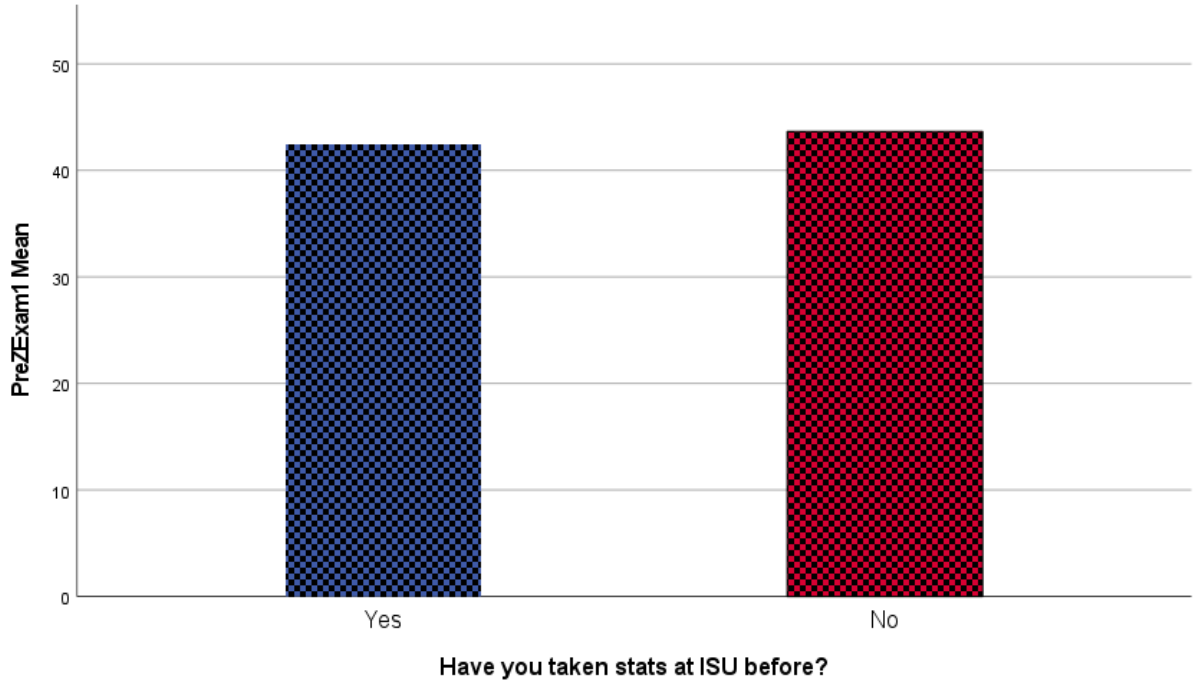


APPENDIX E: SIMPLE BAR GRAPH OF EXAM 1 SCORES BETWEEN STATISTICAL INSTRUCTORS



Note. An independent samples t-test demonstrated a non-significant difference between course instructor A (M = 42.69, SD = 4.60) and B (M = 43.96, SD = 5.21) on participants' exam 1 grades $t(176) = -1.60$, $p = .111$, $d = -.25$.

APPENDIX F: SIMPLE BAR GRAPH OF EXAM 1 SCORES BETWEEN STATISTICAL EXPERIENCE



Note. An independent samples t-test demonstrated a non-significant difference between participants having prior statistical experience (M = 42.45, SD = 5.50) and not having prior statistical experience (M = 43.66, SD = 4.97) on exam 1 grades $t(176) = -1.01$, $p = .313$, $d = -.25$.

APPENDIX G: HOMOSCEDASTICITY AND OUTLERS BY DISTANCE AND INFLUENCE