The Association of Mindfulness on Executive Functioning (EF) in College Students

by

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A Thesis Submitted to the Faculty of

Charles E. Schmidt College of Science

In Partial Fufillment of the Requirements for the Degree of

Masters of Science

Florida Atlantic Univerity

Boca Raton, FL

May 2018

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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Monica Rosselli, Department of Psychology, and has been approved by all members of the supervisory committee. It was submitted to the faculty of Florida Atlantic University and was accepted in partial fulfillment of the requirements for the degree of Master Psychology.

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Acknowledgements

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This Research is supported by the University of FAU and by SONA systems

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Abstract

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Title:	The Association of Mindfulness on Executive Functioning (EF) in College Students
Institution:	Florida Atlantic University
Thesis Advisor:	Dr. Monica Rosselli
Degree:	Master of Science
Year:	2018

Recent research has shown mindfulness practices to be correlated with traits frequently associated with high Executive Functioning (EF) individuals such as greater attention to specific tasks, greater working memory capacity, and the improved ability to inhibit behaviors or emotions. These three traits are highly correlated with each other, and provide an accurate assessment of an individual’s level of Executive Functioning. This study was designed to examine how individual traits associated with Mindfulness such as ‘non-judgement’ can influence attention, working memory and inhibition. This study used three self-administered questionnaires to assess traits associated with mindful individuals and three EF tests to measure performance in inhibition, task shifting and updating working memory tasks. Results showed that certain mindfulness variables from the Freberg Mindfulness Inventory and Five Facet Mindfulness Questioniare, were correlated with performance on working memory tasks while mindfulness experience was not.

Keywords: Dispositional Mindfulness, Executive Functioning, Inhibition, Task Shifting, Updating Working Memory

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Tables

Introduction-The Effects of Mindfulness on Executive Functioning

Mindfulness, defined as a mental state of relaxation and focus, has become increasingly important for psychologists in the past two decades. Once thought to be new-age nonsense, decisive scientific evidence has shown cognitive benefits that are related with the practice of Mindfulness. Exercises such as Mindfulness Based Cognitive Therapy or traditional Buddhist Meditation, are not simply capable of inducing temporary state changes in cognition, but also facilitate long-term behavior and personality adaptations by modifying the physiology of the brain (Lazar et al. 2005). In doing so, many people who engage in mindfulness practices often self-report improvements in cognition (Flook & Smalley, 2010; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010) that appear correlated with changes in behavior and mood. But what is Mindfulness? Is it simply a practice or is it a state of mind? What constructs make up a mindful individual? Are these mindfulness components associated with more complex cognitive processes? If so, which components of mindfulness have more of an impact on cognition?

Mindfulness and Executive Functioning

Mindfulness itself has been defined as a form of mental training which aids its people in directing total attention towards the present moment without judgement or emotional bias (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006). The domain of mindfulness can be divided into two separate components which each deal with an aspect of skill: Intentional Mindfulness, and Dispositional Mindfulness (Tang, Hölzel, & Posner,

2016). Intentional Mindfulness, or state change, is the practice of entering a mental state that clears one's mind to focus objectively on the present and can be used in various situations to aid in allocating attention and controlling emotions. Meanwhile Dispositional Mindfulness entails elements inherent of one's behavior that can be developed through mindfulness practices such as non-judgement, self-regulation, and insight. These facets of dispositional mindfulness allow us to assess overall mindfulness and reminds us that that mindfulness itself is not simply an activity, but an overreaching domain consisting of traits, behaviors and actions.

What distinguishes Mindfulness and sets it apart from other new-age fads or placebos is that it demonstrates the ability to produce not only short-term benefits but also long-term improvements with cognition and mood. While there are many ways to provide increased mental clarity and facilitate improved thinking, few provide beneficial long-term effects which can be clearly measured. The scientifically measurable results of Mindfulness practices are compelling: From improved functional connectivity in regions of the default mode network, a region of the brain associated with the allocation of attention (Taylor et al., 2013); to decreased theta brain waves/increased beta brain waves in the frontal cortex resulting in better inhibition of non-relevant thought processes (Howells, Ives-Deliperi, Horn, & Stein, 2012); and finally, to greater cortical thickness in the superior temporal gyrus, central sulcus, and regions of the prefrontal cortices (Lazar, Kerr, & Wasserman, 2005). In addition to these neurological changes, practitioners of mindfulness have exhibited behavioral and emotional improvements that are related with intentional mindfulness practices. In several studies assessing the results of mindfulness practices, subjects reported cognitive improvements, reduced stress and anxious

symptoms (Wisner, Jones, & Gwin, 2009; Flook, & Smalley, 2010), as well as a greater regulation of negative emotional states. The results of these findings have lead neurologists to reconsider their beliefs about the usefulness of mindfulness practices and what role they could play in the field of mental health and wellbeing.

In fact, many of these improvements have been shown to correlate positively with traits associated with important attributes of Executive Functioning, a core component of individual cognition. Executive Functioning, or EF, is a measurement of one's cognitive ability, quantifying a person's ability to complete daily living tasks, make qualitative decisions, and use critical thinking to solve problems arising in the environment (Lehto, Juujärvi, Kooistra & Pulkkinen, 2003). Because of this, EF has been studied extensively as a predictor of the practical applications of cognitive abilities, making it an essential component for diagnosing mental health. Further, recent links have emerged to indicate that Mindfulness may play a role in the development of EF. For example, mindfulness exercises, or Intentional Mindfulness, have been shown to improve performance in attention tasks (MacLean et al. 2010), working memory (Chambers, et al., 2008), and inhibition (Teper, Segal, & Inzlicht, 2013), all areas associated with EF. Although these experiments have explored the effects that mindfulness practices and meditation have on EF, the relationship between Dispositional Mindfulness and EF has not been sufficiently explored. This fact provides a unique question: Is there a relationship between Dispositional Mindfulness traits and Executive Functioning?

We can begin to examine this question by looking at current research, in which mindfulness practices appear to consistently produce improvements in Executive Functioning across broad demographics. For example, after undergoing an eight-course

training session modeled after a classical mindfulness training exercise for adults, a group of children (aged 7-9 years old) who possessed a deficiency in EF demonstrated an overall improvement in managing inhibition, working memory, social behavior, and positive self-affect after the training (Flook & Smalley, 2010). These cognitive improvements may not require as much training and time as initially believed, as after four 20-minute training sessions a group of university students showed improvements in working memory, visuospatial, and verbal fluency tasks when compared to a control group (Zeidan, et al., 2010).

Yet, despite patients often reporting improved emotional states after practicing mindfulness training, not every individual exhibits the same improvements after practicing mindfulness exercises. In fact, some research indicates cognitive results obtained due to mindfulness training do not appear to be as long lasting as in other test cases (Thompson, 2008; Flook & Smalley, 2010). The reality that some participants could exhibit such meaningful changes so quickly, while others demonstrate only meager results suggests that the effectiveness of mindfulness, like EF, may be dependent on individual factors. These findings suggest that moderating factors or common variables that both mindful and high EF individuals share could play a key role in determining both how effective mindfulness is in affecting cognition. This supposition leads us to ask yet another question: Are there specific Mindfulness traits that determine how mindfulness influences cognition? And if so how do these individual differences influence the association between Mindfulness and EF?

Dispositional Mindfulness

There are five primary variables attributed to mindful individuals, including non-reactivity, observation, describing, non-judgement, and acting with awareness. These attributes are unique in the fact that they are individualized characteristics while at the same time are correlated with the larger construct of an individual's dispositional mindfulness (Baer et al. 2006). In a recent study, Ruth A. Baer (2006) explored common variables as measured by different mindfulness questionnaires to discover if there were any common variables shared by each of the tests. In Baer's analysis of the five commonly used mindfulness questionnaires (MAAS, FMI, KIMS, CAMS, & MQ), it was discovered that 64 of the 112 items could be grouped into one of the five previously defined variables (non-reactivity, observation, describing, non-judgement, and acting with awareness). Just as important was the fact that these five variables seemed correlated with a single overreaching construct hypothesized to be Mindfulness.

In addition to these variables being used to measure Intentional mindfulness, each of these five variables measured a different component of dispositional mindfulness. For example, the first variable identified by Baer, non-reactivity to inner experience, determined awareness and control of one's feelings and thoughts. The second variable, observing sensory sensations, concerns the ability to notice one's environment, bodily sensations, and emotions, and how they affect one's behaviors. The third variable, acting with awareness, concerned preforming actions while focusing in the present moment. The fourth variable, describing, determined a participant's ability to identify and conceptualize abstract feelings and thoughts. And finally, the fifth variable identified by

Baer, non-judgement, outlined the tendency to not assign labels to one's actions, feelings, and thoughts as not identifying them as either good or evil.

It has been argued by Tang and colleagues (2016) that the test Baer constructed from these five variables, the Five Facet Mindfulness Questionnaire (FFMQ), lacks content validity. However, Tang neglected to mention that these five variables have "The highest possible rating… for internal consistency and construct validation" when compared to other questionnaires used to measure mindfulness (Park, Reilly-Spong, & Gross, 2013 Results section, para. 1). In summary, many of these variables (especially variables such as non-judgement, observing, acting with awareness, and describing) are not only strongly correlated with each other but are also correlated with a single overreaching construct defined to be mindfulness (Baer, Smith, & Allen, 2004; Dekeyser et al., 2008). In fact, the Baer paper (2006) later confirms that four variables are correlated with Mindfulness as it states "describe, act with awareness, nonjudge and nonreact are elements of an overreaching mindfulness construct" (p. 42). This supports the position that these individual facets are effective means of measuring Dispositional Mindfulness, because their strong correlation with an overreaching construct means they can accurately measure of an individual's Dispositional mindfulness.

Furthermore, other tests, such as the Mindful Attention Awareness Scle (MAAS), the Kentucky Inventory of Mindfulness, and the Freiburg Mindfulness Inventory (FMI) have used similar variables in order to detect and measure mindfulness in participants. Of these tests, the FMI (Buchheld, Grossman, & Walach 2001) is noteworthy in the fact that despite its simplicity as a 14-item test, it possesses an uncanny accuracy (Alpha = .86) in detecting whether a participant has actively practiced mindfulness. By measuring an

individual's self-awareness, non-judgement, and disassociation, the FMI has been shown to accurately measure longer meditation experience, more frequent meditation, and greater dispositional mindfulness. Walach's 2006 research on the FMI short form showed that participants who meditated frequently had higher FMI scores, indicating a higher Self-Awareness/ Nonjudgement and a lower Dissociation, than those who did not meditate frequently or did not meditate at all. Though the FMI cannot measure these components individually (it's items are highly correlated with each other), it's high reliability and Validity in detecting mindfulness practices further illustrated that awareness and not blocking out emotions are core components of Mindful individuals.

Traits of Executive Functioning

Executive Functioning is difficult to accurately conceptualize as it affects almost every individual cognitive process (Chan, Shum, Toulopoulou, & Chen, 2008). This makes it problematic to accurately quantify EF improvements and detriments without focusing on a few core facets that can represent EF in its totality. Akira Miyake (2000) conducted a series of tests designed to measure EF performance in college students by focusing on the following three facets of EF: 1) set shifting, or 'shifting between tasks or mental sets', 2) working memory, or 'updating and monitoring of working memory representations', and 3) inhibition, or 'inhibition of dominant or preponent responses' (p. 54).

The justification for focusing on set shifting, updating working memory, and inhibition is that these facets are low level, clearly definable, easily testable and most likely to be related to high-level cognitive processes associated with EF such as volition or purposeful action (Lezak, Howieson, Loring, Hannay, & Jill, 2004). In Miyake's

research, he discovered that these three facets of EF were not only clearly definable as separate variables but were moderately correlated with each other, supporting the idea that these three variables accurately represent a single construct. While other models may focus on what EF does, these three facets have been defined as core components of EF in multiple models and experiments (Lezak et al., 2004; Diamond, 2013; Baddeley, 1996). In the cited research and models, these three facets (set shifting, updating working memory, and inhibition) served as accurate predictors of EF capability and as a foundation of high-level cognitive processes.

Of importance to Miyake's study, these three variables were shown to be correlated with Intentional Mindfulness practices (MacLean et al., 2010; Chambers et al., 2008; Teper et al, 2013). Take for example Richard Chambers experiment (2008) where 20 baseline participants outscored a control group in working memory and attention tasks after a brief ten-day mindfulness retreat. This indicates that these EF variables should show correlations with mindfulness, and therefore are indispensable in determining whether Dispositional mindfulness is correlated with EF. Given that these three facets can assess both components of EF and overall EF, measuring them could provide an accurate insight into how specific Dispositional Mindfulness traits are associated with Components of Executive Functioning.

When examining mindfulness and EF, it must be restated that the individual differences in the effectiveness of mindfulness may be due to other variables, such as an individual's personality, rather than a trait of mindfulness itself. The relationship between personality, mindfulness, and the benefits of mindfulness were cited by Tang (2016) who stated, "Individual differences in personality are likely to contribute to how people

respond to and benefit from mindfulness practices…" (p. 3). This observation suggests the possibility that the relationship between EF and Mindfulness may be moderated Big Five personality traits such as openness, conscientiousness and neuroticism. These Big Five traits have been shown in past research to be related to both Executive Functioning (Williams et al., 2010) and mindfulness (Baer et al., 2006) supporting the idea that they might play a moderating role in the relationship between EF and mindfulness. As these personality traits are correlated with high EF and mindfulness, it is a variable that must be accounted for in this mindfulness study, to determine if these traits of personality play a role in the EF-mindfulness relationship. Since mindfulness and EF are not unitary domains, there exists the possibility that both mindfulness and EF are associated with or are modulated by variables of personality. Therefore, to insure they do not unduly influence the relationship between mindfulness and EF, facets of personality common to both mindful and high EF individuals (E.g. Agreeableness) should be measured to determine if personality itself affects EF.

Hypothesizes

The primary aim of this study was to examine how Dispositional Mindfulness, not Intentional Mindfulness, was correlated with Individual differences in EF. Though it appears that Intentional Mindfulness practices can lead to improvements in various aspects of EF (Zeidan et al., 2010), the extent to which Dispositional Mindfulness influences EF had not been confirmed. Many mindfulness studies were based upon the premise that intentional mindfulness training produces cognitive improvements, yet research has shown that individual differences in personality can play a significant role in mindfulness benefits (Tang, Hölzel, Posner, 2015). Therefore, the possibility exists that

these individual differences in dispositional mindfulness, not the practice of mindfulness itself, are correlated with of EF performance. By comparing associations between the facets of mindfulness and EF performance, we hoped to assess the relations between dispositional mindfulness and EF. This would allow us to determine not only how dispositional traits are associated with EF but also how an individual's differences in dispositional mindfulness could be correlated with performance in cognitive tasks. Additionally, given the close relationship between Dispositional Mindfulness Traits and certain personality traits such as agreeableness, it is important to control for Big Five Personality traits to ensure that correlations between Mindfulness and EF performance are not due to a moderating variable. Given that many personality traits from the Big Five are found to be correlated with Mindfulness individuals and individuals with high EF, including this personality inventory could be used to determine whether Personality traits are correlated with performance on EF tasks.

This study was designed to explore two hypotheses: first that there is an association between dispositional mindfulness and performance in EF tasks, and second that certain individual facets of mindfulness may be associated with performance in certain EF tasks. To test these hypothesizes, this study drew upon a baseline population and analyzed their levels of dispositional mindfulness, as well as their performance in inhibition, set shifting, and working memory tasks to determine whether there was an association between these two domains. This study differed from similar studies in that it looked at correlational data to determine if and how traits of mindfulness and individual differences, not practices, affected the cognitive processes we rely upon for everyday functioning.

Hypothesis 1: Participants who possess greater levels of overall Dispositional Mindfulness traits will score higher on inhibition, set shifting, and/or working-memory tasks.

Hypothesis 2: Certain mindfulness traits, such as non-judgmental acceptance, observing, describing, acting with awareness, and non-reactivity will correlate with performance on individual inhibition tasks, set shifting tasks, and/or working memory tasks.

By testing these hypotheses this study planned to reveal whether the dispositional traits of mindfulness, and its facets, were associated with EF and how these dispositional traits, both individually and as a whole, were correlated with the use of Executive Functioning. In addition, as an exploratory/control analysis, we examined the Big Five Personality traits to see if they were correlated with performance on EF tasks.

Methods

Sample and Participants

For this study, subjects were drawn from the FAU subject pool for a one-time study that lasted around one hour and twenty minutes. A total of 127 participants were drawn from the subject pool, with 9 additional subjects being recruited from psychology classes on campus. All participants from the subject pool were contacted and scheduled through SONA with volunteer participants being scheduled independently. Participants were reimbursed by either being provided with volunteer credits for their class (in the case of the subject pool participants) or being provided with extra credit for their class (in the case of recruits from psychology classes on campus).

All participants were between the ages of 17 and 27 (M=19.84, SD=3.844) except for one participant aged 56, and 59.69% of the participants were female. In addition to determining demographics, this experiment also assessed a participant's Mindfulness experience, quantifying whether they practiced an intentional mindfulness exercise, what kind of mindfulness exercise they practiced, and how long they had practiced it. This question asked if they had any experience with Yoga, Chinese martial arts, Mindfulness Meditation, Breathing exercises and other exercises designed to enhance mental and physical health, with room provided for elaboration if they felt they had practiced an exercise designed to enhance their mental health. Every person who self reported practicing a mindfulness exercise was included in the variable Mindfulness Excercises which recorded the participants who reported to have mindfulness experience.

Individuals who did not specify how long they practiced a Mindfulness exercise for or practiced an exercise that had no Mindfulness component (as breath control, awareness of the present moment and/or an emphasis on controlling one's emotions) were not included in Mindfulness Practice which recorded how long each participant practiced mindfulness for. Individuals with intentional mindfulness experience would be expected to score higher on dispositional mindfulness measurements (Baer et al. 2006) and therefore might have improved scores in EF tasks.

Apparatus and Materials

Before the test was implemented the individual was required to fill out a paper copy of a consent form. By signing this form, the participant would allow for the gathering of information for this test in exchange of extra credit and/or fulfilling participation requirements for their class. Additionally, the participant was required to fill out a demographics information form before taking the BFI, the FMI, the FFMQ, and all three of the EF tests (inhibition, working memory updating and task shifting). The first three tests were administered in Word as templates, with each participant's responses for each test stored in their own folder on the computer's hard drive before being transferred to dropbox for transportation purposes.

All testing was administered in the same room using the same headphones and computer for all the electronic tasks. All the data for this study were extracted from Inquisit lab 4, into an Excel format before being exported and analyzed using SPSS version 20. The 4th version of Inquisit was used to administer the next three tests: the Cued Go-NoGo task (Fillmore et al., 2006), the Paced Auditory Serial Addition Task (Gronwall, 1977), and the Wisconsin Card Sorting Task (Grant & Berg, 1948). Other

than being electronic, these tests are identical to paper copies of the same tests. An external USB and Dropbox were also utilized to store, transport, and encrypt all electronic data produced in the study.

Measures-Personality and Mindfulness

The testing period began by requiring participants to fill out the assigned consent and demographics questionnaires, with the demographics questionnaire also assessing the participant's intentional mindfulness experience. The test then continued with the administering of a personality assessment (Big Five Inventory) and two Mindfulness Questionnaires (FMI & FFMQ) designed to measure a participant's level of Dispositional Mindfulness traits.

Big Five Inventory

The BFI is a compressed 44-item version of the larger Big Five assessment and accurately measures a participant's levels of Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness. This test, though shorter than the original Big Five, has been shown to be a quick and accurate assessment of individual's personality while possessing the same power and internal reliability (.83) as its parent test (Pervin & John, 1999, p.116). Also, given its frequent usage and its' reliance on the Big Five personality test, the BFI's standardized validity (.92 Total) is also very high (p.117). The Big Five Inventory was chosen not just for its' reliability and validity in assessing personality traits but also for the commonality several personality variables have with the Dispositional Mindfulness traits being measured in this study (Baer et al., 2006). While Baer's Five Facets measures constructs of mindfulness more closely related to behavior, the addition of the Big Five inventory allows a greater assessment of the individual

differences in personality. This in turn would help to control for the relationship between dispositional mindfulness traits and EF. The Big Five Inventory does test many of the elements of personality that we expected to correlate with Mindful Individuals, however the focus of the test will be on the two Mindfulness assessments designed to measure these dispositional mindfulness traits.

The FMI and the FFMQ

The two Mindfulness tests used in this study to assess the traits of Dispositional mindfulness are the Freiberg Mindfulness Inventory (FMI) and the Five Facet Mindfulness Questionnaire (FFMQ), both of which have their own benefits. The Freiberg Mindfulness Inventory, or FMI (Cronbach's alpha= .93) (Baer et al.2006), is a test with solid construct validity capable of accurately detecting higher or lower levels of intentional mindfulness and can measure more abstract aspects of Mindfulness. The traits that correlate most strongly with performance on the Freiberg Mindfulness Inventory are mindful presence, non-judgmental acceptance, openness to experiences, and insight (Walach, Buchheld, Buttenmüller, Kleinknecht, & Stefan, 2006). The Five Facet Mindfulness Questionnaire, or FFMQ (Cronbach's Alpha= Avg~.85) (Park et al. 2013) measures the five individual facets of mindfulness and was used to explore the relationship between mindfulness as a construct and the variables of EF. The traits that were measured with the Five Facet Mindfulness Questionnaire were observing, describing, acting with awareness, non-judging, and non-reactivity. These tests, administered instandard order prior to any EF tests, measured the dispositional traits most commonly associated with a Mindful individual. This was designed provide an

indication of individual's dispositional mindfulness as well as determining whether these traits are predictive of performance on EF tasks.

Given the strong correlation between the variables that make up the FMI, these four factors were analyzed under the heading of 'insight' encapsulating the more abstract qualities of mindfulness and determining whether a participant has levels of dispositional mindfulness. Meanwhile the FFMQ would measure the individual facets of mindfulness that were expected to be associated with EF performance. In summary, the FMI possesses the validity and power necessary to detect a participant's level of total dispositional mindfulness, while the FFMQ's five factor model is designed to detect these facets and measure how they individually contribute to an individual's mindfulness. Each participant's personality, mindfulness, and self-reported level for each facet were used to determine which mindfulness traits are correlated with improved performance in the three EF tasks.

Measures-Executive Functioning

Inhibition (Go-No-Go task)

The task chosen to test Inhibition, The Go-No-Go task measures impulse control by measuring a participant's ability to supersede proponent responses, the very definition of Inhibition as provided by Miyake and Friedman's (2012) model. This version of the Go-No-Go task, the cued Go-No-Go task (Fillmore & Weafer, 2013), offered via Inquisit, requires 12 to 20 minutes to complete and consists of around 125-250 trials depending on how well the participant preforms. In it, participants are required to press a spacebar in response to the appearance of a green rectangle and inhibit their response in the presence of a blue rectangle. The study begins with the appearance of a fixation cross (a big plus in

the middle of the screen) for 800ms and a blank screen for 500ms which is followed by a 'go cue' which displays an outline of a rectangle shape for 100, 200, 300, 400, or 500ms. However, as a contributing factor, when the rectangle is horizontal there is an 80% chance the rectangle will turn green indicating valid cue condition and 20% chance it will turn blue indicating an invalid cue condition and vice versa when the rectangle is positioned vertically. A participant's inhibition response is measured based upon their accuracy (representing their ability to inhibit incorrect responses as well as their ability to base predictions off of the position of the rectangle) and speed of response (representing their ability to apply attention in stimuli recognition and pattern prediction) with more errors indicating poorer inhibitory control.

Similar to the Stroop task which has shown improvement in individuals who regularly practice Intentional Mindfulness exercises (Teper & Inzlicht, 2013), the Go-No-Go task measures a participant's ability to inhibit behavior in response to a provided stimulus. Research today has also shown the Go-No-Go task to indicate cognitive deficiencies in inhibition and response time as well as their ability to direct sustained attention in the accomplishment of a task, a variable we expect to correspond positively with several Dispositional Mindfulness traits. Yet, what makes the Go-No-Go task truly a fitting addition to this study is the fact that it doesn't simply rely upon inhibition, but also revolves around modifying responses based upon received stimuli (task shifting) and updating working memory (Fillmore et al., 2013). This in turn demonstrates that the Go-No-Go does not just measure the ability to inhibit but can also measure general EF performance.

While the Go-No-Go task is primarily measuring a participant's ability to inhibit responses, it is also correlated with the two other skills we are testing, working memory and set shifting. Therefore, in addition to validation Miyake's Model that these three domains of EF are correlated with each other, this test allows a better overall assessment of EF than a test measuring a single trait. In addition, the Go-No-Go task's simple framework and application means it has few problems to address that haven't yet been corrected through comparison with other inhibition tests. The Go-No-Go task's frequent usage in measuring inhibition over a long series of tests (test-retest reliability), its positive correlation with several other tests that measure the same values (parallel forms reliability), and its excellent internal consistency (r=.9) indicates that the Go-No-Go task is a reliable and valid task to use in testing EF (Fillmore & Weafer, 2013).

Task Switching (WCST)

The second test used, The Wisconsin Card Sorting Task, is a common test in the field of psychological testing used to test activity in the frontal lobe and critical thinking capabilities. This widely used test requires a participant to sort cards into four categories with no implicit instructions on how to sort the cards. These cards vary in terms of shape (triangles, circle, stars, circles), color (red, green, yellow, blue) and number (1, 2, 3, 4). where the participant is can sort the cards by number, shape or color. In this Inquisit based test, the only feedback a participant receives is whether they sorted their cards correctly or not, as identified by the Inquisit program machine (By the color of the symbols, the shape of the symbol and the number of symbols on the card) with this classification rule changing every ten correct answers in a row. Traditionally task shifting tests measure three different kinds of error reports: perseverative errors, non-

perseverative errors, and total number errors that are a combination of the two. In this test, a participant's set shifting abilities are measured by their perseveration errors, which are errors made when the participant keeps applying an old sorting technique to a new rule condition, with fewer errors indicating a greater ability to shift between one of three sorting rules in response to feedback (not reaction time). The WCST requires 12-20 minutes to administer with easy to understand directions (sort cards in any way you see fit until told to stop; you will be told when your sorting is correct or not) and an easy scoring process (number of perseverative errors) which makes it an ideal test to administer in measuring task shifting.

The WCST, and its variations the Modified Card Sort Test and the Simplified WCST have been shown in past research to be a valid measurement of abstract reasoning ability. More specifically it has measured the ability to maintain an appropriate problem-solving strategy while accounting for changing stimuli or conditions in the accomplishment of an objective (Lezak et al., 2004). Additionally, the WCST has been shown to measure not just shifting between tasks but also feedback response, cognitive flexibility, categorization and the testing of multiple hypothesizes which are all elements we associate with Cognitive task shifting (Nyhus & Barcelo, 2009).The fact that the WCST accurately measures task-switching factors (response regulation, categorization, hypothesis testing, etc.) and its history of long and reliable use, leads many psychologists to conclude that the Wisconsin Card Sorting Task has high construct validity in detecting task switching (Bowden et al. 1998).

Updating Working Memory (PASAT).

The final test administered, the Paced Auditory Serial Addition Task (PASAT), measures working memory and short-term memory capacity by analyzing both recall and computation of tasks which are performed too quickly to rely upon long-term memory. Unlike more traditional forms of EF testing, the PASAT doesn't stop at measuring recall but also measures working memory by having participants manipulate and update memory to answer specific questions about the information recalled. In this test, a string of one to nine single-digit numbers are chosen randomly with a three second gap between each number; the entire test consists of 60 strings for each of the three tasks for an average time of eight to twenty minutes. This easily explainable task begins with the participants being informed to mentally sum the last two heard numbers from a sequence to produce one number from one to eighteen. A participant's ability to update working memory is assessed through the time it takes for them to determine the correct result with faster computations indicating an improved ability to update working memory. Additionally, the amount of time between each number is decreased as the test progresses, resulting in an increase in difficulty as the time between numbers is reduced.

Though typically uncharacteristic due to its reliance on auditory processing, it could easily be argued that the PASAT can effectively measure updating working memory by requiring participants to modify attentional processing rather than just recalling data (Tombaugh, 2006). Unlike other working memory tests, such as the N-Back task which has low construct validity and weak correlations with other working memory assessments, or the Sternberg task which tests only recall, the PASAT task tests not only the ability to recall information but also the ability to manipulate said

information and divide attention and apply simple arithmetic skills in context. Working memory isn't simply the ability to recall information but rather the ability to keep track of the present and update data while maintaining and manipulating information to accomplish tasks (Gazzaniga, 2009). For this reason, this is an ideal test test to determine whether mindful participants truly possess an enhanced ability to update and modify working memory.

Several issues have arisen in other instances of the PASAT, such as its susceptibility to practice effects (negligible because the measurement will not be repeated), age of participants (negligible due to the young-adult population), and language impediment (negligible since the participant clicks on answers). However the effect these variables could have on this study is most likely low. The sole confound that could possibly do the most damage, deficient math skills, is most likely negligible given participants are drawn from the college's subject pool. Similarly, significantly low IQ scores are also unlikely to be a problem associated with this test, as college students are unlikely to demonstrate significant mathematical impairment. Like the other tests administered, the PASAT is also correlated with other Executive functioning capabilities; for example, successfully applying inhibition to ignore previous numbered additions and set shifting by requiring the participant to add together numbers when they are presented at a faster rate. This demonstrates the PASAT's ability to measure a participant's skill in updating working memory and their total Executive Functioning capabilities. The PASAT's ability to consistently measure what it is supposed to measure (internal consistency) and the consistency of this measurements over time (Test-Retest reliability)

make it a highly reliable and valid measurement of working memory updating (Tombaugh, 2006).

Procedure

The study was a one-time study in which data were gathered from a group of participants without manipulating the participants. Each participant received the same tests and was given the same information to perform the tests. For this study, the independent variable was each participant's level of dispositional mindfulness, consisting of both individual facets and overall mindfulness scores, and the dependent variable was the participant's performance in inhibition, set shifting, and working-memory and updating tasks.

Initial contact with subjects drawn from the pool followed standard FAU protocol, with first contact and scheduling being made through the SONA site. These participants were informed through SONA of a one-session study to provide research on behalf of the FAU psychology department. Subjects were informed of the length of the study (around one and a half hours), the tasks they will be performing (several quizzes), and the objectives of the study (to measure aspects of mindfulness, personality and cognitive performance). However, participants were not informed as to the goals or hypothesis of the study, to test the relationship between Dispositional Mindfulness traits and EF. Upon accepting the survey opportunity, participants were contacted with a date, time and location where participated in the study. After the test was concluded the individuals were informed of the purpose and goals of the test.

The Study Step-By-Step

Once the subjects arrived on location, they were again reminded of the study's purpose and objectives before signing the necessary consent and confidentiality forms. Afterwards each participant filled out a numbered electronic demographics questionnaire which assessed the participant's age, sex, ethnicity and other relevant information about their lifestyle. At this point, the participants were informed that all answers that they give whether on the paper or Inquisit tests will be graded and scored under a 'participant number' unique to them. This participant number, serves not only to protect against accidental disclosure but to maintain participant confidentiality. Upon completing the demographic information, participants were informed that they would be undertaking a series of Questionnaires and EF tasks and reminded of the fact that they have the right to opt out of the study at any time.

Both the Three mindfulness tests and the three EF tests were administered in a random order depending on the participant's number, with nine possible test orders. However, the mindfulness tests and the EF tests were never mixed together, meaning the participant would take three Mindfulness tests back to back before taking three EF tests. For example, a participant from number 1, after filling out the consent forms and demographics questionnaire, would take the BFI, the FFMQ and the FMI before taking the Go-NoGo, the PASAT, and the WCST. Once all the initial preparations are complete, subjects were informed that they would take a series of personality assessments and Mindfulness Questionnaires. Of these tests, the Big Five Inventory, is a personality assessment with the other two assessments being Mindfulness questionnaires designed to measure aspects of Mindfulness. The Personality /Mindfulness tests will be administered

as electronic Word Templates and were stored on the testing computer in the experiment's Dropbox and on an external flash drive. Each participant's scores were grouped into a folder dependent on the participant's 'Participant number', putting all the participant's data in the same place.

After determining a participant's levels of Mindfulness and personality, participants engaged in an Executive Functioning battery consisting of three EF tests: The cued Go-NoGo, the WCST and the PASAT. Use of this Inquisit software allowed the participant's information to be recorded and saved in their folder as soon as they finished the test. All the tests were presented to the participant manually with each test being brought up for them on the computer immediately after they finished the previous test.

Results

To better look at the effect Mindfulness has on Executive Functioning, six variables from the three EF tasks were selected to measure the participant's ability to update working memory, switch between tasks, and inhibit responses while fourteen variables from the three personality/ mindfulness tests were selected to measure Mindfulness and Personality. Each of these variables were examined and explored in Table 1 to determine the participant's mean score and the SD of that score.

To measure updating working memory, the participant's latency for correct responses from each of the three portions of the PASAT were measured, with a smaller latency equaling quicker a response time for correct answers. The three portions of the PASAT were measured separately as the amount of time the participant had to respond was decreased with each consecutive test. This means the that the first task of the PASAT had to be completed within 2500 ms the second task within 2000 ms and the third task within 1500 ms. The average percentage of correct answers for the 109 participants in this experiment was 58.67% correct for task 1, 25.46% correct for task 2 and 14.55% for task 3.

The Independent Variables for this study were drawn from the Demographics questionnaire, the BFI, the FFMQ and the FMI, with each designed to test a certain hypothesis. To determine that the Mindfulness variables were not overly correlated with each other a bivariate correlation was run between each of the mindfulness variables (Table 2).

To test the hypothesis that greater overall mindfulness would be correlated with improved performance on EF tasks, we used Mindfulness Experience (whether the participant practiced Mindfulness exercises or not) Insight (Total score from FMI) and Total (total score from FFMQ). The amount of Mindfulness experience an individual possessed was also measured (Mindfulness_Practice) to determine if the amount of Mindfulness experience had any impact on the Dependent Variables. For this measure, an individual's Mindfulness Experience was recorded on a scale from zero to three with 0 being no experience, 1 being 0-6 months experience, 2 being 7-23 months of experience, and 3 being 24+ months of experience. However, given the strong correlation between these variables (Table 2), analyzing the data using Multiple linear regression is not advised as the correlation would cause the independent variables to influence the other affecting how we interpret the hypothesizes.

To test the hypothesis that certain individual facets of Mindfulness were correlated with performance on EF tasks, the components of the FFMQ: Observing, Describing, Awareness, Nonjudging and Nonreactivity were utilized. These variables were analyzed using Multiple Linear Regression and Bivariate correlations.

Finally, the scores from the Big Five Inventory: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness, were examined as an exploratory analysis to determine if personality traits are correlated with EF performance. These variables were also analyzed using Multiple Linear Regression and Bivariate correlations.

To measure the capability to switch between tasks we used the percentage of perserverative responses from the WCST with a lower percentage resulting in fewer instances of repeating applying an old, incorrect rule to a new situation. Given that the

number of trials a participant underwent could depend on how well they did (With a maximum of 128 trials) it is more accurate to measure the perservitive errors as a percentage. The percentage was based off the percentage of perserverative errors compared to the total number of trials.

And finally, to measure inhibition we used the total number of errors from the Cued Go-NoGo task with a greater number of errors resulting in a lessened ability to inhibit responses and the Average Latency which was the average time it took for the participant to reply. The errors were responses (pressing the key) presented when the participant had to inhibit the response, with each error counting as one. Meanwhile the Average Latency was the amount of time the participant correctly responded to the stimulus in milliseconds.

These six variables, Correct Lat 1, Correct Lat 2, Correct lat 3, the Percentage of Perseverative Responses, Avg Rep and the Total Number of errors would serve as the Dependent Variables for this study. To determine that these variables would not overly influence each other a bivariate correlation was run between these variables (Table 3). The only correlations between the variables were between Correct Lat 1 and Correct Lat 2 and 3 (Table 3), which given that they are the same test should not negatively impact the analysis of the data.

Statistical Analyses

Before analyses were preformed, outliers had to be removed from the data, and all relevant assumptions were tested to insure the validity of the data. First participants who reported be disgnosed with a psychiatric/neurological disorder or currently taking medication which could interfere with performance on a cognitive task were removed

resulting in 129 participants total. After going through the data and removing all participants with pre-existing health conditions and medication history, the data were examined for abnormal distributions and high kurtosis and skewedness. In variables with high Kurtosis/Skewedness (+/-2), the select cases function to remove extreme outliers outside the first and third quartiles using 1.5 the Interquartile range formula (1.5*IQR). This formula uses the differences between the 25th percentile and the 75th percentile (Quartiles 1 and 3 respectively) to produce the Interquartile range which is then multiplied by 1.5 and added to the 75th percentile and subtracted from the 25th percentile to identify and remove extreme values from each variable with abnormal distribution. For example, to remove outliers from the Variable, Correct Lat2 (Correct latency for task 2 in the PASAT), would be [(CorrectLat2< 1627.71+1.5*161.38) AND (CorrectLat2>1466.33-1.5*161.38)] with 1627.71 being the 75th percentile, 1466.33 being the 25th percentile, and 161.38 being the difference between them. After removing these outliers, this resulted in 109 participants out of all 136 with which to run the analyses.

After this, Kolmogorov-Smirnov tests were run to help determine non-normal distributions. Here it was discovered that the total errors from the Go-NoGo were significant indicating that the variable might possess non-normal distributions. However, given the skewedness after removing outliers was under 1.00 and the kurtosis was under 1.3, there is evidence that the assumption of Normality may not be violated for this variable. Because we are doing an analysis on only one group of participants, we can ignore the need to test for homogeneity of variance.

Next, to test linearity, scatterplots were created to see if there was a linear relationship between the mindfulness questionnaires and the cognitive tasks. This involved creating three different scatterplots: The first scatterplot looking at linear relationships between total mindfulness variables (Mindfulness Experience, Insight, and Total) and the 5 dependent variables, the second between the facets of Mindfulness (Observing, Describing, Awareness, Nonjudging and Nonreactivity) and the third one between the control variables from the BFI (Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness).

From analyzing these scatterplots, we can also conclude that the data does not appear overly heteroscedastic, meaning the data is not overly distributed to one side, supporting the idea that the assumption of homoscedascity seems to be correct. After all the outliers were removed and all assumptions were tested then we were free to examine correlations to test whether there were relationships between facets of Mindfulness/Personality and Executive Functioning. Each correlation was obtained through Bivariate Pearson's Correlation with two tailed tests of significance and each Multiple regression was preformed was a standard regression that checked for Estimates, Model Fit, Descriptive and Collinearity Diagnostics with probability plots of zresid(Y) over zpred(X).

Hypothesis 1

To test Hypothesis 1 we examined the relationship between Mindfulness Experience, Insight and Total Mindfulness and the participant's ability to Update working Memory, Shift between different tasks and Inhibit responses. The results of the Pearson Correlation (Table 4) indicated that there was a significant negative correlation

between Insight and PASAT latency 1, (r(109)=-.232, P=.015) and an almost significant positive relationship between Insight and PASAT latency 3 (r(109)=.181, P=.06). However, no significant correlations were discovered for Mindfulness Experience and Total (FFMQ).

After analyzing whether a participant practiced or did not practice mindfulness and finding no significant effects, the next bivariate correlation focused on examining whether the amount of mindfulness experience (Mindfulness_Practice) influenced performance on EF tasks. As stated before, Mindfulness Experience was recorded on a scale from zero to three with 0 being no experience, 1 being 0-6 months experience, 2 being 7-23 months of experience, and 3 being 24+ months of experience. Individuals who did not specify the amount of time they practiced mindfulness for were excluded from this analysis, resulting in 98 participants total. After examining the data for significant correlations (Table 4) it appeared that the amount of mindfulness experience, just like whether a participant practiced mindfulness or not, was not correlated with performance on EF tasks.

Looking at the Pearson correlation it was found that while the relationship between Insight and Correct Lat 1 is negative (r=-.232) indicating a decrease in latency with an increase in Insight, the almost significant relationship between Insight and Correct Lat 3 was positive (r=.181) indicating that an increase in Insight would result in an increase in latency. This finding suggests that that total mindfulness, or more specifically higher FMI scores, may cause longer response times in tasks which require fast responses or are inherently stressful. This opens the possibility that in certain

situations greater mindfulness may work against a participant's performance, causing them to calmly think over their responses when quick replies are a necessity.

While the single significant result is small, the results indicate that Insight decreases the correct latency for task 1, allowing the individual to respond faster if they possessed greater insight (higher FMI score). This discovery allows us to reject the null hypothesis for hypothesis 1, confirming that having a higher overall mindfulness does increase performance on Updating working memory tasks.

Hypothesis 2

To test Hypothesis 2, we examined how the five components of the FFMQ (Observing, Describing, Awareness, Nonjudging and Nonreactivity), were correlated with these same 5 dependent variables using multiple linear regression. This involved running six multiple regression analyses (One for Correct Lat 1, One for Correct Lat 2, One for Correct lat 3, One for the Percentage of Perseverative Responses, one for Avg Rep, and one for the Total Number of Errors), for each of the six Independent Variables outlined above. The results of these Multiple regressions are in tables 5.1 and 5.2. Yet, after running the analyses and looking at the data it does not seem that the model of the five components of the FFMQ are correlated with performance on EF tasks (Tables 5.1 & 5.2). The results of the analyses indicated that the FFMQ components were not significantly correlated with Correct Lat 1, Correct Lat 2, Correct Lat 3, the Percentage of Perseverative Responses, the Total Number of Errors, and the Average Latency.

Yet though the models were not significant, it was discovered that there were certain variables that were significantly correlated with performance on EF tasks, with Nonreactivity being negatively correlated with Correct Lat 1 (B=-59.28, T=-2.14,

P=.035) and Describing being positively correlated with Correct Lat 3 (B=22.35, T=2.38, P=.019). This is not surprising, as when we look at the correlations table (Table 6) we see that Nonreactivity is negatively correlated with performance on Correct lat 1 (r(109)=-.223, p=.02) and Describing was almost positively correlated with performance on Correct lat 3 (r(109)=.184, p=.056).

These results are similar to what we saw before, with Nonreactivity being negatively correlated with Correct Lat 1 and Describing being positively correlated with Correct Lat 2. This indicates that an increase in Nonreactivity would decrease response time, and an increase in Describing would increase the time it takes to respond. This finding is interesting as it indicates that certain Individual components of Mindfulness can either improve or decrease performance on Working memory tasks, suggesting that individual components of mindfulness may have different effects of EF performance. This also adds further fuel to the idea explored before, that mindfulness variables can either improve or decrease performance on working memory tasks.

Despite these small details, the fact is that an individual mindfulness trait was correlated with performance on a working memory task supports the rejection of the null for hypothesis 2. The fact that an individual component of the FFMQ was significant when the total FFMQ was not, further supports this conclusion, indicating that there are certain components of mindfulness that are correlated with performance on certain EF tasks.

Big Five Inventory

Finally, looking at the Big Five personality traits in this study we examined how personality traits were correlated with performance in updating working memory, set switching and inhibition tasks. Running the multiple regressions (Tables 7.1 & 7.2), it

was found that the five components of the BFI do not have a significant effect on the Dependent variables. Looking at the data we see that Correct Lat 1, Correct Lat 2, Correct Lat 3, the Percentage of Perseverative Responses, Total Number of Errors and the Average Latency are not significantly correlated with the variables of the BFI. Examining the individual components further though we find that while Agreeableness was close to being significantly correlated with the Percentage of Perserverative errors (B=-1.17, T=1.84, P=.068) none of the variables were significant.

By examining the correlations table (Table 8) we see in more detail the effect that these personality variables have on a participant's ability to switch between tasks. The results of the analysis indicated there was a almost significant correlation between BFI's Agreeableness and the percentage of Perserverative errors ($r(109)=-.178$, $p=.064$). This finding is interesting because though insignificant, it indicates that Agreeableness may decrease the number of perserverative errors and therefore may improve performance on set switching tasks. Additionally, findings indicate that Agreeableness is Highly Correlated with Insight (Table 9) and the Total FFMQ ($p=.027$) suggesting that the personality trait of Agreeableness might be closely related to an individual's Mindfulness. In addition, though it is far from significant the variable of Agreeableness was also the variable that was closest to being correlated with performance on the Go-NoGo, with Agreeableness almost significant for Average Latency ($r(109)=-.160$, $p=.097$).

Though not one of the primary variables of interest, the discovery that personality trait was almost correlated with performance on two EF tasks and its subsequent

correlation with total mindfulness variables provides a rationale for exploring the impact of personality variables in future mindfulness research.

Discussion

In addition to the significant correlations in the data between Insight/Nonreactivity and performance on the PASAT task 1, which support hypotheses 1 and 2 respectively, there are several other findings worth reporting that affect how we look at the data.

First, among all the variables explored in the data, the variables Insight, Nonreactivity, Describing and BFI Awareness seemed to have the most significant relationship with the models and would be best at predicting performance on EF tasks. This was concluded from looking not only at the initial T values of multiple linear regression, but also looking at their correlations. To summarize, it appears that mindfulness variables such as insight, describing and nonreactivity were correlated with performance on updating working memory tasks while BFI's Agreeableness was most correlated with performance on Set Shifting tasks and the Go-NoGo. Furthermore, looking at the variables we can see that they appear to be correlated both positively and negatively with performance depending on the nature of the task. Looking at the PASAT's task 1 and PASAT's task 3 we can see that Insight and Nonreactivity decreased the latency for the task which provided more time (Task 1: 2500 Milliseconds) while Insight and Describing increased the latency for the task which provided less time (Task 3: 1500 Milliseconds). This means that the effect mindfulness variables have on EF performance could depend on the task itself, varying based on how much time is allotted and how difficult the task is.

Second, Total Errors, from the Cued Go-NoGo, was the only variable (other than Correct Lat 2), that had no significant t values or correlations with any of the independent variables found in this test. Given that this dependent variable is designed to measure a participant's ability to inhibit responses, this suggests the idea that personality/mindfulness traits cannot predict a participant's ability to inhibit responses. This could be since most participants (N=60) did not make any errors on the Cued Go-NoGo resulting in an insignificant variable. However, this also could be because the ability to control or regulate thoughts as seen in other mindfulness studies (Howells, et al., 2012) did not translate over to the Go-NoGo, a task based on responding to presented stimuli. Tasks like the Strop task have been used in previous mindfulness studies and gotten significant effects (Teper & Inzlicht, 2013) because it challenges a participant to inhibit a thought process, and then respond. This is further supported by the fact that the majority of participants did not make a single error on the Go-NoGo (Table 1) indicating that the task may not be challenging enough to produce the errors needed to efectively assess Inihibition. Therefore, it could be a task like the Go-NoGo which only requires a participant to respond in a set situation does not adequately challenge a participant's ability to inhibit a set response.

Third, though the correlations between the mindfulness variables and PASAT lat 3 were not significant the correlations do suggest the idea that the relationship between dispositional Mindfulness and EF performance could be positive or negative depending on the nature of the task. For working memory tasks where the participant can respond within 2500 milliseconds mindfulness traits were shown to increase performance on working memory tasks with Insight and Nonreactivity being negatively correlated with

performance on PASAT's Lat 1. Yet the correlations were reversed when the participant was required to repeat the same task in three-fifths the time they were allotted before (1500 MS), with variables such as Insight and Describing being correlated positively with performance on PASAT's Lat 3. Therefore, the correlations between mindfulness variables and EF performance might depend on the nature of the task itself, with tasks that require fast replies or are stressful (the third portion was independently reported by almost all participants to be difficult) causing mindfulness variables to negatively impact performance.

Finally, whether an individual had mindfulness experience or not was not directly correlated with performance on any of the tasks. These preliminary results suggest that despite the discovery of variables found to be correlated with the dependent variables and the existence of correlations between Mindfulness Experience and Mindfulness Traits (Table 2) there is not a direct effect of Mindfulness Practices on performance in EF tasks. Further analysis which looked at the amount of experience the participant had (Table 4) were similar indicating that the quantity of mindfulness training was not correlated with performance on EF tasks. This is in addition to the finding that two of the three traits found to not be correlated with Mindfulness Practices (Describing and Nonjudging) were found to be significantly correlated (Table 4) with performance on EF tasks. Though these results may seem surprising, the practice of mindfulness exercise itself does not guarantee any benefits. Previous research (Thompson, 2008; Flook & Smalley, 2010) suggests that it is not whether a participant practices mindfulness that predicts improved performance but rather how well they utilize mindfulness exercises in their daily lives. In other words, this study validates the idea that it is the quality of Mindfulness that we

possess, not the quantity of Mindfulness experience that determines how much of an impact Mindfulness has on our daily lives.

This final finding would be exciting if true, as it would support the idea that certain dispositional mindfulness traits are what predict improved performance on EF tasks. Of course, these results could be due to the fact that 'levels' to quantify mindfulness experience were not confirmed (all were self-report and vague as to the amount of time practiced) nor were their types of mindfulness exercises (Yoga, Breathing Exercises, Meditation) scored based on the type of exercise. If participants were gathered who practiced only an individual type of mindfulness, for example participants had only practiced breathing exercises, were measured against other types of mindfulness practices, then significant results could be obtained that would shed light on the differences between Mindfulness practicing and non-mindfulness practicing groups. In summary though there are many variables that are not significant, there is evidence that alludes to a connection between certain individual components of Mindfulness and Performance on Updating Working Memory and Set Shifting tasks, showing that hypothesis 1 and 2 are quite feasible.

Future Research and Limitations

Due to the number of insignificant variables in the study, it is evident that more research is needed to verify whether dispositional Mindfulness traits themselves are correlated with performance on EF tasks and that this effect is not due to mindfulness practices.

Future research should focus on gathering more participants from a larger and more diverse sample size as many of the participants drawn for this study were from a

single demographic (18-24-year-old college students) rather than the population at large. Gathering more subjects would provide the power necessary to determine whether the nearly significant variables (Insight, Describing and BFI's Agreeableness) found in this study are truly significant or simply close to being significant. In addition, gathering more participants could help determine whether other variables attributed to mindfulness individuals that were not measured in this study, could be significantly correlated with performance on EF tasks. Drawing from another sample would also provide the option to intentionally gather participants with Experience in a specific Mindfulness practice comparing their results to a baseline population to determine if the significant variables obtained in this study were consistent across all demographics.

Future research should also look at variables that focus on measuring individual components of Mindfulness rather than variables that try and measure all traits of Dispositional Mindfulness at the same time. Though the variable Insight was significantly correlated with performance on updating working memory tasks, variables such as Total FFMQ designed to measure all the values of the FFMQ and the individual's Mindfulness Experience were not even closely significant. This suggests that traits of dispositional mindfulness are more effective in predicting improved cognitive performance than total scores of mindfulness tests or even an individual's mindfulness experience.

In fact, the argument could be made that the FMI test is better quantified as a single variable than as a predictor of total Dispositional Mindfulness. Though the FMI was considered as a variable that could measure overall mindfulness, the fact that it was significant while Total FFMQ and Mindfulness Experience was not indicates that it may not be an appropriate measurement of total mindfulness but rather a measurement of a

single quantity of Mindfulness the FFMQ does not measure. This is backed up by previous reports that the FMI cannot be divided into individual components since it's variables are highly inter-correlated (Walach et al., 2006) which further supports the idea that the FMI more closely measures a single component of mindfulness than the multiple components that make up a mindful individual. Though this experiment supports the use of the FMI as a variable designed to measure general Dispositional Mindfulness, future research should focus more on how individual facets of Mindfulness such as Nonreactivity, Describing and Personality traits such as Agreeableness are correlated with performance on a variety of EF tasks.

The failure of the Cued Go-NoGo to demonstrate significant correlations indicates that a better test for Inhibition, such as the Stroop task, should be used in future studies. This also opens the possibility of branching out into testing other aspects of Executive Functioning, such as self-regulation, emotional regulation and Prioritizing as well as utilizing different tests designed to measure these variables. Utilizing different tests would not only allow the testing of different aspects of Executive Functioning but it would determine that the mindfulness traits observed in this study (insight, Nonreactivity and Describing) are consistent across different tests and measure whether these traits are correlated with more than just Updating working memory tasks.

Additionally, even though the results of the PASAT were significantly correlated with Mindfulness traits, the percentage of correct answers was on average very low for tasks two and three (25.46% and 14.55% respectively). Given that each correct answer was dependent on the participant answering correctly consecutively, having such a low percentage of correct answers could indicate participants had difficulty in answering

correctly in a row. This means missing one answer would force participants to listen to the next number in the sequence in order to answer whenever they would 'lose their place'. Given that the variables which assessed a person's working memory was dependent on how quickly they answered correctly, having such a small percentage of correct answers could skew the data providing an unrealistic assessment of how quickly they replied. Therefore, tests in the future should examine whether this correlation between mindfulness traits and working memory tasks translates over to other Working memory tests.

Of additional note, correlations run using the outliers removed from the study (N=129) show different results (Tables 10, 11 &12), indicating that certain extreme outliers may play a role in the correlation between Dispositional Mindfulness Traits and Performance on EF tasks.

Most importantly, any future research should measure mindfulness experience in more detail. Rather than measuring mindfulness as a binary variable or as a category, looking at the type of mindfulness exercise, the age at which they began training and their years of experience should be essential. This would not only allow for a better measurement of how Mindfulness experience moderates the relationship between Dispositional Mindfulness and EF performance, but also would allow analysis into whether there is a difference between groups of participants who practice different kinds of intentional mindfulness and those that do not.

Conclusion

Given the objective of this study to analyze whether dispositional mindfulness traits are correlated with performance on EF tasks this study was a success. Through

standard linear regression and correlations this study uncovered relationships between dispositional mindfulness and performance on certain EF tasks validating Hypothesis 1 and 2.

In its goal to examine what role Dispositional Mindfulness plays in Executive Functioning, this test was successful in uncovering several traits of Mindfulness that predict performance on Updating Working Memory and Set Shifting tasks, providing evidence that dispositional mindfulness traits may play a greater role in Executive functioning than a participant's mindfulness experience.

Appendices

Appendix A The Big Five Inventory

The Big Five Inventory (BFI)

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree Strongly
1	2	3	4	5

I see Myself as Someone Who...

____1. Is talkative

____2. Tends to find fault with others

____3. Does a thorough job

____4. Is depressed, blue

____5. Is original, comes up with new ideas

____6. Is reserved

____7. Is helpful and unselfish with others

____8. Can be somewhat careless

____9. Is relaxed, handles stress well

____10. Is curious about many different things

____11. Is full of energy

____12. Starts quarrels with others

____13. Is a reliable worker

____14. Can be tense

____15. Is ingenious, a deep thinker

____16. Generates a lot of enthusiasm

____17. Has a forgiving nature

____18. Tends to be disorganized

____19. Worries a lot

____20. Has an active imagination

____21. Tends to be quiet

____22. Is generally trusting

____23. Tends to be lazy

____24. Is emotionally stable, not easily upset

____25. Is inventive

____26. Has an assertive personality

____27. Can be cold and aloof

____28. Perseveres until the task is finished

____29. Can be moody

____30. Values artistic, aesthetic experiences

____31. Is sometimes shy, inhibited

____32. Is considerate and kind to almost everyone

____33. Does things efficiently

____34. Remains calm in tense situations

____35. Prefers work that is routine

____36. Is outgoing, sociable

____37. Is sometimes rude to others

____38. Makes plans and follows through with them

____39. Gets nervous easily

____40. Likes to reflect, play with ideas

____41. Has few artistic interests

____42. Likes to cooperate with others

____43. Is easily distracted

____44. Is sophisticated in art, music, or literature

Appendix B: The Big Five Inventory

Five Facet Mindfulness Questionnaire (FFMQ)

Please rate each of the following statements with the number that best describes *your own opinion* of what is *generally true for you.*		Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
FFQM 1	When I'm walking, I deliberately notice the sensations of my body moving. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 2	I'm good at finding words to describe my feelings. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 3	I criticize myself for having irrational or inappropriate emotions. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 4	I perceive my feelings and emotions without having to react to them. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 5	When I do things, my mind wanders off and I'm easily distracted. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 6	When I take a shower or bath, I stay alert to the sensations of water on my body. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 7	I can easily put my beliefs, opinions, and expectations into words. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 8	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 9	I watch my feelings without getting lost in them. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 10	I tell myself I shouldn't be feeling the way I'm feeling. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 11	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 12	It's hard for me to find the words to describe what I'm thinking. (D-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 13	I am easily distracted. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 14	I believe some of my thoughts are abnormal or bad and I shouldn't think that way. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 15	I pay attention to sensations, such as the wind in my hair or sun on my face. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 16	I have trouble thinking of the right words to express how I feel about things. (D-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 17	I make judgments about whether my thoughts are good or bad. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 18	I find it difficult to stay focused on what's happening in the present. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

		Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
FFQM 18	When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 20	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 21	In difficult situations, I can pause without immediately reacting. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 22	When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words. (D-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 23	It seems I am "running on automatic" without much awareness of what I'm doing. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 24	When I have distressing thoughts or images, I feel calm soon after. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 25	I tell myself that I shouldn't be thinking the way I'm thinking. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 26	I notice the smells and aromas of things. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 27	Even when I'm feeling terribly upset, I can find a way to put it into words. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 28	I rush through activities without being really attentive to them. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 29	When I have distressing thoughts or images, I am able just to notice them without reacting. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 30	I think some of my emotions are bad or inappropriate and I shouldn't feel them. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 31	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 32	My natural tendency is to put my experiences into words. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 33	When I have distressing thoughts or images, I just notice them and let them go. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 34	I do jobs or tasks automatically without being aware of what I'm doing. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 35	When I have distressing thoughts or images, I judge myself as good or bad depending what the thought or image is about. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 38	I pay attention to how my emotions affect my thoughts and behavior. OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

		Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
FFQM 37	I can usually describe how I feel at the moment in considerable detail. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 38	I find myself doing things without paying attention. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 39	I disapprove of myself when I have irrational ideas. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

Appendix C the Freiburg Mindfulness Inventory

Freiburg Mindfulness Inventory

Description:

The FMI is a useful, valid and reliable questionnaire for measuring mindfulness. It is most suitable in generalized contexts, where knowledge of the Buddhist background of mindfulness cannot be expected. The 14 items cover all aspects of mindfulness.

The purpose of this inventory is to characterize your experience of mindfulness. Please use the last ___ days as the time-frame to consider each item. Provide an answer the for every statement as best you can. Please answer as honestly and spontaneously as possible. There are neither 'right' nor 'wrong' answers, nor 'good' or 'bad' responses. What is important to us is your own personal experience.

1	2	3	4
Rarely	Occasionally	Fairly often	Almost always

I am open to the experience of the present moment.	1	2	3	4
I sense my body, whether eating, cooking, cleaning or talking.	1	2	3	4
When I notice an absence of mind, I gently return to the experience of the here and now.	1	2	3	4
I am able to appreciate myself.	1	2	3	4
I pay attention to what's behind my actions.	1	2	3	4
I see my mistakes and difficulties without judging them.	1	2	3	4
I feel connected to my experience in the here-and-now.	1	2	3	4
I accept unpleasant experiences.	1	2	3	4
I am friendly to myself when things go wrong.	1	2	3	4
I watch my feelings without getting lost in them.	1	2	3	4
In difficult situations, I can pause without immediately reacting.	1	2	3	4
I experience moments of inner peace and ease, even when things get hectic and stressful.	1	2	3	4
I am impatient with myself and with others.	1	2	3	4
I am able to smile when I notice how I sometimes make life difficult.	1	2	3	4

Appendix D: Tables

Table 1

Descriptive Statistics of the Variables (N=109)

	Mean	Std. Deviation
Demographics Questionnaire[a]		
MindfulnessExperience	.41	.495
Freidberg Mindfulness[b]		
Insight	2.709	.475
Five Facet Mindfulness[c]		
Observing	3.584	.742
Describing	3.554	.858
Awareness	3.388	.796
Nonjudging	3.291	.896
Nonreactivity	3.143	.728
Total	3.374	.459
Big Five Inventory[c]		
bfiExtraversion	3.272	.808
bfiAgreeableness	3.982	.628
bfiConscientiousness	3.678	.563
bfiNeuroticism	2.908	.802
bfiOpenness	3.704	.601
Paced Auditory Serial Addition Task[d]		
Correct Lat 1	2130.16	194.872
Correct Lat 2	1555.524	93.449
Correct Lat 3	1216.766	76.395
Wisconson Card Sorting		
Percentage of Perseverative Response	9.72%	3.77%
Cued Go-NoGo		
Total Errors	.85	1.104
Avg Rep[d]	346.37	3.358

Note: [a]MindfulnessExperience: 0= *No Mindfulness Experience*, 1= *Mindfulness Experience*. Five [b]Facet Freberg Mindfulness Inventory: 1=*Rarely,* 4=*Almost Always*. [c]Mindfulness and Big Five Inventory: 1=*Never/Very Rarely True*, 5= *Very* Often, Always True. [d]Paced Auditory Serial Addition Task & Av Rep: Time measured in Milliseconds

Dependent Variables: Correct Lat 1, Correct Lat 2, Correct Lat 3, Percentage of Perservitive Response, Total Errors, Avg Rep.

Indepenent Variables: Mindfulness Experience, Insight, Observing, Describing, Awareness, Nonjudging, Nonreactivity, Total, BfiExtraversion, bfiAgreeableness, bfiConscientiousness, bfiNeurotocisim, bfiOpenness.

Table 2

Correlations Between Mindfulness Variables (N=109) (N=98 for Mindfulness Practice)

	Mindfulness Experience	Mindfulness _Practice	Insight	Observing	Describing	Awareness	Nonjudging	Nonreactivity	Total
Mindfulness Experience	-								
Mindfulness _Practice	.888**	-							
Insight (FMI)	.201*	.259**	-						
Observing (FFMQ)	.252**	.337**	.282**	-					
Describing (FFMQ)	.182	.218*	.405**	.285**	-				
Awareness (FFMQ)	.057	.086	.268**	.077	.207*	-			
Nonjudging (FFMQ)	.102	.119	.311**	-.186	.239*	.403**	-		
Nonreactivity (FFMQ)	.217*	.235*	.529**	.314**	.233*	.207*	.060	-	
Total (FFMQ)	.278**	.342**	.605**	.485**	.710**	.603**	.554**	.572**	-

**. P< 0.01 level

*. P< 0.05 level

Table 3

Correlations Between EF Variables (N=109)

	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Avg Rep	Total Errors
Correct Lat 1 (PASAT)	-					
Correct Lat 2 (PASAT)	.319**	-				
Correct Lat 3 (PASAT)	.207*	.174	-			
Percentage of Perseverative Response (WCST)	-.111	-.101	-.127	-		
Avg Rep (Go-NoGo)	.132	.075	.162	.025	-	
Total Errors (Go-NoGo)	.045	-.020	-.067	-.067	-.003	-

**. P< 0.01 level; *. P< 0.05 level

Table 4

Correlations Between Total Mindfulness Variables And EF Task Performance (N=109)

	MindfulnessExperience	Mindfulness_Practice	Insight	Total	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Avg Rep	Total Errors
Mindfulness Experience	-									
Mindfulness_Practice	.888**	-								
Insight (FMI)	.201*	.259**	-							
Total (FFMQ)	.278**	.342**	.605**	-						
Correct Lat 1 (PASAT)	-.038	-.061	-.232*	-.151	-					
Correct Lat 2 (PASAT)	-.073	-.076	-.071	-.022	.319**	-				
Correct Lat 3 (PASAT)	.073	-.016	.181	.028	.207*	.174	-			
Percentage of Perseverative Response (WCST)	.095	.079	-.018	-.008	-.111	-.101	-.127	-		
Avg Rep (Go-NoGo)	-.060	-.184	.011	.030	.132	.075	.162	.025	-	
Total Errors (Go-NoGo)	-.075	-.120	-.087	-.107	.045	-.020	-.067	-.067	-.003	-

**. P< 0.01 level; *. P< 0.05 level

Table 5.1

Regression Table to analyze the effect of FFMQ variables on PASAT Tasks 1-3 (N=109)

	PASAT Task 1			PASAT Task 2			PASAT Task 3		
	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta
Observing	6.415	28.456	.024	-8.688	14.012	-.069	-8.772	11.131	-.085
Describing	-19.055	24.055	-.084	-1.287	11.845	-.012	22.353	9.409	.251*
Awareness	14.557	26.300	.059	7.503	12.950	.064	-11.915	10.287	-.124
Nonjudging	-5.708	24.329	-.026	-4.980	11.980	-.048	-3.410	9.516	-.040
Nonreactivity	-59.275	27.689	-.222*	.671	13.634	.005	-3.453	10.831	-.033
R^2		0.058			0.007			0.063	
F		1.279			.149			1.375	

*. p< 0.05; **. p< 0.01

Table 5.2

Regression Table to analyze the effect of FFMQ variables on The WCST and Cued Go-NoGo (N=109)

	Perseverative Errors			Avg Rep			Total Errors		
	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta
Observing	.591	.560	.116	1.794	5.256	.038	-.134	.163	-.090
Describing	-.662	.473	-.151	-1.356	4.443	-.033	.092	.138	.072
Awareness	-.133	.517	-.028	-1.727	4.857	-.039	-.159	.151	-.115
Nonjudging	.196	.478	.046	3.731	4.493	.095	-.132	.140	-.107
Nonreactivity	.350	.544	.068	1.370	5.114	.028	.061	.159	.040
R^2		0.028			0.007			0.033	
F		0.601			0.161			0.708	

*. p< 0.05; **. p< 0.01

Table 6

Correlations Between FFMQ variables And Performance on EF tasks (N=109)

	Observing	Describing	Awareness	Nonjudging	Nonreactivity	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Avg Rep	Total Errors
Observing (FFMQ)	-										
Describing (FFMQ)	.285**	-									
Awareness (FFMQ)	.077	.207*	-								
Nonjudging (FFMQ)	-.186	.239*	.403**	-							
Nonreactivity (FFMQ)	.314**	.233*	.207*	.060	-						
Correct Lat 1 (PASAT)	-.060	-.122	-.013	-.040	-.223*	-					
Correct Lat 2 (PASAT)	-.057	-.028	.038	-.011	-.009	.319**	-				
Correct Lat 3 (PASAT)	-.026	.184	-.102	-.016	-.029	.207*	.174	-			
Percentage of Perseverative Response (WCST)	.084	-.096	-.018	-.019	.066	-.111	-.101	-.127	-		
Avg Rep (Go-NoGo)	.017	-.001	.001	.066	.030	.132	.075	.162	.025	-	
Total Errors (Go-NoGo)	-.046	.006	-.142	-.117	-.002	.045	-.020	-.067	-.067	-.003	-

*. p< 0.05; **. p< 0.01

Table 7.1

Regression Table to analyze the effect of BFI variables on PASAT Tasks 1-3 (N=109)

	PASAT Task 1			PASAT Task 2			PASAT Task 3		
	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta
Extraversion	.088	24.381	.000	10.367	11.797	.090	4.103	9.596	.043
Agreeablenes	41.876	32.818	.135	-1.971	15.879	-.013	17.222	12.917	.142
Conscientiousness	24.025	38.311	.069	-10.187	18.537	-.061	-14.661	15.079	-.108
Neuroticism	36.147	26.217	.149	8.333	12.685	.071	-2.455	10.319	-.026
Openness	-32.508	32.057	-.100	-12.489	15.511	-.080	-14.414	12.617	-.113
R^2		0.041			0.024			0.034	
F		0.886			0.505			0.716	

*. p< 0.05; **. p< 0.01

Table 7.2

Regression Table to analyze the effect of BFI variables on The WCST and Cued Go-NoGo (N=109)

	Perseverative Errors			Avg Rep			Total Errors		
	B	SE B	Beta	B	SE B	Beta	B	SE B	Beta
Extraversion	.084	.471	.018	-4.785	4.355	-.110	.199	.140	.145
Agreeablenes	-1.168	.633	-.194	-9.344	5.862	-.167	-.067	.188	-.038
Conscientiousness	.069	.739	.010	-.156	6.843	-.003	.043	.219	.022
Neuroticism	.130	.506	.028	-5.781	4.683	-.132	.078	.150	.056
Openness	.741	.619	.118	-4.988	5.726	-.086	-.046	.184	-.025
R^2		0.047			0.055			0.021	
F		1.006			1.197			0.438	

*. p< 0.05; **. p< 0.01

Table 8

Correlations Between BFI variables And Performance on EF tasks (N=109)

	bfiExtraversion	bfiAgreeableness	bfiConscientiousness	bfiNeuroticism	bfiOpenness	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Avg Rep	Total Errors
Extraversion (BFI)	-										
Agreeableness (BFI)	.088	-									
Conscientiousness (BFI)	.105	.389**	-								
Neuroticism (BFI)	-.281**	-.233*	-.362**	-							
Openness (BFI)	.119	.147	.173	-.067	-						
Correct Lat 1 (PASAT)	-.034	.113	.051	.099	-.078	-					
Correct Lat 2 (PASAT)	.052	-.058	-.097	.077	-.087	.319**	-				
Correct Lat 3 (PASAT)	.038	.093	-.059	-.024	-.104	.207*	.174	-			
Percentage of Perseverative Response (WCST)	.008	-.178	-.053	.056	.091	-.111	-.101	-.127	-		
Avg Rep (Go-NoGo)	-.098	-.160	-.046	-.056	-.115	.132	.075	.162	.025	-	
Total Errors (Go-NoGo)	.126	-.034	-.002	.018	-.013	.045	-.020	-.067	-.067	-.003	-

*. p< 0.05; **. p< 0.01

Table 9

Correlations Between Significant IV (N=109)

	Insight	Nonreactivity	Describing	bfiAgreeableness
Insight (FMI)	-			
Nonreactivity (FFMQ)	.529**	-		
Describing (FFMQ)	.405**	.233*	-	
bfiAgreeableness (BFI)	.310**	.093	.136	-

*. p< 0.05; **. p< 0.01

Table 10

Correlations including Extreme Outliers (Hypothesis 1) (N=129)

	Mindfulness_Experience	Insight	Total	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Total Errors	Avg Rep
Mindfulness Experience	-								
Insight (FMI)	.124	-							
Total (FFMQ)	.199*	.594**	-						
Correct Lat 1 (PASAT)	-.009	-.242**	-.214*	-					
Correct Lat 2 (PASAT)	.057	.067	-.017	.189*	-				
Correct Lat 3 (PASAT)	.075	.179*	.034	.114	.009	-			
Percentage of Perseverative Response (WCST)	.047	.041	.062	-.151	.095	-.116	-		
Total Errors (Go-NoGo)	-.043	-.023	-.055	.081	-.207*	-.209*	-.096	-	
Avg Rep (Go-NoGo)	.054	.013	.146	.173	.053	.156	-.026	.038	-

*. p< 0.05;

**. p< 0.01

Table 11

Correlations including Extreme Outliers (Hypothesis 2) (N=129)

	Observing	Describing	Awareness	Nonjudging	Nonreactivity	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Total Errors	Avg Rep
Observing (FFMQ)	-										
Describing (FFMQ)	.256**	-									
Awareness (FFMQ)	.066	.243**	-								
Nonjudging (FFMQ)	-.142	.276**	.428**	-							
Nonreactivity (FFMQ)	.327**	.245**	.196*	.081	-						
Correct Lat 1 (PASAT)	-.126	-.157	-.052	-.051	-.266**	-					
Correct Lat 2 (PASAT)	-.030	-.014	.106	.009	-.108	.189*	-				
Correct Lat 3 (PASAT)	-.078	.153	-.007	-.047	.036	.114	.009	-			
Percentage of Perseverative Response (WCST)	.111	-.035	.016	.049	.069	-.151	.095	-.116	-		
Total Errors (Go-NoGo)	.082	-.045	-.188*	.027	-.072	.081	-.207*	-.209*	-.096	-	
Avg Rep (Go-NoGo)	.013	.064	.085	.177*	.099	.173	.053	.156	-.026	.038	-

*. p< 0.05;

**. p< 0.01

Table 12

Correlations including Extreme Outliers (Big Five Inventory) (N=129)

	bfiExtraversion	bfiAgreeableness	bfiConscientiousness	bfiNeuroticism	bfiOpenness	Correct Lat 1	Correct Lat 2	Correct Lat 3	Percentage of Perseverative Response	Total Errors	Avg Rep
bfiExtraversion	-										
bfiAgreeableness	.105	-									
bfiConscientiousness	.099	.364**	-								
bfiNeuroticism	-.312**	-.268**	-.426**	-							
bfiOpenness	.120	.164	.155	-.040	-						
Correct Lat 1 (PASAT)	-.104	.064	-.015	.181*	-.138	-					
Correct Lat 2 (PASAT)	.059	-.094	-.071	.082	-.036	.189*	-				
Correct Lat 3 (PASAT)	.074	.100	.013	-.039	-.027	.114	.009	-			
Percentage of Perseverative Response (WCST)	-.011	-.139	.028	-.002	.082	-.151	.095	-.116	-		
Total Errors (Go-NoGo)	-.065	.036	-.055	.110	.006	.081	-.207*	-.209*	-.096	-	
Avg Rep (Go-NoGo)	-.146	-.156	.006	-.022	-.100	.173	.053	.156	-.026	.038	-

*. p< 0.05;
**. p< 0.01

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