

Running head: MINDFULNESS, STRESS, AND WORKING MEMORY

**TOWSON UNIVERSITY  
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**DOES MINDFULNESS MITIGATE THE NEGATIVE EFFECT  
OF STRESS ON WORKING MEMORY?**

**by**

**Allison Kinter**

**A thesis**

**Presented to the faculty of**

**Towson University**

**in partial fulfillment**

**of the requirements for the degree**

**Master of Arts**

**Department of Experimental Psychology**

**Towson University**

**Towson, Maryland 21252**

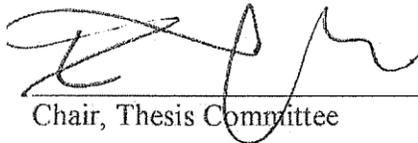
**May, 2013**

MINDFULNESS, STRESS, AND WORKING MEMORY

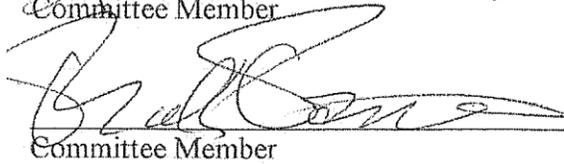
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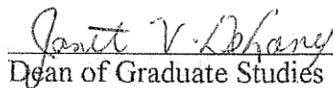
THESIS APPROVAL PAGE

This is to certify that the thesis prepared by Allison Kinter entitled, "Does Mindfulness Mitigate the Negative Effect of Stress on Working Memory?" has been approved by the thesis committee as satisfactorily completing the thesis requirements for the degree of Master of Arts in Experimental Psychology.

 \_\_\_\_\_ 4-26-2013  
Chair, Thesis Committee Date

 \_\_\_\_\_ 4/26/2013  
Committee Member Date

 \_\_\_\_\_ 4/26/13  
Committee Member Date

 \_\_\_\_\_ 5/8/13  
Dean of Graduate Studies Date

# MINDFULNESS, STRESS, AND WORKING MEMORY

Abstract

## **DOES MINDFULNESS MITIGATE THE NEGATIVE EFFECT OF STRESS ON WORKING MEMORY?**

**Allison Kinter**

Both the positive effect of mindfulness training on stress and the negative effect of stress on working memory have been documented extensively in the academic literature, but, research on the relationship between mindfulness, stress, and working memory is negligible. The present study evaluated the effect of trait mindfulness on working memory in a stress group and a control group, using a modification of the Trier Social Stress Test (TSST) to elicit stress in the experimental group. The Modified Lag Task (MLT) was used to measure working memory, and the Kentucky Inventory of Mindfulness Skills (KIMS) measured trait mindfulness. Although it was hypothesized that mindfulness might mitigate the negative effects of stress on working memory, significant correlations were not found. Findings are discussed in terms of the limitations of mindfulness as a variable, along with suggestions for future studies given the finding that simply the anticipation of giving a speech is sufficient to induce stress in a group setting.

*Keywords:* mindfulness, meditation, working memory, stress, TSST

# MINDFULNESS, STRESS, AND WORKING MEMORY

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## **Introduction**

The effect of acute psychological stress, specifically the activation of neurochemicals to the prefrontal cortex (PFC), has been studied extensively for years, and the recent development of brain imaging technology has allowed researchers to pinpoint the exact regions of the brain affected by specific stressors (Butts, Weinberg, Young, & Phillips, 2011; Beauchamp-Turner & Levinson, 1992; Callicott et al., 1999; Lazar, Bush, Gollub, Fricchione, Khalsa, & Benson, 2000). Understanding the effect of stress on working memory (i.e., the mind's ability to coordinate and attend to multiple tasks simultaneously) has become a major area of study. Stress is an unavoidable part of life and the ability to circumvent its negative effect on working memory could lead to personal and professional gains. A recent public acceptance of holistic alternatives as legitimate forms of treatment for stress has resulted in a surge of research on mindfulness (i.e., the ability to focus in the present moment) and its application as a technique for relieving stress (Baer, Smith, & Allen, 2004; Beauchamp-Turner & Levinson, 1992; Brown & Ryan, 2003).

The present study examined the role that mindfulness plays in reducing the negative effect of stress on working memory. This paper will outline the relationship between stress and working memory, discuss the effect of mindfulness on both stress and working memory, and present a new study that combines these fields of research.

## **Stress and Working Memory**

Working memory is defined as an attentional system with multiple components that coordinate and manipulate current information with long-term memories (Baddeley, 2003). It is a critical component of executive functioning and allows individuals to

manage a multitude of daily activities, such as answering questions in conversation and navigating obstacles while driving. Research also indicates that an efficient working memory correlates with superior performance on tasks of verbal comprehension and logical reasoning (Shelton, Metzger, & Elliott, 2007; Unsworth & Engle, 2005; Wiley, Jarosz, Cushen, & Colflesh, 2011). Baddeley's model of working memory consists of three parts: the phonological loop (i.e., an area specialized for language), the visuospatial sketchpad (i.e., an area specialized for visual and spatial information), and the central executive (i.e., an area that manipulates and coordinates all information in the subsystems). The central executive, which has been linked to the dorso-lateral prefrontal cortex (DLPFC), has received the most attention in brain imaging studies.

From a biological perspective, stress exposure results in a release of dopamine to the prefrontal cortex (PFC), an activation of the hypothalamic-pituitary-adrenal axis (HPA), and an influx of glucocorticoid (GC) hormones to receptors in the PFC (Butts, Weinberg, Young, & Phillips, 2011). This series of events results in an increase in cortisol, which negatively affects performance on cognitive tasks dependent on the PFC. Previous research indicates that the PFC is essential in tasks of working memory (Callicott, et al., 1999; Oei, Everaerd, Elzinga, Van Well, & Bermond, 2006; Schoofs, Preub, & Wolf, 2008).

Callicott et al. (1999) designed an fMRI study to understand the physiological responses underlying working memory performance. Past research has found that an increase in cognitive load results in an increase in activation in the DLPFC but a decrease in performance on working memory tasks. A recall version of the *n*-back task (Gevins et

al., 1990), a popular measure of working memory, was used in conjunction with fMRI to study this conflicting relationship. In this task, a list of numbers is presented and participants are cued at the end of the list to recall a certain number based on its position in the list (e.g., one back, two back, etc.).

Results identified three types of loci in the DLPFC: *capacity constrained loci*, *capacity independent loci*, and *capacity unconstrained loci* (Callicott et al., 1999). The capacity independent loci and capacity unconstrained loci continued to activate throughout the working memory task, thus, explaining the pattern of increased activation in the DLPFC with an increase in cognitive load. However, the capacity constrained loci increased in activation with cognitive load, peaked when cognitive capacity was reached, and then declined significantly. The identification of a capacity constrained loci explains the sharp decrease in performance on working memory tasks once participants can no longer handle the increase in cognitive load.

Stress has been shown to mimic this effect and decrease individual ability to handle increasing cognitive load. Oei, Everaerd, Elzinga, Van Well, and Bermond (2006) induced socio-evaluative stress in an experimental group using the popular Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993), where participants were provided 10 minutes to anticipate and prepare for a 5-minute speech and a 5-minute arithmetic task, both to be conducted in front of an impassive committee. Working memory performance was measured using a Sternberg paradigm (Sternberg, 1966) that increased in difficulty to indicate increasing levels of cognitive load (i.e., participants indicated if they recognized a target letter from a list, and the length of the lists increased

from one to four letters to create an increase in cognitive load). Cortisol, blood pressure, and heart rate were also measured.

Oei et al. (2006) found a significant increase in cortisol in the stress group compared to the control group, indicating that the TSST protocol was successful. At high cognitive loads, the stress group performed significantly worse, indicated by slower reaction time and fewer correct responses, in comparison to the control group on the working memory task. However, there was no significant difference between groups at low cognitive loads. These results indicate that socio-evaluative stress negatively affects performance on working memory tasks specifically at high cognitive loads, supporting the notion of the capacity constrained loci (i.e., working memory performance declines once cognitive capacity has been reached).

Schoofs, Preub, and Wolf (2008) utilized a similar design to replicate these findings; these authors used a version of the TSST to induce stress in an experimental group and cortisol was collected to confirm the success of the stress induction. The authors used the *n*-back task instead of the Sternberg paradigm and included only high cognitive load conditions (i.e., two back or three back). Again, a significant increase in cortisol was found in the stress group, whose performance was significantly worse (i.e., slower reaction times and fewer correct responses) on the working memory task compared to the control group. The authors suggested that these results combined with those of Oei et al. (2006) indicate that using measures that create high cognitive loads (e.g., the *n*-back) will best detect the negative effect of stress on working memory.

**Effect of Mindfulness and Meditation Training on Stress and Working Memory**

Mindfulness, in its most simplistic form, is the act of focusing attention on stimuli introduced in the present moment. Mindfulness techniques have been applied in a multitude of settings ranging from seated meditation sessions in the East to integrative therapy practices in the West. Baer, Smith, and Allen (2004) proposed that mindfulness consists of four components: observing stimuli with an open mind, describing stimuli with words, acting with awareness, and accepting the present moment without judgment. The authors *believe* that individuals can practice mindfulness in daily life, and, while individuals have inherently different capacities for mindfulness, techniques can be implemented to cultivate this skill. However, it should be noted that mindfulness is predominately measured in the scientific literature with the practice of meditation.

Lazar, Bush, Gollub, Fricchione, Khalsa, and Benson (2000) used fMRI technology to identify the brain areas that are active in participants engaged in seated meditation compared to participants seated silently. Results indicated a significant increase in brain activation in areas involved in controlling arousal (i.e., midbrain and pregenual anterior cingulate cortex) in the meditation group compared to the control group. Additionally, brain scans from the beginning of the meditation induction compared to those from the end of the meditation induction showed a significant increase in activation in areas involved in maintaining attention (i.e., prefrontal and parietal cortices). These results indicate that meditation practice affects the regulation of arousal and attention, leading to the assumption that meditation may reduce stress and enhance working memory.

The ability of mindfulness to reduce stress has been replicated extensively in the research literature. Beauchamp-Turner and Levinson (1992) found that frequent meditators reported significantly lower levels of stress and anxiety compared to infrequent meditators. In a study of cancer patients, Brown and Ryan (2003) found that levels of stress decreased significantly after participation in an eight-week mindfulness-based stress reduction (MBSR) program. Furthermore, Mohan, Sharma, and Bijlani (2011) induced stress in healthy participants with no meditation experience via a stressful computer game and found that a brief meditation session significantly reduced physiological measures of stress. Thus, even though these participants lacked previous experience with meditation, a guided meditation session of only 20 minutes elicited results (Mohan et al., 2011).

Conversely, the effect of meditation on working memory is sparse and less definitive in the literature. Zeidan, Johnson, Diamond, David, and Goolkasian (2010) studied the effect of a brief four-day MSBR training on an experimental group and compared measures to a control group that listened to an audio book for four days. Various measures of executive functioning, including working memory, were used. While there was no significant effect on the *n*-back task, the MSBR training resulted in a significant improvement on the Symbol Digit Modalities Test (SDMT; Smith, 1982) in the experimental group compared to the control group. The SDMT is a measure of working memory that requires participants to match a series of numbers to corresponding geometric figures using a reference key. Therefore, the results of this study provided a mixed review of the effect of mindfulness on working memory.

Nonetheless, Jha, Stanley, Kiyonaga, Wong, and Gelfand (2010) trained military personnel in mindfulness in an effort to protect them from the negative impact of overseas deployment. Participants were provided with an 8-week mindfulness training during their 10-week predeployment period and were given time each day to practice their mindfulness techniques. Working memory was measured using OSPAN before and after the training, and the experimental group was compared to a control group of military personnel that did not receive mindfulness training predeployment.

Jha et al. (2011) report that OSPAN performance typically degrades in military personnel during this stressful predeployment period, most likely as a result of exceeding cognitive load capacity, and results for the control group support this pattern: OSPAN scores declined in the control group over time. However, participants in the experimental group who spent more hours practicing their mindfulness techniques per day exhibited a significant improvement in working memory performance over time. These results indicate that mindfulness training can negate the effects of stress and improve working memory, lending support to the present study.

In summary, this paper has presented studies using fMRI technology and cognitive testing to demonstrate the negative effect of stress on working memory performance, specifically at high cognitive loads. While the literature conclusively links mindfulness (i.e., meditation) to stress relief, research on mindfulness and working memory is negligible and requires further investigation, however, recent research by Jha et al. (2010) indicates a significant effect of mindfulness on stress and working memory in military personnel. Not only did this study identify a significant relationship between

these variables but it did so in a realistic setting without artificial inductions of stress. The ecological validity of these results suggests that the relationship between mindfulness, stress, and working memory may be a fruitful area of research.

### **The Present Study**

The purpose of the present study was to determine the effect of trait mindfulness on stress and working memory. While previous research indicates that engaging in meditation reduces stress, the present study examined if the same effect occurs in individuals who have more mindfulness in their personality makeup. In addition, this study took into the account the effect of trait anxiety on the relationship between trait mindfulness, stress, and working memory.

This study was conducted in groups (i.e., not individually), and, since the TSST was recently validated for group administration (Von Dawans, Kirschbaum, & Heinrichs, 2010), it was chosen as the method of stress induction. Specifically, this study used a modified version of the TSST in which simply the *anticipation* of giving a speech was used to elicit stress. Kirschbaum, Pirke, and Hellhammer (1993), the originators of the TSST, stated that the anticipation of negative consequences and ego involvement are major components in effectively generating socio-evaluative stress. In light of this information, Starcke, Wolf, Markowitsch, and Brand (2008) studied the effect of stress on decision-making and found that the mere anticipation of a stressful socio-evaluative event evoked the stress response (i.e., an increase in cortisol and sympathetic nervous system activation), validating this modified protocol for use when time is of the essence.

This study featured a mixed design: Stress was created in the experimental groups using the modified TSST (i.e., anticipation-only), while the control groups participated in a neutral activity, and both groups completed measures of working memory, trait mindfulness, and trait anxiety. Since previous research indicates that stress mimics high cognitive load (Oei et al., 2006; Schoofs et al., 2008), it was hypothesized that exposure to stress in the experimental group would negatively affect performance on the working memory measure compared to the control group. Additionally, it was hypothesized that participants that scored higher in trait mindfulness would be more effective at handling stress, thus, resulting in better performance on the working memory task compared to participants that scored lower in trait mindfulness.

## **Method**

### **Participants**

Thirty-two undergraduate students ( $M = 20.6$  years old; 81.3% female; 59.3% Caucasian) from Towson University were recruited to participate in this study in exchange for research credit. After receiving university IRB approval (Appendix A), recruitment took place via an online research pool within the psychology department. Since this study was designed for group administration, groups of 10 were set-up within the research pool, however, due to inadequate recruitment, the groups ranged from only two to seven participants. Half of the groups were randomly assigned to the experimental condition ( $N = 18$ ) and half were randomly assigned to the control condition ( $N = 14$ ). While a power analysis conducted on related published research (i.e., small effect size,

.10) recommended approximately 124 participants for testing, logistical issues significantly affected recruitment.

### **Materials**

**Working Memory.** A version of the Modified Lag Task (MLT; Shelton et al., 2007), which has been validated for group administration, was used as a measure of working memory. The MLT was chosen because it is very similar to the *n*-back, which was recommended for measuring the effect of stress on working memory (Schoofs et al., 2008). All participants viewed a list of words on an overhead projector, and each word was presented for one second. At the end of each list, participants were cued to recall a specific word depending on its placement in the list and were asked to write the answer on their individual data collection sheet. Each participant viewed 27 lists of words: three lists for each combination of three lag types (i.e., lag 0, lag 1, and lag 2) by three list lengths (i.e., six words, seven words, and eight words). The working memory score was generated by tabulating the number of correct responses, with 27 being the highest possible score.

**Mindfulness.** The Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al., 2004) was used as a measure of mindfulness, specifically because it was designed to measure mindfulness as a trait. This scale measures four distinct categories of mindfulness: observing, describing, acting with awareness, and accepting without judgment. Additionally, this measure has been validated to test for individual capacity for mindfulness in daily activities regardless of experience with formal practice (i.e., meditation or yoga). The KIMS is a 39-item questionnaire where participants are asked to

rate the truth of each statement on a scale of 1 (*never or very rarely true*) to 5 (*very often or always true*). A higher score indicates more trait mindfulness.

**Anxiety.** The Spielberger State-Trait Anxiety Scale (STAI; Spielberger, 1983) was used to compare anxiety pretest and posttest (i.e., state) and anxiety within individuals (i.e., trait). Each sub-scale consists of 20 items and each item is measured on a 4-point Likert scale. Examples of items from both scales are “I feel nervous and restless” or “I am tense.” A higher score indicates more anxiety.

### **Procedure**

Participants were tested in groups of two to seven and were told that they were taking part in a study on cognition in exchange for research credit. Once informed consent (Appendix B) was collected from each member of the group, all participants were asked to sit for 5-min and relax to acclimate to the testing environment. Participants were allowed to close their eyes, the lights were dimmed, and all personal affects were kept at the front of the room. Upon completion of the acclimation period, all participants completed the KIMS, the Trait Anxiety Scale (STAI-T), and the State Anxiety Scale (STAI- S) as baseline measures.

Groups were randomly assigned to the experimental or the control condition prior to study commencement. After collection of baseline measures, initiation of the modified TSST began in the experimental group. First, the experimenter read the following instructions to participants:

Before we move on, I want to let you know that as part of this experiment, you will be asked to give a 5-minute speech on gun control. You should express your opinions on this issue in a well-formulated argument. When it is time to give your speech, you will come to the front of the room and speak in front of the other participants as well as two undergraduate Liberal Arts professors, who are waiting in the hall. I will also videotape

this speech using my iPhone, because a prize will be given to the participant who gives the best speech.

I will now give you three minutes to formulate your argument and prepare your speech. You may use this scrap paper to outline your speech and gather your thoughts, but you will not be able to use these notes when you give your speech. Again, it is expected that you use all of the five minutes allotted to you when it is time for you to make your speech, so please keep that in mind while you are preparing.

Participants were then given two pieces of scrap paper and a pen and were provided three minutes to prepare for their speech. Upon completion of the 3-minute anticipation period, all participants were presented with a sheet containing 15 multiplication problems (e.g.,  $454589 \times 56$ ;  $7345 \times 897$ ; see Appendix C) and the following instructions:

Next, we will complete another activity that will determine the order of the speeches. This sheet contains 15 math problems; all problems should be easy to complete for a student at the college level. After you have completed your calculations, please circle your answer. Again, please circle your answer. You will have five minutes only to complete these problems. The participant who has the most incorrect and/or unanswered questions will have to make their speech first. Therefore, your goal is to complete as many problems correctly as possible in five minutes.

At the end of the 5-min math section, the TSST was effectively complete, however, with each subsequent task, the group was told that they just had one more task to complete before the speeches began. Therefore, it was expected that each participant would anticipate the act of giving a speech up until the very end of the study.

Alternatively, the control group was told to take 3-min to think about their last vacation; participants were offered a pencil and paper to write down their thoughts or allowed to simply sit, with eyes open or closed. Then, these participants were asked to review the same set of math problems for five minutes, but they were told that it was not necessary to write down any answers and that they would not be judged or scored in any way.

At the end of either the stress induction or the neutral activity, each group was asked to complete the STAI-S again as a post-test measure of anxiety. Then, each group began the MLT, an automated Power Point presentation lasting approximately 10 minutes. The MLT was presented in a group format, but each participant was given an individual answer sheet.

Lastly, all participants were asked to complete a demographics form (Appendix D). Participants in the experimental condition were then told that they would not have to give a speech but that the anticipation of a speech was designed to induce stress. Participants in both groups were fully debriefed and all questions were answered.

### Results

A univariate analysis was conducted to confirm the effectiveness of the stress induction. The analysis showed a significant difference between groups at Time 2 for state anxiety,  $F(1, 30) = 10.012, p < .05$ , indicating that the stress induction was successful.

Data were then analyzed using a linear regression analysis with group (i.e., stress or control), trait mindfulness, and trait anxiety as predictors in the model, and the MLT score (i.e., working memory score) as the dependent measure; no significant relationships were found,  $R^2 = .046, F(3, 28) = .454, p > .05$ .

A *t*-test examined the difference between groups on working memory scores, and, again, while a significant difference was not found between the control group ( $M = 23.21; SD = 2.69$ ) and the stress group ( $M = 22.22; SD = 2.82$ ),  $t(30) = -.450, p > .05$ . Interestingly, a significant negative correlation between trait mindfulness and trait anxiety ( $r = -.627$ ) was found, indicating that high trait mindfulness was related to low

levels of trait anxiety. This relationship was not predicted in the present study but it is certainly worthy of future investigation.

### **Discussion**

The effect of mindfulness on executive functioning is an important area of research with many practical applications. Proficiency in executive functioning, specifically working memory, is a desired skill in most careers and any activity that could improve these cognitive processes deserves substantial research attention. While a significant effect of trait mindfulness on working memory was not found in this study, the trend of the data suggest that a significant relationship could be uncovered if adequate power was achieved. In the present study, logistical issues significantly impacted data collection and only a quarter of the desired participants were assessed. In addition, while Schoofs et al. (2008) recommended a working memory test similar to the *n*-back for testing the relationship between stress and working memory, the results of this study indicate that this working memory task may not have been challenging enough. Future research should consider using an incredibly tasking working memory task like OSPAN.

However, if a significant effect of trait mindfulness is still not found, further research should investigate the relationship between state mindfulness (i.e., meditation) on executive functioning. While Baer et al. (2004) believe that mindfulness is a trait inherent in all human beings and is demonstrated in everyday life activities, Brown and Ryan (2003) suggested that mindfulness is a skill that needs to be cultivated through the act of seated meditation. This debate should be explored further to determine if mindfulness is in fact a state of being versus a personality trait. If it is believed that mindfulness is a state that needs to be cultivated, this line of research could be used to

persuade educators to incorporate meditation into primary school curriculums in an effort to help children foster this important skill. In addition, research indicating a positive effect of meditation on executive functioning could motivate employers to offer mindfulness training free of charge during lunch hour in an effort to create more efficient employees.

The significant correlation between mindfulness and anxiety could have important implications for mental health research. Since mindfulness is described as focusing on the present moment and anxiety is described as worrying about the past or fearing the future, it may be that human beings do not have enough cognitive resources to maintain both states of mind concurrently. Therefore, if you are in the present moment, you may not be able to devote resources to worrying about the past. Future research in this area should investigate if meditation training teaches individuals to replace anxiety with mindfulness, allowing for an improvement in mental health symptoms.

Lastly, the success of the stress induction is noteworthy; this is the first study to date to demonstrate that the anticipation of giving a speech was sufficient to induce stress in a group setting. While the anticipation of giving a speech in the TSST has been shown to effectively generate stress (Starcke et al., 2008) and the TSST has been validated for group administration (Von Dawans et al., 2010), this researcher is unaware of any previous research that has incorporated these two methods. The TSST is a well-respected method of inducing socio-evaluative stress in psychological research, however, it has been criticized for being lengthy and inefficient when a large sample is needed in a study. The ability to conduct this modification in a group setting would negate these issues,

therefore, it is recommended that future research specifically tests the reliability and validity of the modified TSST in a group setting among different sample populations.

Appendix A



**APPROVAL NUMBER: 13-A038**

To: Allison Kinter  
8000 York Road  
Towson MD 21252

From: Institutional Review Board for the Protection of Human  
Subjects, Patricia Alt, Member *ALT*

Date: Thursday, February 21, 2013

RE: Application for Approval of Research Involving the Use of  
Human Participants



Office of University  
Research Services

Towson University  
8000 York Road  
Towson, MD 21252-0001

t. 410 704-2236  
f. 410 704-4494

Thank you for submitting an Application for Approval of Research  
Involving the Use of Human Participants to the Institutional Review Board  
for the Protection of Human Participants (IRB) at Towson University.  
The IRB hereby approves your proposal titled:

*Does Mindfulness Mitigate the Negative Effect of Stress on Working  
Memory?*

If you should encounter any new risks, reactions, or injuries while  
conducting your research, please notify the IRB. Should your research  
extend beyond one year in duration, or should there be substantive changes  
in your research protocol, you will need to submit another application for  
approval at that time.

We wish you every success in your research project. If you have any  
questions, please call me at (410) 704-2236.

CC: E. Wheeler  
File



Date: Thursday, February 21, 2013

**NOTICE OF APPROVAL**

**TO:** Allison Kinter **DEPT:** PSYC

**PROJECT TITLE:** *Does Mindfulness Mitigate the Negative Effect of Stress on Working Memory?*

**SPONSORING AGENCY:**

**APPROVAL NUMBER:** 13-A038

The Institutional Review Board for the Protection of Human Participants has approved the project described above. Approval was based on the descriptive material and procedures you submitted for review. Should any changes be made in your procedures, or if you should encounter any new risks, reactions, injuries, or deaths of persons as participants, you must notify the Board.

A consent form: [] is [] is not required of each participant

Assent: [] is [] is not required of each participant

This protocol was first approved on: 21-Feb-2013

This research will be reviewed every year from the date of first approval.

*Patricia Alt AVP for Research*

Patricia Alt, Member

Towson University Institutional Review Board

## Appendix B

**Informed Consent**

**Principal Investigator:** Allison Kinter, Department of Psychology, Towson University

This is a study on awareness and cognition. You will be asked to complete a task involving words and to complete a few surveys.

There are minimal known risks associated with participation in this study, however, should you become upset, you may end your participation in this study at any time. You will receive 1 credit on the research pool for participating. This study should take no longer than one hour to complete.

Participants must be at least 18 years old.

Your participation is entirely voluntary. You do not have to participate in this study, and, if you choose to participate, you may discontinue your participation at any time.

If you have any questions, please ask them now. If you should have questions after today, you can call 856-904-7643 and ask for Allison Kinter, or call (410) 704-2236 and ask for Dr. Deborah Gartland, Chairperson of the Institutional Review Board for the Protection of Human Participants at Towson University.

I, \_\_\_\_\_ affirm that I have read and understand the above statements and have had all of my questions answered.

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

THIS PROJECT HAS BEEN REVIEWED BY THE INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN PARTICIPANTS AT TOWSON UNIVERSITY.

## Appendix C

**Math Problems**

1) 
$$\begin{array}{r} 3498 \\ \times 76 \\ \hline \end{array}$$

9) 
$$\begin{array}{r} 63128 \\ \times 507 \\ \hline \end{array}$$

2) 
$$\begin{array}{r} 45765 \\ \times 143 \\ \hline \end{array}$$

10) 
$$\begin{array}{r} 719456 \\ \times 666 \\ \hline \end{array}$$

3) 
$$\begin{array}{r} 37081 \\ \times 567 \\ \hline \end{array}$$

11) 
$$\begin{array}{r} 45097 \\ \times 478 \\ \hline \end{array}$$

4) 
$$\begin{array}{r} 76047 \\ \times 745 \\ \hline \end{array}$$

12) 
$$\begin{array}{r} 1733 \\ \times 56 \\ \hline \end{array}$$

5) 
$$\begin{array}{r} 454589 \\ \times 56 \\ \hline \end{array}$$

13) 
$$\begin{array}{r} 56901 \\ \times 92 \\ \hline \end{array}$$

6) 
$$\begin{array}{r} 29487 \\ \times 609 \\ \hline \end{array}$$

14) 
$$\begin{array}{r} 7345 \\ \times 897 \\ \hline \end{array}$$

7) 
$$\begin{array}{r} 3056 \\ \times 79 \\ \hline \end{array}$$

15) 
$$\begin{array}{r} 56439 \\ \times 67 \\ \hline \end{array}$$

8) 
$$\begin{array}{r} 76598 \\ \times 407 \\ \hline \end{array}$$

Appendix D

**Demographics**

**Participant #**

Please answer the following questions.

Gender: \_\_\_\_\_ Age: \_\_\_\_\_ Ethnicity:  
 \_\_\_\_\_

Is English your first language? \_\_\_\_\_ If not, what is your first  
 language? \_\_\_\_\_ How long have you been speaking English?  
 \_\_\_\_\_

Have you ever been diagnosed with any of the following by a professional? Answer YES  
 or NO and please share details if you wish next to each condition.

\_\_\_\_\_ Color Blindness \_\_\_\_\_ Major Mental Health Disorder  
 \_\_\_\_\_ Traumatic Brain Injury \_\_\_\_\_ Neurological Disorder

Do you do yoga? \_\_\_\_\_ If so, how long have you been practicing?  
 \_\_\_\_\_

How many times per week/month do you practice? \_\_\_\_\_ Is there a specific  
 style of yoga you practice? \_\_\_\_\_

Do you practice mediation? \_\_\_\_\_ If so, how long have you been practicing?  
 \_\_\_\_\_ How many times per week/month do you practice? \_\_\_\_\_

Is there a specific style of meditation you practice? \_\_\_\_\_

On a scale of 1 to 5, **with 5 being the most stressful**, how stressful did you find the idea  
 of making the speech?  
 \_\_\_\_\_

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**Curriculum Vita**

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M.A. in Experimental Psychology, May 2013 (Pending)

**Lehigh University**, Bethlehem, Pennsylvania

B.A. with Honors in Psychology, May 2003

Research Experience

**Aerotek, Inc.**, Aberdeen, MD

*Industrial Psychology Consultant*, 2010-2011

Conducted qualification testing of airport security screening technologies and administered training to airport security screeners following the Transportation Security Administration (TSA) protocol at Aberdeen Proving Grounds and airports nationwide

**Johns Hopkins University**, Baltimore, MD

*Research Interventionist*, 2007-2008

Recruited 150 participants for a study on the effect of exercise on mental health via phone and community based surveys; facilitated group interventions, conducted daily observational assessments, and adhered to appropriate research protocols to maintain a confidential database

**Battelle Memorial Institute**, Aberdeen, MD, and Egg Harbor Township, NJ

*Industrial Psychology Research Associate*, 2004-2006

Developed training packages for airport security screeners and conducted field projects to identify environmental deterrents and job stressors in compliance with the Transportation Security Administration (TSA) protocol at Aberdeen Proving Grounds, the Transportation Security Laboratory, and airports nationwide

Publications and Presentations

“The Effect of Stress and Coping Strategies on Executive Function” (with Jessica Kegel). Presented at the Towson University Research Expo in April 2013.

“Positive Emotion Rehabilitates a Ruined Working Memory” (with Dr. Evangeline Wheeler). Pending submission to the American Psychological Association conference in May 2013.

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Additional Professional Experience**Bikram Yoga Baltimore**, Baltimore, MD

*Certified Bikram Yoga Teacher and Studio Manager*, 2008-Present

- Five years experience teaching yoga; classes ranging in size from 30-60 students of varying skill level
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**Colonial Academic Alliance**, Fairfax, VA

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- Taught two sections to undergraduate students; average class size 35 students
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