The Effects of Mindfulness Training and Cognitive Attention Training on Mindfulness, Working Memory Capacity, and Affect in Middle School Students

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Abstract

Working memory capacity has been shown to be closely related to cognitive and emotional wellbeing (de Abreu, Conway, & Gathercole, 2010; Unswork, Heitz, & Engle, 2005). Further, poor working memory is associated with a variety of cognitive and emotional deficits among adolescents, including poor mathematical performance, poor reading comprehension, and increased rates of depressive symptoms (Swanson, 2011; Daneman & Carpenter, 1980; Jha, Stanley, Kiyongaga, Wong, & Gelfand, 2010). Both mindfulness training (Jha et al., 2010) and cognitive attention training (Holmes et al., 2010) have been linked, in recent psychological research, to positive impacts on working memory capacity. The current study, using mindfulness training and cognition training strategies, investigates the impact of these techniques on mindfulness, working memory capacity, and affect in middle school students. No evidence was found that either training strategy improves working memory capacity, mindfulness, or affective experience. It is possible that incorrect measurement tools were used to assess the various constructs under examination with this particular population. The results suggest middle school age students may best be assessed individually using task-related methods as opposed to self-report inventories delivered in a group setting. These conclusions point to the need for further research to identify whether measurement manipulation has an impact on measurable outcomes.

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Working Memory

In general, working memory (WM) can effectively be categorized as executive attention skills (Baddeley, 2003). More specifically, working memory capacity (WMC) has been related to many skills necessary in the learning process including following directions, reasoning ability, and reading comprehension (Engle, Carullo, & Collins, 1991; Daneman, & Carpenter, 1980). While high WMC has many positive implications for learners, low WMC has been connected to numerous cognitive and emotional deficits that can negatively impact learning. Low WMC has been shown to inhibit an individual's ability to selectively attend to relevant task-related information in the environment and to deficits in learning and attentional abilities, as well as heightened negative emotional affect (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Baddeley, 2003). With the numerous positive implications of high WMC and the negative implications of low WMC, it is important to investigate strategies that can enhance the high-order cognitive skill of WM. Strategies that have been linked to improvements in working memory, and which are specifically addressed in the current study, include mindfulness training and cognition training. The current study aims to investigate the usefulness of these particular strategies in improving WMC as a tool for increasing the learner experience among middle school students.

Mindfulness

A commonly referenced conceptualization of mindfulness training in the field of psychological science comes from Bishop et al. (2004). Bishop et al. (2004) describe

mindfulness techniques as approaches meant to increase awareness and skillful responding to "mental processes that contribute to emotional distress and maladaptive behavior" (p. 230). Mindfulness is further defined as a two-component system, consisting of self-regulation of attention and non-elaborative awareness of immediate perceptual experience. In attempting to further concretize the working definition of mindfulness, Williams (2010) elaborates that mindfulness techniques are not about attaining the cessation of normal cognitive processes (a common misconception of mindfulness practices), but instead as techniques meant to allow an individual to more clearly identify errors in cognition. The errors typically unnoticed occur between natural, automatic reactions to experience and simulation/elaboration and avoidance processes of those same experiences. Simulation and elaboration errors are when an individual responds to an experience, thought, or emotion in a way that is beyond the scope of the facts available. For example, an individual calls a friend and asks them to go to the movies. The friend replies hurriedly that they cannot go to the movies and must get off the phone immediately, with a quick goodbye they hang up. An elaboration would be for the caller to assume that the person was unable to talk or go to the movies for reasons they have no actual evidence for, such as the friend being mad at them. An error in cognition happens not when the individual experiences the elaborative thinking but when they react to the elaboration as if it is fact.

Benefits of Mindfulness Training

As indicated above, research suggests that mindfulness may be important to emotional and cognitive functioning for a variety of reasons (Holzel, Lazar, Gard, Schuman-Olivier, Vago, & Ott, 2011b). Mindfulness training has been connected to decreases in stress, anxiety, and

depressive symptoms (Williams, 2010; Holzel et al., 2011b; Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). These training strategies have also been shown to increase learning and memory (Chiesa, Calati, & Serretti, 2011; Kee & Liu, 2011), and, more specifically, heighten WMC (Jha et al., 2010). Evidence for these benefits comes from experimental and neurological research (Holzel, Carmody, Vangel, Congleton, Yerramsetti, Gard, & Lazar, 2011a). Recent research looking at changes in grey matter density after participation in an 8-week mindfulness training course demonstrated significant increases in "brain regions associated with learning and memory, emotional regulation, self referential processing, and perspective taking" (Holzel et al., 2011a, p. 36).

Mechanisms of Mindfulness

The current research on mindfulness training is enticing as a potential strategy for increasing WMC. In a recent literature review on mindfulness, Holzel et al. (2011b) proposed the working mechanisms of mindfulness strategies. The mechanisms identified are: attention regulation; body awareness; emotional regulation, and change in perspective of self. These facts present a potential overlap between executive processes described by the construct of working memory and the operating mechanisms theorized to be working in mindfulness training. When deficiencies exist within any one of these four mechanisms, a host of negative affects have been implicated, including depressive symptoms, decreases in positive view of self, and decreases in cognitive and emotional control. This overlap is of particular interest to the author of the current study, specifically how this could be translated to learning environments. Is it possible that WMC can be improved at the same time as emotional functioning and all a student has to do is nothing? Can sitting still, eyes closed, attention focused on the breath, do more for cognition and

emotions than years of rote memorization and recitation in educational institutions? Certainly, it can be inferred that increasing the efficient functioning of even one of the related mechanisms evidenced in mindfulness research may have strong associations with the improvement of cognitive and emotional functioning.

Evidence for the Influence of Mindfulness Techniques on WMC

The inference referenced above is supported by recent research looking at the link between working memory and mindfulness training (van Vugt & Jha, 2011; Buttle, 2011; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). Recently, a study looking at protecting working memory capacity in pre-deployment military professionals showed a significant positive relationship between mindfulness training and WMC (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). Jha (2010), conducted an experimental study where pre-deployment military professionals participated in one of two conditions, either mindfulness training or a control condition where no protective procedures were introduced. Both groups involved were undergoing the high stress of the pre-deployment interval, an event considered traumatic and connected to decreases in working memory capacity.

According to Jha (2010), when working memory is degraded following a traumatic event, the likelihood of developing Post Traumatic Stress Disorder (PTSD) and other psychological impairments increases. It was demonstrated that, for these specific populations, participation in a mindfulness program and practice time of mindfulness techniques were positively correlated with increases in working memory capacity. This study further showed mindfulness training to be related to gains in positive psychological affect and decreases in negative psychological affect.

Purpose of the Current Study

The implications of Jha's (2010) research are exciting. While it can be argued that military professionals are a unique population, stress and chaos are not unique experiences. One such time in a typical American's lifespan that can be particularly stressful is during the ages of 12-14, when a young person is attending middle school. For these reasons the aim of the current study is to investigate whether mindfulness training can affect working memory capacity when delivered to a population of middle school students in an educational setting.

Notwithstanding the recent findings regarding the effect of mindfulness training on cognition (Chiesa, Calati, & Serretti, 2011; Holzel, Carmody, Vangel, Congleton, Yerramsetti, Gard, Lazar, 2011a; Holzel, Lazar, Gard, Schuman-Olivier, Vago, & Ott, 2011b; Kee & Liu, 2011), not much research is available looking at the effects of mindfulness training on the cold cognitive processes as a tool to increase learning. Cold cognitions are cognitive skills unrelated to emotions such as working memory (Williams, 2010). Similarly, there is sparse information regarding the use of mindfulness training as a protective or preventative tool in relation to cognitive and/or emotional functioning (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010).

In the current study, strategies for increasing cognitive and emotional abilities were tested with middle school students. Alongside WMC, affective experience, and mindfulness were assessed using task and self-report inventories. It is predicted that the use of short duration mindfulness meditation training will increase participant's WMC. As a comparison strategy, generalized attention training, using memory games and tasks that require focused attention, was implemented simultaneously. It is hypothesized that, while both strategies (mindfulness training

and attention training) will increase WMC, participants undergoing mindfulness training will also experience the added benefit of increases in positive affect and decreases in negative affect.

Methods

Participants

The participants in this study were 46 students from two separate middle schools. They were selected and identified with the help of school counselors and administrators. After school officials referred eligible students to the study the students and their parents were given the option to participate voluntarily. See Table 1 for a site-specific break down of age and gender.

This study was conducted independently with participants at each school. The two schools were Chico Junior High School in Chico, California (referred to as Site One) and Bidwell Junior High School in Chico, California (referred to as Site Two). Principals from both schools gave written consent and signed approval from the Chico Unified School District Office authorizing this research was obtained. All interactions with participants took place on school grounds, including pre- and post-assessments as well as all sessions for the specific experimental conditions.

Materials

This study was designed to assess initial working memory functioning and emotional states in a pre-assessment interval. Once assessed, students underwent six weeks of participation in one of the three conditions. At the conclusion of the six weeks, all students were assessed again to identify if any changes had taken place. To assess cognitive and emotional functioning, a battery of working memory span tasks and self report inventories were used.

Memory span is defined as the largest amount of accurately recalled sequential information an individual can recount in a specified time interval (Gathercole, & Pickering., 1999). Working memory span is the amount of sequential information that can be recalled in a specific time interval while processing other material (Dehn, 2008). Working memory span measures are also referred to as complex span tasks, whereas simple span tasks, tasks that require the recall of information through passive retention, are typically considered assessments of short term memory (Dehn, 2008).

The assessment battery used for the present study was comprised of two non-standardized assessments of working memory; word span and operation span (OSPAN). Both measures have been frequently administered in psychological research investigating the relationship between working memory, learning, and memory (Daneman & Carpenter, 1980; Engle, 2002). Due to the non-standardization of these tasks, PowerPoint slides were created specific to this study. In the word span task students are asked to look at a series of simple words (one word per slide) and at the completion of each set to write down, in order, the words that were presented. Word sets began at four words per set and progressed to nine. The OSPAN is a similar task with the addition of a simple arithmetic problem introduced between each word. Students are asked to read each word silently without writing the word down until the end of the slide set. When a math problem is presented (between the presentation of each word) the students are asked to solve the math problem as soon as they see it and record the answer on an answer sheet. At the end of each set of slides (words and math problems) students are asked to write down as many of the words as they remember on a separate answer sheet in the order they were presented.

Aside from the span tasks, students were also given two self-report inventories, the Child and Adolescent Mindfulness Measure (CAMM) and Positive and Negative Affect Scale for Children (PANAS-C). The CAMM is a ten-item single factor inventory adapted from three of the four aspects of the Kentucky Inventory of Mindfulness Scale (observing present experience, acting with awareness, accepting without judgment) and was chosen for its reliability and validity (Greco, Baer, & Smith, 2011). The PANAS-C is a modified version of the Positive and Negative Affect Scale for adults (Laurent et al., 1999). This inventory has been normed with students ranging in grade from 4th through 8th as a successful measure of depression and anxiety.

Procedure

At each school site, participants were randomly assigned to one of three conditions: mindfulness training, cognition training, and a control group. The study consisted of 14 sessions. During the first session all participants completed pre-assessment tasks. The following 12 sessions the participants in the two experimental conditions received either mindfulness or cognition training, while the participants in the control group did not receive any interaction. During the final sessions all participants completed post-assessment tasks.

In the pre- and post-assessment sessions, the protocol was identical and consistency in delivery was maintained for Site One and Site Two. Subjects were first assessed on working memory through presentation of word span tasks (three trials) and operation span tasks (two trials) via PowerPoint. The researcher asked students to perform each task silently and to respond using provided answer sheets and writing instruments. Once all span tasks were completed, answer sheets were collected and the two inventories, Child and Adolescent

Mindfulness Measure (CAMM) and Positive and Negative Affect Scale for Children (PANAS-C), were distributed. Subjects were asked to complete these inventories silently and, upon completion, return the inventories to the researcher at the front of the room. At the conclusion of pre-testing, students were given their condition assignments and instructed as to meeting times and places for the two experimental conditions; mindfulness training and cognition training.

Mindfulness training condition. Participants assigned to the mindfulness condition were asked to participate in twelve twenty-minute sessions spanning six weeks, with two sessions per week At the start of each session participants checked in with the group facilitator on a pre-printed roster. Once checked in, students were asked to find a place to sit on the floor in the room. Participants were provided with a mat for their comfort as sessions required they be seated or supine on the floor for the duration of sessions. Once students were seated the facilitator began recording time.

For each twenty-minute session, seventeen minutes were spent actively engaged in specific mindfulness tasks. The remaining three minutes of each session were allotted for questions and answers and regrouping for a return to scheduled school activities. At the twenty-minute mark students were excused to return to their routine. The initial session consisted of an introduction to the tasks and brief exposure to the various techniques that were to be utilized throughout the program. All remaining sessions had a specific focus, either on breath awareness or body awareness.

In the breath awareness sessions students were asked to pay attention to their breath throughout the duration. Breath practices, where students focused on controlling the depth and

the movement of breath in the body, were used. For example students would be asked to make their inhalation and exhalation equal in length and maintain that equality during the session. There was also a focus on moving the breath in an upward direction from the center of the abdomen to the top of the collar bones, leaving the stomach relaxed. Having participants focus on one specific area or task offered a mental anchor for the mind to grasp while being trained in sustained focus and attention.

In the body awareness sessions participants were instructed to pay attention to specific areas of the body and maintain focus on those areas. As an example, students were asked to feel their toes, concentrate on their toes and feel each toe with their mind. Time would be spent focusing on the toes, and then the focal point would move in an upward direction, next to the whole foot, and so on. In both types of sessions, participants were instructed to attempt to maintain focus throughout the practice, but that if their mind did wander, to acknowledge that wandering had occurred and bring their attention back to the task at hand without judgement. For additional details regarding the specific breakdown of sessions, please contact the first author.

Cognition training condition. The cognition training condition sessions took place twice a week over the course of six weeks. Each session lasted exactly twenty minutes; time was kept by the researcher on a stopwatch. Participants were checked in on a roster at the start of each session. Once checked in students were asked to find a desk and be seated quietly until the session began. Once all participants were checked in the researcher initiated the session timer. At twenty minutes, subjects were released back to their normal routine. Seventeen minutes of

each session were spent performing specific tasks, leaving a three-minute closing period for questions and answers, regrouping, and preparation for a return to scheduled activities.

Each cognition training session focused on one of three specific cognitive skills; attention, memory, or logic. The initial session consisted of an introduction to each of these target skills and students were instructed in what tasks they would be asked to practice during the various sessions. Students then had the opportunity in the first session to try sample tasks for each target skill. Remaining sessions rotated through the three skills. The second session focused on attention, the third on memory, and the fourth on logic, after which the rotation started again. During each session appropriate tasks were assigned**,** tasks included games and puzzles meant to address each of the specific skills.

During the attention sessions, students were given count-the-dot and word search puzzles. Participants were asked to accurately complete as many puzzles as possible in the session time allotted, choosing for themselves which puzzles (count-the-dot or word search) they would most like to work on during each session. Count-the-dot puzzles are groups of shapes with dots of varying amounts covering the entire page. For these puzzles, instructions were to keep a mental count of the dots and then write the final total on a sheet of paper to be checked against the answer key provided by the researcher (See Figure 1 for an example of a Count-the-Dots puzzle).

In the memory sessions students partnered with another student to play the game Memory using a single deck of playing cards. Participants were asked to play as many games as they could fit into each session, an emphasis was placed on trying to go as fast as they could to complete the games.

For the logic sessions students were given two tasks; labyrinth mazes and sudoku puzzles (See Figure 2 for an example of a labyrinth maze). Students were instructed to select one type of puzzle to work on for the first half of the session and then switch to the other for the remaining time. Students were instructed to complete as many games as possible during each session and were told that their progress was recorded and would be analyzed for any improvement.

Results

To analyze the data, the data was first split by school site and then individual site analyses were performed. The five outcome variables under examination for each site were: word span task, operation span task (OSPAN), PANAS positive score, PANAS negative score, and the Child and Adolescent Mindfulness Measure (see Table 2 and 3 for site specific descriptives). Separate ANCOVA analyses were conducted for each of the five dependent variables. In each case, post-test scores were used as the dependent variable, condition assignments (mindfulness, cognition, control) as the factor, and pretest scores as covariate.

No significant differences between conditions were found for any of the dependent variables. The results from these analyses are summarized in Table 4.

Discussion

The purpose of the present study was to investigate the impact of mindfulness training with two groups of middle school students. Specifically, working memory capacity, positive and negative affect, and trait mindfulness were measured. For a comparison, cognition training was used alongside mindfulness training. It was hypothesized that while cognition training and mindfulness training would have similar impacts on improving working memory capacity,

mindfulness would have the added benefit of increases in positive affect, decreases in negative affect, and increases in trait mindfulness.

To examine this hypothesis, middle school students from two separate sites were randomly assigned to either a control group or one of two interventions: mindfulness training or cognition training. Participants were assessed in a pre and post-testing procedure using a battery of measures. In addition to assessments of working memory capacity, two self-report inventories were used to assess emotional affect. The Positive and Negative Affect Scale for Children (PANAS - C) was used to assess emotional affect and the Child and Adolescent Mindfulness Measure (CAMM) was used to identify trait mindfulness.

Working memory capacity, the ability to avoid distractions while maintaining relevant current stimuli in mind for a brief period, can be categorized as an executive cognitive function (Baddeley, 2003; Daneman & Carpenter, 1980). In general, high working memory capacity has been related to both cognitive and emotional functioning, such as intelligence and affect (de Abreu, Conway, & Gathercole, 2010; Unsworth, Heitz, & Engle, 2005). More specifically, individuals with high working memory capacity appear to have greater cognitive skills such as reading comprehension and mathematical ability as well as lower instances of anxiety and depression (Swanson, 2011; Engle, Carullo, & Collins, 1991). In fact, low working memory capacity has been connected not just to poor cognitive functioning in the areas described previously, but also to potential vulnerability for individuals to develop emotional disorders such as Post Traumatic Stress Syndrome during periods of intense stress (Jha, Stanley, Kiyonaga, Wong, & Gelfand,2010). After introducing an eight-week mindfulness training program it was

shown that, in fact, for the group of participants in the mindfulness condition, working memory capacity improved, but also that positive affect increased and negative affect decreased.

As a result of these findings and others connecting heightened working memory capacity to mindfulness training (Buttle, 2011; Chiesa, Calati, & Serretti, 2011; Kee & Liu, 2011), the question arose, could these benefits be received by different populations undergoing times of extreme stress, as in the middle school period. It was also of interest whether the reported numerous benefits of mindfulness training (Holzel, Lazar, Gard, Schuman-Olivier, Vago, & Ott, 2011b) were specific to this type of training. Is it possible that other strategies to improve working memory capacity and executive functions, such as cognition training, could have similar benefits?

After implementing six weeks of mindfulness training and cognition training with two groups of middle school students, no significant changes were found. None of the five outcome variables (word span, OSPAN, positive affect, negative affect, and mindfulness) showed evidence of significant change between pre- and post-test scores, regardless of condition. While non-significant results could mean that a relationship between the training strategies and the outcome variables does not exist, it seems unlikely with the existing amount of research positing otherwise (Buttle, 2011; Chiesa, Calati, & Serretti, 2011; Holzel et al., 2011b). Instead, it is conjectured that the study design was flawed. It is believed by the current author that the most salient flaw of the present study lies in the measures selected for assessment. Additionally, non-significant results could be a product of a short duration of both program and session implementation.

While all assessments have been used in previous research (Daneman & Carpenter, 1980; Greco, Baer, & Smith, 2011; Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Laurent et al., 1999), for the present study they appeared to be either incorrect in form or delivery for the population under examination. The working memory capacity assessments were delivered in a group setting with as many as 40 participants at a time. It is believed that due to the age and maturity level of this population, assessing them in a group setting invited a host of confounds. During test-time students purposefully did not pay attention to or focus on the task at hand. With so many students at one time to present the task to, it was difficult for the researcher to sufficiently direct all participants' attention appropriately. Participants were also found copying answers from their peers' answer sheets, which makes results unsuitable for a proper assessment of each individual's working memory. For future research it would be of interest to see if testing students independently would have a beneficial effect on the results.

The other two assessments, PANAS-C and CAMM, were similarly delivered in a group setting. From informal observation it appeared students feared peer-judgment based on their answers. During assessment students were inspecting, critiquing or copying their peers' answers. This caused obvious stress, which was possibly reflected in the results. Due to the sensitive information of the PANAS-C, it is thought that this assessment would be best delivered individually. In addition, pre-test response sheets were rife with answers that did not appear to accurately represent the students' actual behaviors and feelings but instead were attempts to be "funny" or "cool". Due to this experience, the author believes a more effective method of assessment for all outcome variables would have been through task-related activities instead of self-report surveys. It is also believed that individual assessments would be more effective than

group testing. Possibly eliminating peer influence or interference would result in students feeling comfortable giving accurate information about their internal lives.

A final potential flaw in the study design was the duration of sessions and program delivery. Many mindfulness studies use an eight week delivery model where participants take part in sessions lasting as long as 45 minutes, five days a week (Teleki, 2010). Often these models also have homework for participants in addition to the time spent in the program. This is a considerably longer amount of time spent in active mindfulness practices than for the present study. This eight-week model has been frequently used with adult populations in therapeutic settings. For the present study, the model was not therapeutic but instead an attempt to identify strategies that may be useful in academic settings for support of cognitive and emotional functioning. Given the time constraints in schools, it is difficult to imagine a scenario where the often-used therapeutic mindfulness models would work. While the present study was short in program length, it was a model that easily fit into a school schedule. It is therefore advisable to first address assessment procedures and tools before eliminating programming based on length.

Future research should aim to identify effective measurement tools and procedures for middle school populations as well as effective minimum time commitments needed for program delivery. There is no question that if the numerous benefits of mindfulness technique found in other studies could be translated to this unique population, students, teachers, and administrators could benefit tremendously. This line of research should be exhausted completely before being cast aside as irrelevant. With the current climate of educational institutions in constant flux to discern ways to best serve students' needs in both academic and emotional ways, identifying scientifically tested, effective strategies is extremely important. Mindfulness techniques could

potentially offer a simple method to support students' development, but first rigorous research must identify the most appropriate method of delivery.

References

Baddeley, A. (2003). Working memory and language: an overview. *Journal Of Communication Disorders, 36*(3), 189.

Bishop, S.R., Lau, M., Shapiro, S., Carlson, L., Anderson, N.D., Carmody, J., ...& Devins, G. (2004). Mindfulness: A Proposed Operational Definition. *Clinical Psychology: Science and Practice, V11* (N3), 230-241.

Buttle, H. (2011). Attention and working memory in mindfulness-meditation practices. *Journal Of Mind And Behavior, 32*(2), 123-134.

Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review, 31*(3), 449-464. doi:10.1016/j.cpr.2010.11.003

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal Of Verbal Learning & Verbal Behavior, 19*(4), 450-466. doi:10.1016/S0022-5371(80)90312-6

de Abreu, P., Conway, A. A., & Gathercole, S. E. (2010). Working memory and fluid intelligence in young children. *Intelligence, 38*(6), 552-561. doi:10.1016/j.intell.2010.07.003

Dehn, M. J. (2008). *Working Memory and Academic Learning: Assessment and Intervention.* Hoboken, New Jersey. John Wiley & Sons, Inc.

Engle, R. W., Carullo, J. J., & Collins, K. W. (1991). Individual differences in working memory for comprehension and following directions. *The Journal Of Educational Research, 84*(5), 253-262.

Gathercole, S. E., & Pickering, S. J. (1999). Estimating the capacity of phonological short-term memory. *International Journal Of Psychology*, *34*(5-6), 378-382. doi: 10.1080/002075999399729

Greco, L. A., Baer, R. A., & Smith, G. T. (2011). Assessing mindfulness in children and adolescents: Development and validation of the Child and Adolescent Mindfulness Measure (CAMM). *Psychological Assessment, 23*(3), 606-614. doi:10.1037/a0022819

Holmes, J., Gathercole, S. E., Place, M., Dunning, D. L., Hilton, K. A., & Elliott, J. G. (2010). Working memory deficits can be overcome: Impacts of training and medication on working memory in children with ADHD. *Applied Cognitive Psychology, 24*(6), 827-836. doi: 10.1002/acp.1589

Holzel, B.K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S.M., Gard, T., Lazar, S.W. (2011-a). Mindfulness Practice Leads to Increases in Regional Brain Gray Matter Density. *Psychiatry Research: Neuroimaging, V191*(1), 36-43.

Holzel, B.K., Lazar, S.W., Gard, T., Schuman-Olivier, Z., Vago, D.R., & Ott, U. (2011-b). How Does Mindfulness Meditation Work? Proposing Mechanisms of Action From a Conceptual and Neural Perspective. *Perspectives on Psychological Science, V6*(6), 537-559.

Jha, A. P., Stanley, E. A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the protective effects of mindfulness training on working memory capacity and affective experience. *Emotion, 10*(1), 54-64. doi:10.1037/a0018438

Kee, Y., & Liu, Y. (2011). Effects of dispositional mindfulness on the self-controlled learning of a novel motor task. *Learning And Individual Differences, 21*(4), 468-471. doi:10.1016/ j.lindif.2011.01.009

Laurent, J., Catanzaro, S. J., Joiner, T. r., Rudolph, K. D., Potter, K. I., Lambert, S., ... Gathright, T. (1999). A measure of positive and negative affect for children: Scale development and preliminary validation. *Psychological Assessment, 11*(3), 326-338. doi: 10.1037/1040-3590.11.3.326

Mrazek, M. D., Franklin, M. S., Phillips, D., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science, 24*(5), 776-781. doi:10.1177/0956797612459659

Phillips, D. (2009). *The Zen of the Labyrinth: Mazes for the Connoisseur.* New York, NY. Sterling Publishing Co., Inc.

Teleki, J. (2010). Mindfulness-based stress reduction: A meta-analysis of psychological outcomes. *Dissertation Abstracts International*, *71*, incomplete…

Swanson, H. (2011). Working memory, attention, and mathematical problem solving: A longitudinal study of elementary school children. *Journal Of Educational Psychology, 103*(4), 821-837. doi:10.1037/a0025114

Unsworth, N., Heitz, R. P., & Engle, R. W. (2005). Working Memory Capacity in Hot and Cold Cognition. In R. W. Engle, G. Sedek, U. von Hecker, D. N. McIntosh (Eds.), *Cognitive limitations in aging and psychopathology* (pp. 19-43). New York, NY US: Cambridge University Press. doi:10.1017/CBO9780511720413.003

van Vugt, M. K., & Jha, A. P. (2011). Investigating the impact of mindfulness meditation training on working memory: A mathematical modeling approach. *Cognitive, Affective & Behavioral Neuroscience, 11*(3), 344-353. doi:10.3758/s13415-011-0048-8

Williams, J. G. (2010). Mindfulness and psychological process. *Emotion, 10*(1), 1-7. doi: 10.1037/a0018360

Tables

Table 1

Site-Specific Participant Demographics

Age	12		13		14		
Gender	M	F	M	F	M	F	Total n
Site One	6	12	1	11	2	2	34
Site Two	2	5	3	2	0	0	12

Table 2

Site One Condition Specific Descriptives for the Five Outcome Variables

		Pre		Post	
Condition	Variable	M	SD	M	SD
Mindfulness	Word Span	4.28	1.58	4.05	1.01
	Operation Span	3.13	1.81	1.71	1.82
	PANAS Positive	35.91	13.44	42.50	8.07
	PANAS Negative	27.00	11.79	23.83	8.91
	Mindfulness	26.25	11.26	30.16	10.36
Cognition	Word Span	4.67	1.01	3.67	0.59
	Operation Span	3.95	1.94	2.00	2.00
	PANAS Positive	41.60	12.02	39.57	11.82
	PANAS Negative	25.70	12.95	29.57	14.60
	Mindfulness	29.00	9.55	30.00	9.05
Control	Word Span	4.27	1.68	3.69	1.54
	Operation Span	2.41	1.41	1.36	1.95
	PANAS Positive	35.45	14.74	34.72	10.17
	PANAS Negative	21.72	10.11	25.72	10.83
	Mindfulness	29.63	11.80	30.80	9.41

Table 3

Site Two Condition Specific Descriptives for the Five Outcome Variables

		Pre		Post	
Condition	Variable	M	SD	M	SD
Mindfulness	Word Span	4.08	0.87	4.08	0.79
	Operation Span	4.00	3.65	3.25	2.59
	PANAS Positive	42.75	5.12	46.50	10.08
	PANAS Negative	32.75	16.46	32.25	14.17
	Mindfulness	27.25	7.58	29.50	6.07
Cognition	Word Span	4.25	0.87	5.00	0.47
	Operation Span	2.00	1.47	2.75	0.35
	PANAS Positive	45.00	3.36	45.50	0.71
	PANAS Negative	28.50	12.58	31.50	21.92
	Mindfulness	34.00	8.44	39.00	12.72
Control	Word Span	4.21	0.56	4.16	1.65
	Operation Span	2.62	1.88	3.75	0.35
	PANAS Positive	43.25	6.60	47.50	0.70
	PANAS Negative	24.25	4.35	29.50	9.19
	Mindfulness	32.25	9.25	34.00	5.66

Table 4

Site-Specific Inferential Statistics

Site	Variable	Results
One	Word span task	$F(2,22)=.76$, $MS=.84$, $p=.48$
	Operation span task	$F(2,22)=.04$, $MS=.15$, $p=.96$
	PANAS positive	$F(2,19)=.2.03$, $MS=197.05$, $p=.16$
	PANAS negative	$F(2,19)=.04$, $MS=3.55$, $p=.96$
	CAMM	$F(2,21)=.04$, $MS=3.62$, $p=.96$
Two	Word span task	$F(2,4)=.38$, $MS=.17$, $p=.71$
	Operation span task	$F(2,4)=.20$, $MS=.80$, $p=.83$
	PANAS positive	$F(2,4)=.01$, $MS=.91$, $p=.99$
	PANAS negative	$F(2,4)=.17$, $MS=12.06$, $p=.85$
	CAMM	$F(2,4)=.66$, $MS=24.43$, $p=.56$

Figures

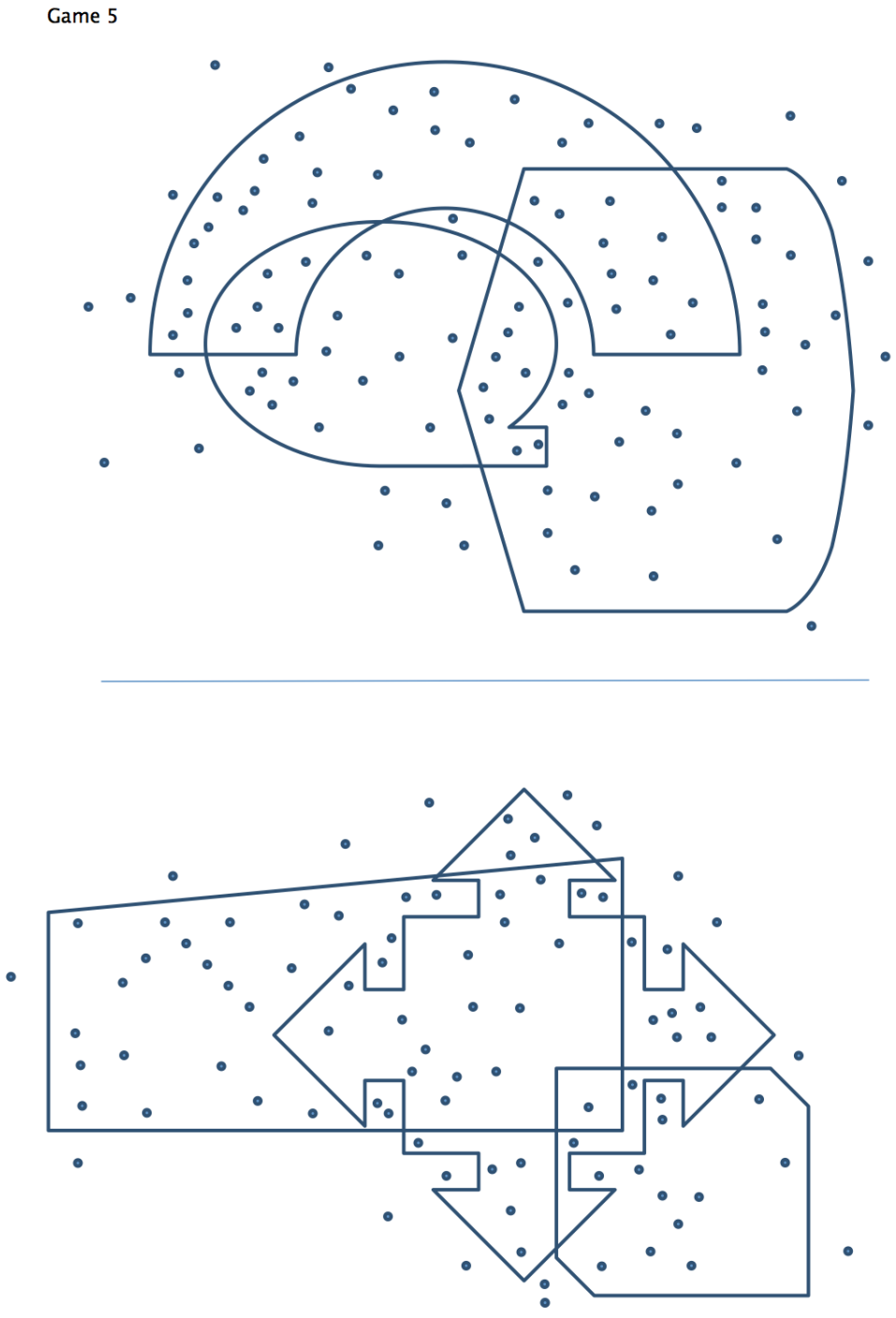
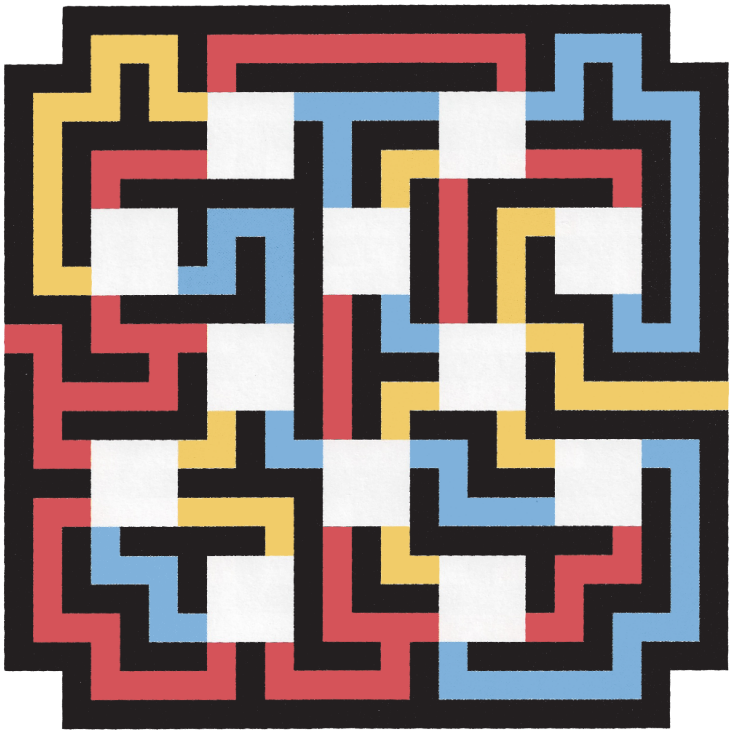


Figure 1. Count-the-Dots puzzle used in cognition training condition during attention themed sessions.



GOAL: Enter from the bottom; exit by the top.

RULES: You may retrace your path. Follow paths in the order red, blue, yellow.

Figure 2. Labyrinth maze used in cognition training condition during logic themed sessions (Phillips, D., 2009).