Inspiration from Meditation: Investigating the Relationship between Mindfulness and Creativity

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Abstract

The purpose of the present study was to investigate the potential relationship between mindfulness and creativity. The authors hypothesized that mindfulness would lead to a greater capacity for both convergent and divergent creative thinking (as measured by insight problem solving ability and unusual use tasks, respectively), and that this effect would be mediated by the reduction of stress and negative affect. Seventy-eight participants were randomized to either a control condition (N = 37) or an experimental condition (N = 41). All participants completed measures assessing chronic stress, state stress, affect, trait mindfulness, and state mindfulness. They then completed two unusual use tasks, after which they spent 12 minutes completing either a control task or following instructions for mindfulness meditation. All participants then completed two more unusual use tasks (one of which they had previously encountered) and a series of five insight problems, completing two more measurements of state stress and state mindfulness, and one additional measurement of affect. The results consistently failed to show any association between mindfulness (state or trait) and creativity (divergent or convergent). Results did show a significant reduction in stress and improvement in state mindfulness for the experimental condition, and a significant correlation between state stress and convergent creativity performance. Further research is needed in order to identify conditions which effectively foster creative thinking, as well as further investigation of the cognitive and emotional benefits of mindfulness training.
Introduction

The capacity for creative thought has enabled human beings to make all modern cultural and technological advancements, from the discovery of fire to the construction of the iPhone. Throughout human history, creativity has furthered the development of science and civilization, but it has now become crucial for the success of the planet, as well as the people who populate it. As Albert Einstein observed, “The significant problems we face cannot be solved at the same level of thinking we were at when we created them” (Kreutzer, 1995, p. 229). Many of the ongoing major problems of today—such as the climate crisis, political gridlock, and an ongoing economic recession—demand creative solutions. Considering its importance for our success and progress as individuals and as a global community, more research is needed on strategies for cultivating creativity.

Previous studies indicate that too much stress and negative emotion can hinder creativity (Byron, Khazanchi, & Nazarian, 2010). Mindfulness training, which clinical psychologists have recently adapted from ancient Buddhist tradition, has been shown to have a broad range of psychological benefits, including stress reduction and improved affect. In addition to helping individuals who suffer from depression and anxiety (e.g., Hofmann, Sawyer, Witt, & Oh, 2010), mindfulness has been studied for its cognitive benefits, including improving creative problem solving (Ostafin & Kassman, 2012). The present study aims to investigate whether mindfulness can enable greater creativity, and to understand the mechanisms underlying this effect. In order to begin to understand this potential link, it is important to review what we mean by “creativity”
and “mindfulness.” I will begin by explaining how creativity is defined in relation to this research.

**Creativity**

What does it mean to be creative? Creativity is often thought to be exclusively in the realm of individuals who are artistically inclined, but it can also refer much more generally to the ability to discover novel connections and insights. For the purpose of the present research, creativity is defined by Franken (1994) as “the tendency to generate or recognize new ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others” (p. 396), and by Gotz (1981) as “the process or activity of deliberately concretizing insight” (p. 300). Creative thinking includes the ability to show mental flexibility, originality, elaboration, abstractness, and resistance to premature closure (Cropley, 2000). According to this definition, creativity, rather than having value merely in terms of the arts, is an asset--if not a necessity--across many different domains and situations. It is this ability to make creative connections and novel associations that has spurred technological innovations and scientific discoveries, in addition to the creation of literature, fine arts, and other cultural expressions. The capacity for creative thinking is critical when it comes to excelling both academically and in today’s competitive job market (Sternberg, 1997). Additionally, creative expression has been linked to improvements in mental health and overall well-being (Schmid, 2005).

Increasingly, employers across industries are searching for creative workers who can generate innovative products, ideas, and approaches to problems. Research has even been conducted specifically looking at the ways in which managers and other leaders can increase the
creativity of their employees by altering their expectations, goals, supervision, evaluation, and social context (Shalley & Gilson, 2004). A more creative workforce would mean more efficient and more effective production, greater technological advances, continued scientific developments, smarter and stronger design, as well as more motivated and fulfilled workers, among numerous other benefits. As Florida states in his 2002 book *The Rise of the Creative Class*, “human creativity is the ultimate economic resource” (p. xiii).

Creativity is generally considered to be a relatively stable trait within individuals. Much of the previous research on the subject has looked at creativity in relation to personality and intelligence. Creative thinking has widely been thought to be intimately related to intelligence; however, several psychological studies have found only a modest relationship between the two (Batey & Furnham, 2008), or no relationship at all (Kim, 2006; Madaus, 1967). Other psychologists have maintained that creativity is associated with various aspects of personality. McCrae (1987) found creativity to be significantly positively associated with openness to experience, but unrelated to neuroticism, extraversion, conscientiousness, or agreeableness. Findings from other studies, which link openness to experience with reduced cognitive inhibition--a precursor for creative thought--shed further light on this relationship (Peterson & Carson, 2000; Peterson, Smith, & Carson, 2002). In their meta-analysis of creativity and personality, Batey and Furnham (2009) reported a consistent and significant predictive relationship between extraversion and creative thinking.

While this research helps us to understand the nature of creativity by suggesting that certain people might be more likely to be highly creative than others, it does little to indicate the ways in which individuals can enhance their own creativity. Although significant research exists
on the personality correlates of creativity, there is a lack of research on conditions or behaviors that improve creativity (an April 2013 PsycINFO search for “improve creativity,” “elicit creativity,” “increase creativity,” or “foster creativity” yielded no relevant titles of peer reviewed scholarly articles). As creativity is so beneficial to individuals as well as to society as a whole, it would be highly valuable to discover and implement strategies for its optimization. Creative though requires the use of two different thought processes: divergent and convergent thinking.

Divergent creativity.

Divergent creativity refers to the cognitive process of generating as many ideas or associations as possible that are appropriate to a given task (Harrington, Block, & Block, 1983). These processes require that the brain identify novel connections between seemingly disparate concepts, combine ideas in unexpected ways, and transform familiar information into new forms (Cropley, 2006). A person utilizes divergent thinking when considering many possible solutions to a problem, engaging in word association exercises, or brainstorming ideas for a paper. The classic understanding of creative thought typically refers to this process. For this reason, many previous experimental studies on creative thinking have measured and defined it in terms of divergent creativity (e.g., Dijksterhuis and Meurs, 2005; Baird et al., 2012). Tests of divergent creativity ask that individuals give as many answers as they can come up with that satisfy a given set of constraints. A classic example of such a task is “Tell me all of the things you can think of that are round” (Wallach & Kogan, 1965). In this example, an infinite amount of answers are possible, as long as they fit the condition of being round. The nature of these tasks is that two people might come up with very different answers, but no answer is more correct than another, so long as they all fit the given constraints. When assessing divergent creativity performance on
these tasks, it is important to consider quality of responses, in addition to quantity. According to Harrington, Block, and Block (1983), a response that indicates a high degree of divergent creativity is one which demonstrates both imagination and a sensitivity to the task’s given limitations.

Much of the previous research on divergent creativity has investigated its relation to stable traits within individuals. Some studies have found divergent thinking to be associated with extraversion and disagreeableness (Furnham, Crump, Batey, & Chamorro-Premuzic, 2009); however, these findings have not been consistently replicated throughout the literature. More conclusive evidence has been found for a significant relationship between divergent creativity and openness to experience (Batey et al., 2009; McCrae, 1987). Individuals who are high in openness likely generate more (and higher quality) responses to these tasks because they are more receptive to unconventional ideas, and more willing and able to combine familiar information in novel ways. McCrae (1987) found that both openness to experience and divergent thinking were related to Gough’s (1979) Creative Personality Scale, which measures creativity as a stable trait within individuals. Many studies have also claimed to find a link between divergent thinking and intelligence (e.g., Furnham et al., 2009), but a 2005 meta-analyses of this relationship reported that results have been too inconclusive to claim any association between the two (Kim).

Convergent creativity.

In contrast to divergent creativity, convergent creativity refers to the process of integrating and reapplying stored knowledge in order to arrive at one idea. Convergent processes are used when deriving one correct solution to a given question by recalling and/or reinterpreting
stored knowledge. Whereas divergent thinking aims to produce many possible solutions to one problem, convergent thinking orients towards simplicity and feasibility (Cropley, 2006). Tasks of convergent creativity challenge participants to recall and consider stored knowledge in unconventional or abstract ways in order to arrive at one correct answer to a given question. One example of a commonly used test of convergent creativity is the Remote Associates Task (RAT) (Mednick, 1962). During an RAT, the participant is presented with three unrelated words and is tasked with identifying their shared associate. Three such words might be “time,” “hair,” and “stretch,” where in this case the correct answer is “long” (Colzato et al., 2012).

In contrast to divergent thinking, convergent thinking has not been shown to correlate with any of Big Five personality traits (Chamorro-Premuzic & Reichenbacher, 2008). Because it relies upon the use of reasoning, evaluation, and logic, convergent creativity is thought to be related to performance on intelligence tests (Mumford). Runco, Dow, and Smith (2006) found that GPA was predictive of performance on convergent thinking tasks in students. This finding is unsurprising, as typical school assessments and standardized tests call for convergent thought processes in order to come up with an answer which matches the one the test-makers had in mind.

**Mindfulness**

Mindfulness, which has been shown in recent years to be a holistic tool for improving mental health (in the sense that it benefits the whole person, rather than targeting just one symptom) might offer such a strategy for enhancing creativity. Mindfulness describes a state of consciousness in which the mind is intentionally oriented towards fully experiencing the present moment. This awareness includes a conscious effort to approach the immediate experience of
thoughts, feelings, and sensations with curiosity, openness and acceptance (Bishop et al., 2004). According to Jon Kabat-Zinn (1994), the developer of mindfulness-based stress reduction (MBSR), “mindfulness means paying attention in a particular way: on purpose, in the present moment, and non-judgmentally. This kind of attention nurtures greater awareness, clarity, and acceptance of the present moment reality” (p. 4). This may sound like an obvious concept, but to consciously dwell within such a state, rather than reacting emotionally to the immediate experience or becoming preoccupied by thoughts of the past or future, is much easier said than done.

Mindfulness is not the absence of distracting thoughts (which are difficult to suppress and, realistically, frequently arise), but rather the decision not to become absorbed in such distractions. Individuals in a mindful state would acknowledge these distractions, choose not to devote energy to them, and return instead to a focus on the present moment. Mindfulness helps individuals to observe their own emotional and cognitive experiences, rather than mindlessly reacting to those thoughts and feelings and seeing themselves as powerless against them (Knight, 2010). This practice of observation allows individuals to view situations objectively, free of the distortions their emotions might otherwise cause.

The concept of mindfulness is relatively new to western psychology, but the idea itself is quite ancient, originally stemming from the Buddhist tradition and dating back thousands of years. Mindfulness meditative practice is considered to be at the very heart of the Buddha’s teachings, providing a path to eventually overcome suffering and worldly attachments (Cullen, 2011; Thera, 1962, as cited in Kabat-Zinn, 2003). Only recently have western clinical psychologists adopted mindfulness practices as a tool for improving mental health. In 1979,
while working at the University of Massachusetts Medical Center, Jon Kabat-Zinn, a student of yoga, vipassana and zen, founded mindfulness-based stress reduction (MBSR) as a therapeutic technique for combatting stress (Cullen, 2011). MBSR combines three main practices: mindful movement, the body scan, and sitting meditation. “Mindful movement” describes the practice of maintaining a keen awareness of the body during gentle yoga. The “body scan” refers to the practice of focusing one’s awareness on all the different parts of one’s body. During sitting meditation, individuals focus their attention on the movement of their breath, while also non-judgmentally observing their own physical and mental state. Although inspired by Buddhist philosophy, MBSR brings mindfulness into a clinical context, making it accessible to westerners who might otherwise be skeptical about the idea of meditation (Cullen, 2011).

In the past few decades, MBSR as well as informal mindfulness techniques have been used in clinical practice as part of a holistic approach to reducing stress and anxiety. Mindfulness is often used by clinicians in conjunction with cognitive behavioral therapy (CBT; e.g., Follette, Palm & Pearson, 2006) and as a part of dialectical behavior therapy (DBT; Linehan, 1993). Patients can use the mindfulness techniques taught by MBSR therapists as strategies for coping with their symptoms independent of medications or regular psychotherapy, which can be expensive and difficult to access. Mindfulness based therapies (MBT) offer patients a tool for well-being which is always immediately available to them. Much like CBT, mindfulness empowers the patient to claim agency over his or her symptoms in a way that medication, as relief that comes from an external source, cannot. Mindfulness theorists stress the importance of becoming aware of one’s emotional reactions as soon as they arise, rather than
simply “becoming the reaction,” so as to cultivate a sense of control and to learn how to respond appropriately and compassionately (Strong, 2010).

In the past few decades, an explosion of research has shown mindfulness based therapies to have far reaching psychological benefits. In addition to stress reduction, Brown and Ryan (2003) found mindfulness to be correlated with various other measures of well-being, including improved self-regulated behavior, positive emotional states, declines in mood disturbances, and heightened self-awareness. Mindfulness has proven to be highly effective in treating anxiety disorders (Kabat-Zinn et al., 1992), including generalized anxiety disorder and panic disorder (Evans et al., 2008; Miller, Fletcher & Kabat-Zinn, 1995). Mindfulness meditation has also been used to treat unipolar depression, as it has proven especially effective for correcting depressive cognitive tendencies such as rumination, the practice of dwelling extendedly on negative experiences and emotions (Ramel, Goldin, Carmona & McQuaid, 2004). Studies have shown MBT to be effective at combatting post-traumatic stress and promoting acceptance in survivors of child abuse (Kimbrough, Magyari, Langenberg, Chesney & Berman, 2010) and adult trauma (Vujanovic, Youngwirth, Johnson & Zvolensky, 2009).

In addition to the substantial research in support of the clinical benefits of mindfulness meditation, it has also been shown to have significant cognitive benefits in terms of attention and learning. Adults and adolescents with ADHD showed improved concentration and self-regulation following mindfulness meditation (Zylowska et al., 2008). Parish (2010) found that regular mindfulness practice facilitated higher-level learning in adult students, who reported that they were better able to focus and felt less stressed about their academics. The implementation of mindfulness breathing and meditation practice in the classroom has also been shown to have
tremendously positive effects with children, whose minds (not unlike those of adults) are constantly overloaded with thoughts, feelings, and distractions, which can be a hinderance when it comes to focused thinking and learning. These practices strengthen short-term memory and attention, while also improving emotional intelligence and self-esteem (Erricker & Erricker, 2001).

Mindfulness practice creates a state of relaxed attention, which researchers have argued is the optimum psychological state for learning (Claxton, 1997, as cited in Fisher, 2006). Teachers report that incorporating mindfulness exercises into the classroom promotes happier and healthier learning environments (Fisher, 2006). Mindfulness encourages students to be more sensitive to the context and perspective of what they are learning (Langer, 2000). Students can engage more actively in their learning process by approaching subject matter mindfully, allowing themselves to gain new insight and draw novel distinctions, rather than mindlessly accepting what they are taught to be true (Langer, 2000). Even brief mindfulness training has been shown to improve self-control when cognitive resources are taxed (Friese, Messner & Schaffner, 2012), reduce fatigue and anxiety, increase mindful awareness, and enhance visuo-spatial processing and executive functioning (Zeidan, Johnson, Diamond, David & Goolkasian, 2010). Just two weeks of mindfulness training has been proven to reduce mind-wandering, boost working memory capacity and improve reading comprehension (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). These findings demonstrate the potential benefits of mindfulness to extend well beyond traditional clinical contexts.

The Relationship between Mindfulness and Creativity
In addition to its positive impacts on cognition and learning more generally, mindfulness has been shown to facilitate creative thinking, both inside and outside of the classroom. As mindfulness practices have been incorporated into academic classrooms, teachers of the arts have also experimented with beginning their classes with mindful breathing exercises to enhance students’ creative performance. According to clinician and school board coordinator Bochun (2011), by focusing on a single sound, or on the rhythm of their breath, students are able to overcome the ordinary agitation of the mind and to instead attune to the present moment and prepare for the task at hand. Bochun believes that in this way students become less reactive, and more receptive to their own new ideas. They are able to focus on the current activity, while still remaining open to input from their surroundings. Although Bochun’s explanation for the unique impact of mindfulness practices is certainly compelling, it is important to note that his hypotheses are drawn from his own observations and experiences, and have yet to be confirmed or contradicted by psychological research data.

Fisher (2006) suggests that mindfulness meditation helps to prepare the mind for the task of creative learning by expanding the range and depth of mental associations. Whereas the scope of human expression and experience is limited by linguistic reference during conscious thought, meditation, which is free of such restraints, allows for a more intuitive experience of the world, in which the mind is engaged beyond the use of words. According to Fisher (2006):

Meditation can expand the range and depth of mental associations by dissolving blocks and relaxing conventional connections and logical linkages. Meditative awareness allows increased access to the forgotten details of past experiences that are stored in the brain/
body and to unnoticed details of current experiences that are registered subliminally. (p. 150)

This assertion that meditation can prime the brain for creative thought by encouraging it to make connections beyond traditional cognitive limitations has been proposed by other researchers as well. In his analysis of the connection between meditation and creativity, Horan (2009) suggests that the two are related because both involve similar neuropsychological mechanisms. Citing evidence from EEG research looking at the activity of different classifications of brain waves, he suggests that meditation enhances creative illumination and incubation by enabling transcendence (i.e., the surpassing of informational limits) and integration (i.e., the transformation of informational boundaries), two mechanisms relied upon for creative thought. Horan’s explanation suggests that meditation encourages the brain to make novel connections both on a cognitive level, in terms of concepts that might not ordinarily be linked, and on a neural level in terms of facilitating communication between different parts of the brain.

The notion that meditation and other mindfulness practices may enhance creativity by allowing for mental associations that would not otherwise be made is echoed by Siegel (2010), as well. Much like Horan, Siegel proposes that mindfulness facilitates the strengthening of underdeveloped neural pathways connecting the right and left sides of the brain. While some cognitive processes are believed to be lateralized to one cerebral hemisphere or the other, insight is likely a joint effort by both hemispheres. The left hemisphere processes information analytically, making judgments based on reason and synthesis of details (Allinson & Hayes, 1996). In contrast, the right hemisphere relies more on intuition, making judgments based on feeling and a more global perspective (Allinson & Hayes, 1996). Language comprehension and
production are primarily confined to the left hemisphere, along with convergent problem-solving and arithmetic (Pinel & Dehaene, 2010), but the right hemisphere is capable of looking at problems more abstractly and connecting new input to stored, distantly related information in the brain (Bowden & Beeman, 1998). When the two are properly balanced, the mind is able to synthesize all information in order to acknowledge, organize, and express many different possibilities. Mindfulness rests on three main components: openness, observation, and objectivity. By remaining open and objectively observing whatever is in one’s awareness, a person may be able to see beyond his or her habitual reactions and restrictive preconceived judgments of the way things should be (Siegel, 2010).

As the idea of mindfulness and its clinical and cognitive implications is relatively new to the field of psychology, few major experimental studies have been done examining the relationship between mindfulness and creativity, and much of the existing literature is theoretical rather than empirical. One of the few studies directly investigating this connection was conducted by Ostafin and Kassman in 2012. Their study examined the impact of mindfulness on insight problem solving, one measure of convergent creativity. Ostafin and Kassman posited that as mindfulness aims to engage individuals in perception and cognition beyond their customary thoughts and processes, it may be beneficial in solving insight problems, the solutions to which rely upon creative, non-habitual thinking.

Non-insight problems are those which can be solved using logic and knowledge from past experiences. When facing an insight problem task, previous knowledge can be a hindrance, and often leads to an impasse. Cognitively restructuring the problem resolves this impasse, eliciting a moment of insight in which the problem’s solution becomes clear (Ohlsson, 1992, as
cited in Ostafin & Kassman, 2012). The solutions to these problems rely on creative, non-habitual approaches, which can be impeded by verbal-conceptual processes derived from previous experiences. To illustrate this concept, Ostafin and Kassman give an example problem: A man and his son were in a bad car accident together. The father was killed in the crash, and the son was gravely injured. When the son was taken to the hospital for emergency surgery, the surgeon exclaimed, “I can’t operate on this boy-- he is my son!” Participants are asked to explain how this scenario is possible. Individuals presented with this problem often reach an impasse due to previous associations of surgeons as male. The concept of “surgeon” then automatically activates the concept of “male,” such that search strategies are biased towards answers involving a man. Once the individual steps back from the problem, allowing this incorrect assumption to be reevaluated, he or she is able to come to the correct solution that the surgeon is the boy’s mother (Ostafin & Kassman, 2012).

Ostafin and Kassman (2012) conducted two related studies on the impact of mindfulness on insight problem solving. In the first study, they compared differences on insight problem solving tasks for participants who scored high and low on trait mindfulness--that is, the extent to which they were generally mindful in their approach to the present moment. They found that individuals with greater trait mindfulness were superior at solving insight problems. The researchers assessed the correlation between trait mindfulness and problem-solving for both insight and non-insight problems, and found the relationship to be nonsignificant for non-insight problem solving.

In their second study, state mindfulness was manipulated, such that one group underwent a brief mindfulness induction and one group did not. The mindfulness group again showed
better performance on the insight problem tasks but not on the non-insight problem tasks.

Findings from the second study demonstrated a causal relationship between state mindfulness and insight problem solving. Ostafin and Kassman’s (2012) research is one of the first studies to empirically support a direct link between mindfulness (both state and trait) and creative thinking. Although their findings are certainly valuable, their research assesses only one aspect of creativity (convergent creativity as defined by insight problem solving), thus limiting the potential applications of their results.

Another recent study by Colzato, Ozturk, and Hommel (2012) supports a connection between meditation and divergent creativity. Colzato et al. investigated the ways in which two styles of meditation that employ unique types of cognitive processes might be associated with different types of creative thinking. Specifically, they compared the influence of two different types of meditation (focused-attention and open-monitoring) and a control relaxation task on convergent and divergent creativity. The nineteen participants in their studies were all experienced meditators who had been practicing both focused-attention (FA) and open-monitoring (OM) meditation for about two years prior to the experiment. Participants were tested on three separate occasions for their performance on unusual use tasks (which require the use of divergent thought processes) and remote association tasks (which require the use of convergent thought processes). During each of these sessions, participants completed a different type of guided visualization or meditation exercise for 35 minutes prior to completing the tasks. Each individual participated in one session of FA meditation, one of OM meditation, and one guided visualization exercise as a control condition. The experimenters also collected participant
data on participants’ mood states during each session, in order to assess the impact of meditation on mood and any effect that might have on convergent or divergent creativity.

The researchers found that participant performance on the unusual use tasks was improved following OM meditation above FA meditation or visualization. They suggest that OM, which involves being intentionally open and accepting to all thoughts and emotions, enhances divergent creativity by allowing thoughts to flow freely from one to the next. They also suggest that the impact on divergent thinking may be due in part to the enhancing effect of OM meditation on mood. The work by Colzato et al. is the first of its kind to identify a causal relationship between meditation and divergent creativity through empirical research. It is important to note, however, that the two types of meditation examined in this study are distinct from mindfulness meditation, which incorporates both the focused breathing aspect of FA and the intentional openness and acceptance characteristic of OM. These findings are also based exclusively upon data from experienced meditators, which is mildly problematic. Unlike novice meditators, individuals who regularly practice meditation are likely to be aware of its cognitive and emotional benefits and might therefore be more susceptible to experimental demands. The recent findings of Ostafin and Kassman (2012) and Colzato et al. (2012) demonstrate an effect of meditation on creativity, but very little is known about the mechanisms that might be responsible for this relationship.

**Unconscious-Thought Theory**

One possible cognitive explanation for the connection between meditation and creativity is that the mind unconsciously generates creative ideas even when taking a break from focusing on a given task. Dijksterhuis and Nordgren’s (2006) unconscious-thought theory posits that
generative thought can occur on a subconscious level, when attention is either undirected or
directed elsewhere. The theory rests on the principle that the capacity of consciousness is
limited, and as such conscious thought is constrained in a way that unconscious thought is not.
Conscious thought is only capable of focusing intently on one task at a time, and working
memory can only store about seven items at once (Miller, 1956). Because of these limitations,
conscious thought is only capable of considering a subset of all important or relevant information
at a given time, while unconscious thought has a much greater capacity for storing and
processing information (Dijksterhuis & Nordgren).

This effect was demonstrated by one experiment in Dijksterhuis’ 2004 study (Experiment
2), in which participants were presented with information about four different apartments, one of
which was objectively the best option. Some were asked to identify the best apartment
immediately, while another group was given a few minutes to consciously consider the decision,
and a third group was distracted from the task at hand, such that they could not consciously think
about it. After choosing the best apartment, participants were asked whether their decision was
made based on one or two characteristics of the apartments or based on a global impression.
Fifty-six percent of the unconscious thinkers reported having made a holistic judgment of the
apartments, compared to 42% of the group that chose immediately and only 27% of the
conscious thinkers, who mostly indicated that their decisions had been based on only one or two
attributes. Additionally, the unconscious thought group chose the objectively best option
significantly more often than either of the other two groups.

In addition to its application to decision making processes, unconscious-thought theory
can be applied to creativity. In their 2005 study, Dijksterhuis and Meurs presented subjects with
a specific instruction which required divergent creative thinking (i.e., the generation of as many ideas as possible). Subjects were asked to generate ideas immediately, after a few minutes of conscious thought, or after a distractor task. The ideas generated by participants in the unconscious thought condition were judged to be more creative than the ideas generated by participants in the other conditions. These results suggest that unconscious thought processes may be superior to conscious thought processes when it comes to divergent creative thinking.

The aforementioned findings show that participants perform best on divergent creativity tasks following a distractor task, but do all types of distractions have the same effect? Baird et al. (2012) found that the degree of difficulty of the distractor task determined the facilitation (or lack thereof) of unconscious creative thought. Participants in their study performed a baseline unusual use test (a measure of divergent creativity), and were then randomly assigned to one of four conditions. Participants spent 12 minutes performing a demanding task, an undemanding task, no task, or were given no break at all. Following the experimental manipulation, all subjects once again performed the previously encountered unusual use task. Subjects who performed the easy distractor task showed the greatest amount of improvement on the unusual use task. The authors suggested that these results reflect a difference in the extent to which participants were able to let their minds wander, depending on the cognitive load of the tasks they performed. The undemanding task facilitated mind-wandering, allowing for optimum unconscious incubation of creative ideas.

The findings of the Baird et al. (2012) study suggest that individuals are most able to generate creative ideas when revisiting a task after taking a mental break to daydream. Daydreaming may promote unconscious incubation because it allows the mind to relax, to have
free-flowing, unstructured thoughts. In this sense, mindfulness meditation is likely to produce similar, if not better results than an undemanding task. Meditation is very similar to daydreaming, in that the mind is relaxed, openly observing whatever thoughts may arise without judging them. Unconscious-thought theory, along with the results of these studies, supports the notion that meditation would foster unconscious thought, and by extension creative thinking, at least on previously encountered divergent creativity tasks.

**The Role of Stress and Affect**

When discussing creativity, mindfulness meditation, and the connection between the two, it is important to consider well documented relationship that stress and affect have with both mindfulness and creativity. These associations are especially key when examining the effect of mindfulness on creativity, as such an effect could conceivably be explained by the mediating factors of stress and mood.

**Stress, affect, and mindfulness.**

Contemporary psychologists theorize that the often constant stream of information and stimuli characteristic of our modern society can negatively impact well-being (Evans & Wachs, 2010). Mindfulness theorists suggest that mindfulness teaches the brain psychological flexibility, training it to cope with overstimulation and the accompanying anxiety and negative emotions (Miller, 2012). Over the past few decades, research has found mindfulness to be effective at reducing stress and improving affect (Hofmann et al., 2010; Chang et al., 2004). A 2009 meta-analysis found that MBSR was at least as effective as standard relaxation training at reducing stress in healthy adults. MBSR was also found to reduce trait anxiety and ruminative thinking--associated with symptoms of anxiety and duration of negative affect (Lalande,
Bambling, King & Lowe, 2012)--, and to increase empathy and self-compassion--a buffer against anxiety, associated with improved overall psychological well-being (Neff, Kirkpatrick, & Rude, 2007) (Chiesa & Serretti, 2009).

Carson, Carson, Gil and Baucom’s 2004 study on relationship satisfaction found that mindfulness improved individuals’ sense of autonomy, optimism, relaxation, and overall psychological distress. Mindfulness practice had an effect on these outcomes both in the short term and over time. Those who practiced mindfulness regularly had better outcomes at a 3 month follow-up, and greater mindfulness on a given day was associated with continued improvements in overall stress, affect, and acceptance of self and partner over several consecutive days. Arch and Craske (2005) found that individuals who first completed a mindful breathing exercise reported less negative affect reactivity and lower emotional volatility in response to the presentation of negative visual stimuli. Those participants also showed increased tolerance for viewing highly negative images.

Mindfulness has led to similar benefits in clinical populations, as well. Carlson, Speca, Patel and Faris (2007) looked at the effectiveness of MBSR in cancer patients at 6 month and 1 year follow-ups. Mindfulness practice was correlated with enhanced quality of life, as evidenced by decreased stress symptoms, decreased blood pressure, and improved cortisol and immune patterns consistent with lower levels of stress and mood disturbance.

**Stress, affect, and creativity.**

The significant impact of stress and affect on creativity has also been empirically supported. Many studies have found high stress to have a negative impact on creativity. In one such study, Cowen (1952) posited a linear positive correlation between stress and problem-
solving rigidity. When stress was manipulated, participants in the non-stress control group showed the most flexible approach to creative problem-solving, while participants in the mild stress condition were more rigid, and participants in the strong stress condition showed the most rigidity in their problem solving approach.

In a more recent meta-analysis, Byron, Khazanchi, and Nazarian (2010) found the relationship between stress and creativity to be a bit more complex. Byron et al. propose several different hypotheses regarding this relationship. They first hypothesize that stressors decrease creative performance due to the exhaustion of cognitive resources. Later they posit the opposite based on the notion that stressors increase arousal and motivation. Both ideas, it turns out, can simultaneously be true. Citing the Yerkes Dodson law (1908) and Gardner’s (1990) activation theory, they propose a curvilinear relationship between stressors and creative performance.

In studies assessing creative performance, Byron et al. (2010) found that participants in low-evaluative contexts (i.e., moderate stress) significantly outperformed participants in both high evaluative contexts (i.e., high stress) and in control conditions where there was no evaluation (i.e., no stress). Rather than a positive or negative correlation between the two, stress increases performance to a point, but after exceeding a certain threshold stress begins to impede performance, particularly on complex tasks (e.g., creative tasks). This threshold for stress was shown to vary among individuals with different levels of trait-anxiety. Induced stress decreased creative performance for individuals who reported high trait-anxiety, while the same manipulation increased creative performance for those with low trait-anxiety. In general then, this pattern of results supports the hypothesis that creativity is optimized when there exists a moderate level of stress, as moderate arousal levels increase motivation and engagement without
exhausting cognitive resources or eliciting a detrimental increase in negative affect (Byron et al., 2010).

The negative impact of significant stress on creativity might also be due to the fact that stress causes a spike in negative affect. Anxiety and fear, in particular, have been shown to hinder creative thinking by decreasing cognitive flexibility (Baas, De Dreu, & Nijstad, 2008). Induced stress might lead to poorer performance on divergent creative tasks because stress is associated with negative mood. Individuals who are in a bad mood are likely to judge the quality of their ideas more harshly than they would otherwise, causing more inhibition in the answers they report (Vosburg, 1998). Conversely, positive affect improves creativity. Individuals in a positive mood are more creative than those in a neutral mood (Baas et al., 2008). A study by Isen, Daubman, and Nowicki (1987) found that positive affect facilitates creative problem solving significantly above the effects of either negative affect or exercise. In addition to giving more creative responses, happy subjects show greater pre-task interest and are more receptive and willing to learn (Bochun, 2011; Hirt, McDonald, Melton, & Harackiewicz, 1996).

Previous research supports the association between stress, affect, and creativity, as well as the impact of mindfulness on stress and affect. Given these well-documented findings, it is logical to posit that mindfulness would promote creativity through the reduction of stress and negative affect. Although researchers have suggested an effect of mood on the relationship between meditation and creativity (Colzato et al., 2012), none have formally tested the mediational role of stress and affect. For this reason, further research is needed on the effect of mindfulness on creativity, investigating stress and affect as variables that might be responsible for mediating this relationship.
The Present Study

There is a paucity of research explicitly linking mindfulness and creativity, although previous literature on these two variables, as well as on related factors (unconscious thought, stress and affect), empirically suggests a connection. As far as we are aware, only two such studies exist on this particular association. Ostafin and Kassman (2012) found that mindfulness fosters convergent creativity, as demonstrated through insight problem solving. Research from Colzato et al. (2012) identifies a relationship between a open-monitoring meditation and divergent creativity. They found this association for a particular meditative technique similar to but distinct from mindfulness--which involves components of OM meditation as well as more focused attention on the breath and bodily sensations.

The present study aims to further examine the nature of the relationship between mindfulness and creativity, by examining a broader range of creative thinking, as well as investigating the mechanisms underlying this effect. Insight problems, such as those used in Ostafin and Kassman’s (2012) study, require convergent thinking, in which an individual must arrive at one clearly correct answer to solve the problem. In contrast, tests of divergent thinking (e.g. the unusual use task) challenge individuals to generate a theoretically limitless number of original solutions to one problem. Previous studies have found that induced stress inhibits divergent but not convergent creativity (Krop, Alegre, & Williams, 1969), and that positive affect improves performance on divergent tasks but not convergent tasks (Vosburg, 1998). Our study employs measures of both convergent and divergent creative thinking, in order to address these differences and assess creative thinking more holistically. By directly measuring stress and
affective changes, the present study investigates the relationship between mindfulness and creativity, taking into account stress and affect as potential mediators.

Based on the existing research, we propose the following hypotheses:

**Hypothesis 1:** Mindfulness will be positively associated with creative thinking.

We hypothesize that the overall relationship observed between mindfulness and creativity will be positive. The present study investigates both state and trait mindfulness, as well as convergent and divergent creativity (on novel and previously encountered tasks). In order to address the variety of ways in which this hypothesis could be supported (or unsupported), we have divided Hypothesis 1 into several sub-hypotheses:

- **H1a:** Trait mindfulness will be positively associated with performance on divergent creativity tasks.

- **H1b:** State mindfulness will be positively associated with performance on novel divergent creativity tasks.

- **H1c:** State mindfulness will be positively associated with performance on convergent creativity tasks.

- **H1d:** Mindfulness meditation will facilitate greater creative incubation of ideas for previously encountered divergent creativity tasks than a control task.

- **H1e:** Performance on the divergent creativity task will be greater following meditation than following conscious contemplation of the task.

**Hypothesis 2:** High levels of stress and negative affect will be associated with poorer creative performance.
The literature does not comment extensively on the influence of chronic stress on creativity. In their investigation of individuals with average levels of trait stress, Byron et al. (2010) found that a few stressors can raise arousal to an optimal level, but too many stressors are cognitively exhausting. Research has shown that negative affect similarly decreases creative performance by hindering cognitive flexibility (Baas, De Dreu, & Nijstad, 2008). Based on the existing findings, we expect to find that high levels of stress and negative affect impede creativity. As we are assessing the impact of chronic stress, state stress, and positive and negative affect on convergent and divergent creativity, Hypothesis 2 has been divided into the following sub-hypotheses:

H2a: High levels of chronic stress and negative affect will hinder performance on divergent creativity tasks.

H2b: There will be an inverse relationship between current stress and creative performance on both convergent and divergent creativity tasks.

Hypothesis 3: Stress reduction and improved affect will mediate the positive impact of mindfulness on creativity.

Although several previous studies have demonstrated the impact of mindfulness on stress and affect, while others have found a significant relationship between stress and affect and creativity, very little previous literature exists integrating all of these factors into a single model. The present study aims to investigate the impact of mindfulness meditation on creative thinking, considering the mediating effect of stress and affect. Mindfulness meditation may be effective in diminishing the negative impact of stress and negative affect on creativity.
\( H3a: \) Inducing state mindfulness will decrease current stress and improve affect, relative to a control task.

**Method**

**Participants**

The study included 78 college students between the ages of 17 and 22 (\( M = 19.56 \)). Subjects were recruited via the social networking website Facebook and the college’s online bulletin board. The study was also advertised on fliers around the college’s campus, as well as on a website for introductory psychology students for their experimental participation for course credit. Participants were informed that would receive either course credit or $10 as compensation for completing the study. The sample was 55.7% female and 43% male, with the remaining 1.3% choosing not to identify with either gender. Participants represented a variety of different racial backgrounds, with 60.8% identifying as White/Caucasian. They also represented several different religious affiliations, with the majority identifying as non-religious (32.9%) and Christian (not Quaker) (30.4%). The majority of participants indicated little or no previous experience with meditation (29.1% had never meditated, 35.4% reported having meditated a few times in their lives, 19% reported meditating a few times per year, and only 15.2% reported meditating more frequently than that). Participants were excluded from participating in the study if they were already aware of the goals of our research (e.g., close friends of the experimenters, students who were present for the proposal of this research, etc.).

**Measures and Materials**

**Mindful Attention Awareness Scale (MAAS):**
The Mindful Attention Awareness Scale, developed by Brown and Ryan (2003), is a 15 item scale which measures trait mindfulness. It assesses individual differences in the disposition to mentally dwell within a mindful state. Each of the 15 items is a statement describing a mindless state of awareness (e.g., “I do jobs or tasks automatically, without being aware of what I’m doing”). Participants rate the frequency with which they have these experiences on a 6-point scale ranging from 1 (almost never) to 6 (almost always), where a lower score corresponds to a more mindful cognitive style. The MAAS has been shown to have excellent psychometric properties among college student samples, with high test-retest reliability and an internal consistency of .82, as well as high convergent, discriminant, known-groups, and criterion validity (Brown & Ryan).

**State mindfulness measurement:**

In contrast to the MAAS, the state mindfulness measurement aims to assess current moment mindfulness, or the extent to which participants are presently dwelling within a mindful state of awareness. This measure consists of only one item, modified from one of the original MAAS items, which states “At this moment (right now) I feel like I will rush through activities without being really attentive to them.” Participants are asked to indicate the degree to which the statement is truly reflective of their experience on a scale ranging from 1 (completely inaccurate) to 6 (extremely accurate), where a lower score corresponds with a more mindful cognitive style. This measurement was employed by Ostafin and Kassman in their 2012 study investigating the relationship between mindfulness and insight problem solving.

**Perceived Stress Scale (PSS):**
The Perceived Stress Scale is a 14 item scale developed by Cohen, Kamarck, and Mermelstein (1983) which measures individual differences in chronic stress. Specifically, it assesses the degree to which participants consider situations within their lives to be stressful, and the degree to which they consider their lives in general to be unpredictable, uncontrollable, and overloaded. The scale asks participants how many times in the past month they have felt a certain way (e.g., “upset because of something that happened unexpectedly”), with responses ranging from 0 (never) to 4 (very often). Higher PSS scores indicate higher levels of perceived life stress. The PSS has been widely used in psychological research, and has been shown to have high internal reliability (alphas range from .84 to .86) and construct validity among college students (Cohen et al., 1983).

Positive and Negative Affect Schedule (PANAS):

The PANAS is a 20 item scale created by Watson, Clark, and Tellegen (1988) which measures participants’ current affective state. Each item on the scale is a one word description of a different mood-state, 10 of which describe a positive mood-state (e.g., interested, enthusiastic, proud), and 10 of which describe a negative mood state (e.g., hostile, irritated, afraid). Participants are asked to indicate the extent to which each item describes the way they feel in the present moment on a 5-point scale ranging from 1 (very slightly or not at all) to 5 (extremely). Like the PSS and the MAAS, the PANAS has been well tested in psychological research. Both the positive and negative affect scale items have been shown to be highly reliable for the present moment PANAS (alphas range from .89 to .90 for positive affect and .84 to .87 for negative affect), and to have high convergent and discriminant validity (Watson et al., 1988).

Visual analog scale for current stress (VAS):
Unlike the PSS, the visual analog scale (adapted from Grant et al., 1999) is an assessment of current moment feelings of stress. The scale consists of three items: anxious, overwhelmed, and frustrated, each of which addresses a different facet of the affective experience of stress. Each of the three scales asks “To what extent do you feel ______ right now?” with the first scale asking about feeling anxious, the second overwhelmed, and the third frustrated. Each item consists of a horizontal line with marks along it ranging from 0 (not at all) to 10 (extremely). Participants are asked to mark the point on the line that best corresponds with their current experience. Previous assessments have found the VAS to have high construct validity as a measure of stress, due to observed correlations with related concepts (Lesage, Berjot, & Deschamps, 2012).

**Unusual use tasks:**

Unusual use tasks measure divergent creative thinking (Gilhooly, Fioratou, Anthony, & Wynn, 2007). During a UUT, participants are asked to generate as many different uses as they can think of for a single object. Participants can come up with a theoretically infinite number of responses to the task, rather than relying strictly on intuition or insight in order to find one correct solution. UUTs provide a comparative measure which allows for the observation of a range of creative responses generated by different participants regarding the same topic. The present study employs three of the most commonly used UUTs: a brick, a wire, and a tablecloth. Each participant’s UUT responses are scored for creativity based on four dimensions. Each response is assessed in terms of fluency (the number of uses provided for a given object), flexibility (the diversity of uses provided for a given object), elaboration (the degree of detail given for each proposed use), and originality (the degree to which each use is unique compared
to those provided by other participants for the same object), all of which are reliable and valid measures of creativity (Guilford, 1967).

**Insight problem-solving tasks:**

In contrast to UUTs, insight problem-solving tasks test convergent creative thinking. Insight problem tasks require participants to focus on finding the single correct solution to a given problem. In order to find the solution, participants are required to think “outside of the box.” Insight problem tasks, when first presented, appear to be impossible to solve. Participants must think flexibly about the proposed problem in order to discover the solution when it logically seems that no progress is possible. Unlike on unusual use tasks, which allow for many acceptable answers, on insight problem tasks participants either reach the correct solution or they do not. The present study employs a combination of five verbal, spatial, and mathematical insight problem tasks which have been used to reliably study convergent creativity in conjunction with mindfulness prior to our research (Ostafin & Kassman, 2012). Four of the problems were adopted from Schooler, Ohlsson, and Brooks (1993), and the fifth came from Batchelder and Alexander (2012). The problems from Schooler, Ohlsson, and Brooks, were chosen for their study out of a larger pool of insight problems because mean performance during a pilot study was closest to 50% for those four. For this reason, these problems seemed to be at an optimal level of difficulty for the purpose of our experiment as well, such that we could expect to observe a wide range of performance across participants. All problems can be seen in Appendix B.

**Mindfulness meditation:**
For participants in the experimental condition, state mindfulness was induced during the manipulation phase of the experiment via a 12 minute recording of meditation instructions. The meditation instructions were modified from the script used by Ostafin and Kassman (2012). The modified instructions were recorded by a female with a soothing voice who was not a member of the college community, and would therefore be unrecognizable to our participants. In contrast to Ostafin and Kassman’s, we also chose to add in several longer pauses throughout the instructions (as is typical of most guided meditation recordings), so that participants would be able to let their minds wander, rather than attending only to the narration for the duration of the recording. The meditation instructions focused primarily on encouraging listeners to attend to the natural movements of their breath, to the subtle physical sensations throughout their bodies, and to observe their own thoughts without passing judgment. To view the full mindfulness script, see Appendix A.

**One-back:**

During the experimental manipulation phase of the procedure, participants in the control condition completed a 1-back working memory task—a commonly employed distractor task in psychological research (Kirchner, 1958). During a 1-back, participants are presented with a series of letter clusters (e.g., “zzzwzzz”) which quickly flashes, one after another, on the computer screen in front of them. The clusters appear in the same spot and vary only by the letter located in the middle. For each cluster that appears, participants are asked to indicate whether or not it matches the one that appeared immediately before it. The 1-back task requires that participants actively engage with it rather than letting their minds wander freely. While it would be impossible to definitively claim that individuals are not unconsciously thinking of
other things, previous studies have posited that tasks which require the use of working memory--such as the 1-back--enable significantly less mind wandering than tasks without a working memory load (Smallwood, Nind, & O’Connor, 2009). The 1-back is engaging to some extent, but it places only a moderate demand on cognitive resources compared to the heavier demands of a 2-back or 3-back task (in which participants have to indicate whether a given string of letters matches the one that appeared 2 or 3 before it) (Harvey et al., 2005). This makes it an ideal control task, as it is likely engaging enough to distract from mind-wandering, but not cognitively taxing enough to impede subsequent creative performance.

Procedure

The study design is illustrated in Figure 1. Participants were randomly assigned to either the mindfulness meditation (MM) group, or the control group. In order to avoid practice effects on the unusual use tasks, each participant was randomly assigned to one of six different versions of the survey, in which the order of the objects (brick, tablecloth, and wire) was counterbalanced.

Figure 1. Study design. Task X is conscious thought UUT; SMM refers to state mindfulness measurement.
After providing their informed consent, all participants completed four scales: the MAAS, the PSS, the PANAS, and the current stress VAS. Following these self-reports, the participants completed two unusual use tasks. The first, Task X, served as a conscious thought task. Subjects were asked simply to think about possible uses for Object X for 2 minutes, after which they were given two additional minutes to write down their ideas. Following Task X, participants completed a second unusual use task, Task Y1, in which they were asked to generate and immediately write down possible uses for Object Y. During all of the unusual use tasks, participants were given 2 minutes to enter as many uses as they could come up with for the object into a text box on a computer, after which the screen directed the participant to the next question.

After completing the baseline unusual use tasks, participants completed one of two different 12 minute tasks, depending on the experimental condition to which they had been assigned. In the experimental condition, participants engaged in mindfulness meditation. These participants were instructed to sit quietly while listening to a guided meditation recording. The meditation instructions encouraged participants to close their eyes, to pay particular attention to their breath, to be aware of their physical experience in the present moment, and to remain open to and accepting of whatever thoughts might arise. Participants in the control condition engaged in a 1-back task for approximately the same length of time.

Following the experimental manipulation, all participants completed the same tasks for the remainder of the experiment, regardless of condition. Immediately after the 1-back or the mindfulness meditation, participants completed another unusual use task, Task Y2. During this task subjects were presented with the same Object Y that was used in the first set of unusual use
tasks. The purpose of Task Y2 was to test improvement through incubation, and whether there was a differing incubation effect between the mindfulness and 1-back groups. Following Y2, participants completed the state mindfulness measurement. They were then prompted to again complete the VAS. After these two questions, participants completed their final unusual use task, Task W, based upon a novel object, Object W.

After the unusual use tasks, participants completed a convergent creativity task. They were given a piece of paper with five different insight problems, and were instructed to solve as many problems as they could within an allotted 10 minute time period (timed by experimenters). Participants were asked to indicate if they were already familiar with a given problem. If they were familiar with a given task and its solution, their response was excluded from the analysis for that particular problem.

At the end of the experiment, participants completed the VAS, the PANAS, and the state mindfulness measurement for a final time. Participants then responded to questions regarding their age, gender, race, education level, and religion. Finally, participants were asked how regularly, if ever, they practiced meditation.

**Coding Procedures and Data Analysis**

In order to analyze divergent creativity, individual responses to each UUT were coded in terms of fluency, flexibility, originality, and elaboration. All coders followed the same instructions for established UUT coding procedures adopted from Guilford (1967). The “fluency” rating reflected the number of different uses that the individual reported for a given object. “Flexibility” referred to the number of different categories of uses represented in the UUT response (e.g., “blanket, dress, toga” would receive a flexibility score of 2, because a dress
and a toga are both items of clothing, but a blanket is a separate type of object). “Originality” was calculated with respect to the answers given by the rest of the sample for a given object. If a proposed use was suggested by 5% or less of the sample, the object received a score of 1, and if it was suggested by 1% or less of the sample, it received a score of 2. The final originality score for a participant’s UUT response was calculated as the total number of originality points divided by the fluency of that set of answers. The more uses generated by a participant (fluency), the greater the likelihood that some of those items would be unique, due to chance alone. By dividing originality scores by fluency, we were able to control for the number of uses generated, such that the final “originality” score was an honest reflection of the uniqueness of a given participant’s divergent thought processes. The “elaboration” score reflected the degree of detail with which a particular use was proposed, where one additional point was given for each level of description (e.g., “To throw at my sister when she is being mean” would receive an elaboration score of 2, because in addition to the basic use “to throw” the participant specified at whom, and in what situation).

Convergent creativity data was measured as the percentage of correct answers that each participant gave for the five insight problems. A “correct” answer was identified either as matching the traditional answer for the insight problem, or as an alternative solution that all four coders unanimously agreed adequately answered the question and was feasible under the given conditions. Each participant’s convergent creativity score was calculated as the number of correct answers they gave divided by the total number of questions available to them (five, unless they indicated having been previously familiar with a problem, in which case it was excluded).
All statistical tests relied upon a 2-tailed test of significance, where significance was defined as a p-value of .05 or below. The data analysis focused on several different aspects of the study design in order to test the sub-hypotheses of Hypothesis 1 (mindfulness will lead to an increase in creative thinking), Hypothesis 2 (high levels of stress and negative affect will hinder creative thinking), and Hypothesis 3 (the relationship between mindfulness and creativity will be mediated my reduced stress and improved affect). Hypothesis 1a states that trait mindfulness will be positively associated with performance on divergent creativity tasks. We tested this hypothesis using a correlation of baseline unusual use task scores with MAAS scores. We expected that participants high in trait mindfulness would perform significantly better (in terms of both depth and breadth of responses) on Task Y1 than those who are low in trait mindfulness.

Hypothesis 1b states that state mindfulness will be positively associated with performance on novel divergent creativity tasks. To test hypothesis 1b we performed an independent samples t-test to compare the performance of the experimental and control groups on Task W (after the experimental manipulation), expecting that the experimental group would outperform the control group. We also assessed this hypothesis by doing a between-subjects comparison of change in performance on novel UUTs before (Task Y1) and after (Task W) the experimental manipulation between the control and experimental groups. We expected that participants in the experimental group would show greater improvement from Task W to Task Y1 than participants in the control group.

Hypothesis 1c states that state mindfulness will be positively associated with performance on convergent creativity tasks. To assess the validity of Hypothesis 1c, we observed the correlation between state mindfulness and correct insight problem responses,
anticipating a positive association between the two. We also conducted a between-subjects comparison of the experimental and control group performance on the insight problem tasks. We expected that the experimental group (having just meditated) would correctly solve more insight problems than the control group.

Hypothesis 1d states that mindfulness meditation will facilitate greater creative incubation of ideas for previously encountered divergent creativity tasks than a control task. We expected that meditation would elicit unconscious creative incubation more effectively than the 1-back task—that is, that improvement on previously encountered unusual use tasks could be attributed to the incubating effects of mindfulness meditation, rather than simply that of the time passing between tasks. To test this hypothesis, we compared improvement from Task Y1 to Y2 between the experimental and control groups using an independent samples t-test. Although the participants in the control condition may have also improved when encountering a task for the second time, we predicted that participants who underwent the mindfulness induction would show significantly greater improvement than those who did not.

Hypothesis 1e states that performance on the divergent creativity task will be greater following meditation than following conscious contemplation of the task. We predicted that meditation would facilitate creative incubation more effectively than conscious thought. To test this, we compared the performance of participants in the experimental group on Task X (baseline conscious thought UUT) and Task Y2 (repeated UUT after meditation), expecting that they would perform better on Task Y2 than on Task X. We also looked at the amount of improvement between participants in the experimental and control conditions from Task X to Y2. To conclude that it was meditation, rather than time, which was more effective than conscious thought, we
would have needed to observe greater improvement in the experimental group than in the control group.

Hypothesis 2a states that high levels of chronic stress and negative affect will hinder performance on divergent creativity tasks. In order to support this hypothesis, the data would need to show that subjects who reported high chronic stress and negative affect performed worse on the baseline novel divergent creativity tasks than participants with lower levels of stress and negative affect. To test this hypothesis, we correlated PSS and PANAS scores with Task Y1 performance. We anticipated that those with high stress would perform worse than those with low stress on Task Y1, and that those with more negative affect would perform worse than those with more positive affect.

Hypothesis 2b states that there will be an inverse relationship between current stress and creative performance on both convergent and divergent creativity tasks. To test this hypothesis, we looked at reported VAS scores throughout the experiment in correlation with UUT responses and insight problem completion. We expected to find that lower levels of stress on a given VAS would be associated with improved creative performance on the accompanying UUT. A correlation would need to be observed between stress reduction from the first to the second VAS and improvement from Task W to Task Y1 in order to be able to attribute the improvement to a decrease in stress, and not to practice effects. We also anticipated that lower scores on the final VAS would be associated with better performance on the insight problem solving task.

Hypothesis 3a states that inducing state mindfulness will decrease current stress and improve affect, while a non-mindful control task will not. To test this, we compared change in state stress and affect between the experimental and control groups using an independent samples
t-test, comparing their scores on the initial VAS and PANAS to their scores on the VAS and PANAS after meditating or completing the 1-back. In order to observe changes in state stress, we first computed a new variable to represent the difference in state stress over the course of the experiment by subtracting the second VAS (after the manipulation) from the first VAS (before the manipulation). Similar variables to that for state stress change were computed for change in both positive affect scores and negative affect scores from the first to the second PANAS. In the experimental group, we expected that the second VAS would be lower than the first, and that the second PANAS would be more positive than the first. We anticipated that participants in the control group would not report a significant change on either of these measures, but that if they did, the overall improvement in stress and affect would be greater for participants who meditated than for those who did not. We were unable to run a mediational analysis to test our overarching Hypothesis 3 (The association between mindfulness and creativity will be mediated by the impact of induced state mindfulness on state stress and affect), given constraints of the data set which are explained in the next section.

Results

Coding Reliability and Measurement Analysis

The measurement scales the study employed proved to be highly reliable. Each of the three different instances of current moment VAS measures was assessed for the degree to which the three included scales (frustrated, overwhelmed, and anxious) appeared to measure the same construct. All of the VAS scales were found to be highly reliable, with Cronbach’s alpha ranging from .78 to .82. The PSS proved highly reliable, with a Cronbach’s alpha of .90. The 15 item
MAAS was also found to be highly reliable (Cronbach’s alpha = .83). Although there is no way to assess reliability of the state mindfulness measurement (as it consisted of only one item), the fact that it was taken directly from the MAAS—a well-established, highly reliable scale—allows us to infer its validity as a measure targeting the same construct as the other MAAS items. The positive affect measures were also highly reliable on both the first PANAS measure at the start of the experiment (Cronbach’s alpha = .86) and the second PANAS at the end (Cronbach’s alpha = .88), as were the negative affect measures on the first PANAS (Cronbach’s alpha = .81) and the last (Cronbach’s alpha = .86).

The divergent creativity data were assessed in terms of fluency, flexibility, originality, and elaboration by four different coders. Each coder was randomly assigned to two of four data sets, such that each data set was independently coded twice, by a random combination of coders. Data analysis revealed inter-rater reliability to be consistently very high for all four dimensions of divergent creativity. Across all objects and coder combinations, correlations ranged from $r = .78$ to $r = .995$ ($p < .001$ for all).

**Manipulation Efficacy**

In order to ensure that the meditation exercise effectively induced state mindfulness significantly above a control task, we ran an independent samples t-test looking at the difference from item number 8 in the MAAS (from which the state mindfulness measurement was modified) to the first state mindfulness measurement following the experimental manipulation for both the experimental and control groups (state mindfulness measurement 1 - MAAS item 8). Our analyses revealed a mean difference of -1.07 ($SD = 1.97$) for the mindfulness group and -.16 ($SD = 1.79$) for the control group. The independent samples t-test confirmed that the two groups
differed significantly in state mindfulness change, \( t(77) = -2.16, p < .05 \). Because a lower score on the mindfulness measures was reflective of a more mindful state, the negative mean difference shows that state mindfulness increased following 12 minutes of meditation for participants in the experimental condition, and increased slightly following the 1-back as well.

A second independent samples t-test looking at change from the post-manipulation state mindfulness measurement to the final one at the end of the experiment (state mindfulness measurement 1 - state mindfulness measurement 2) found that the experimental group experienced a minor decrease in state mindfulness (\( M = -.02, SD = 1.37 \)), while the control group showed a significantly greater decrease in state mindfulness during the same period (\( M = -1.16, SD = 1.52 \)), \( t(77) = 3.48, p < .01 \).

A second independent samples t-test tested the difference between the experimental and control groups in state mindfulness change from the first state mindfulness measurement (after the first UUT post-manipulation) to the last state mindfulness measurement (at the end of the experiment, following all of the UUTs and the insight problems). The mean change in mindfulness was -.02 for the experimental group and -1.16 for the control group. Both groups decreased in state mindfulness from the first measurement to the end of the experiment, but an independent samples t-test revealed that the decrease in the control group was significantly greater than the very minor change in the mindfulness group, \( t(77) = 3.48, p < .01 \).

We ran another independent samples t-test to investigate change in state stress before and after mindfulness meditation and the 1-back task, respectively. The t-test looked at the difference from the first VAS (at the start of the experiment) to the second VAS (following the first UUT after the manipulation) in the mindfulness condition as compared with the control condition. The
analysis revealed that stress was effectively reduced following meditation \((M = 1.30, SD = 1.60)\), and remained essentially the same following the 1-back \((M = -.11, SD = 1.58)\). The t-test proved the change in stress between groups to be highly significant, \(t(77) = 3.93, p < .01\), supporting Hypothesis 3a.

We also ran a similar t-test observing the change in state stress from the second VAS (after the first UUT post-manipulation) to the final VAS (at the end of the experiment, after the convergent creativity task) by condition. The analysis yielded a mean of \(-.72 (SD = 1.65)\) for the mindfulness group, and a mean of \(.09 (SD = 1.64)\) for the control group. The difference between groups was significant, \(t(77) = -2.16, p < .05\). These results indicate that state stress increased from the assessment post-manipulation to the end of the experiment for those participants who meditated, and decreased for those participants who completed the 1-back.

The PANAS data revealed significant changes in positive affect before and after the manipulation, but no significant difference for negative affect. The mean change in positive affect from the beginning (before any UUTs, the experimental manipulation, or the insight problems) to the end of the experiment (following the UUTs, manipulation, and insight problems) was \(-.18\) for the mindfulness group \((SD = .73)\) and \(.25\) for the control group \((SD = .63)\). The negative mean indicates an increase in positive affect for participants in the experimental group, and the positive mean indicates a decrease for those in the control group (supporting H3a). An independent samples t-test revealed the differences between conditions to be statistically significant, \(t(77) = -2.66, p = .01\), providing moderate support for Hypothesis 3a. A follow-up independent samples t-test, however, revealed that the difference between groups
was no longer significant when the control group’s decrease in positive affect was eliminated, \( t(77) = -1.50, p = .14 \).

**Mindfulness and creativity**

The data analysis yielded very few significant relationships between mindfulness and creativity on any of the measures we assessed, failing to support Hypothesis 1a. Participant MAAS scores were not significantly correlated with fluency, flexibility, or elaboration, for any of the UUTs, nor was it correlated with percentage of correct insight problems at the .05 level. The only significant correlation found between trait mindfulness and creativity was a relationship between MAAS scores and originality on responses to Task X, the first UUT \( (r = -.22, p < .05) \). Although the value is negative, this reflects a positive relationship between trait mindfulness and originality on Task X, as the MAAS was scored such that a low score reflected a mindful outlook.

The correlations between the two state mindfulness measurements and originality, flexibility, fluency, and elaboration on all of the UUTs (Task X, Task Y, Task Y2, and Task W) did not reveal any significant associations \( (p > .12 \text{ for all}) \), failing to support Hypothesis 1b. An independent samples t-test revealed no significant differences between the mindfulness and control conditions on originality, flexibility, or fluency on Task Y2 (the previously encountered UUT following either meditation or the 1-back) \( (p > .22 \text{ for all}) \). A t-test did reveal significantly greater elaboration by the mindfulness group on Y2, where the mean was 2.90 for the mindfulness group and 1.72 for the control group, \( t(77) = 2.07, p < .05 \). The two groups did not differ significantly, however, when observing individual improvement from Task Y1 to Task Y2 on elaboration or any other dimension of creativity. After conducting a univariate ANOVA with
Y2 elaboration as a dependent variable and both condition and Y1 elaboration as independent variables, we found that only Y1 elaboration was a significant predictor of Y2 elaboration, $F(1, 76) = 64.0, p < .01$, while the effect of condition was insignificant, $F(1, 76) = .69, p = .41$, leaving Hypothesis 1d unsupported. A significant positive correlation between elaboration on Y1 and Y2 supported this idea as well ($r = .69, p < .01$). An independent samples t-test confirmed that elaboration on Y1 was significantly greater for participants assigned to the experimental condition ($M = 3.32, SD = 2.34$) than for those in the control condition ($M = 2.26, SD = 2.06$), $t(77) = 2.12, p < .05$.

We conducted a paired samples t-test of participants in the experimental condition to compare creative performance on Task X (conscious thought, before meditation) and Task Y2. The analysis revealed no significant improvements in creativity on Y2, failing to support Hypothesis 1e, although the data suggested a trend of improved fluency, $t(78) = -1.96, p = .05$, and flexibility, $t(78) = -1.93, p = .06$, on Y2. Additionally, we found a significant decrease in originality, $t(78) = 2.91, p < .01$, on Y2. Participants showed greater fluency on Y2 than on X in both the mindfulness group ($M = .02, SD = 3.80$) and the 1-back group ($M = 1.83, SD = 4.16$), but this improvement was significantly greater for the 1-back group, $t(77) = 2.01, p < .05$. The mindfulness group did not differ significantly from the control group on percentage of correct insight problems, as demonstrated by an independent samples t-test, $t(77) = .44, p = .67$. Additionally, no significant correlation was observed between insight problem percentage and the final state mindfulness measurement ($r = -.06$), leaving Hypothesis 1c unsupported.

**Stress, affect, and creativity**
Participants ranged in chronic stress reports from PSS scores of 1.30 to 4.70 (out of 1-5), with a mean of 2.70 ($SD = .70$). In terms of state stress at the start of the experiment, participant VAS responses ranged from 0 to 9.33 (out of 0-10), but with a very low mean of only 2.72 ($SD = 2.21$). Negative affect responses were similarly low at baseline ($M = 1.61, SD = .54$), and fell within a restricted range. Scores were only reported between 1 to 3.30, although the scale allowed for a range of 1 to 5. Baseline positive affect scores, in contrast, were much more evenly distributed, ranging from 1.30 and 4.80, with a mean score of 2.72 ($SD = .76$).

The data revealed consistently strong correlations between state stress and chronic stress. Highly significant positive correlations were observed between PSS scores and the first VAS ($r = .50, p < .01$), the second VAS ($r = .38, p < .01$), and the final VAS ($r = .27, p = .017$), with correlations appearing to weaken slightly as the experiment progressed. Additionally, all three VAS measurements correlated significantly with one another at the .001 level, but the correlation was stronger between VAS 1 and 2 ($r = .69$) and 2 and 3 ($r = .69$) than it was between 1 and 3 ($r = .48$). PSS scores trended towards a negative correlation with elaboration on Task X ($r = -.20, p = .08$), Task Y1 ($r = -.22, p = .053$), and Task W ($r = -.22, p = .051$), but not on Task Y2 ($r = -.15, p = .19$), generally failing to support Hypothesis 2a. PSS scores did not approach significant correlations with any other dimensions of creativity for any of the UUTs ($p > .13$ for all). The first and second VAS scales did not correlate with UUT creativity ($p > .11$ for all dimensions on all UUTs), but the final VAS was significantly correlated with originality ($r = -.23, p < .05$) and fluency ($r = -.25, p < .05$), and approached significance on flexibility ($r = -.22, p = .053$) for Task X. A significant negative correlation was found between percentage of correct insight problems and the final VAS (completed immediately afterwards in the experiment), such that higher
current stress was associated with fewer correct insight problems \((r = -0.36, p = 0.001)\), supporting Hypothesis 2b.

Data analysis revealed no significant correlations between negative affect and originality, flexibility, fluency, or elaboration on any of the UUTs \((p > 0.13\) for all). Positive affect approached significance for flexibility on Task W \((r = 0.21, p = 0.06)\), but otherwise appeared to have no relationship to UUT creativity, leaving Hypothesis 2a unsupported. Correlations of specific mood states and creativity measures yielded several relationships that were significant at the .05 level; however, none of these relationships seemed to follow any consistent pattern across multiple UUTs. The only association significant at the .01 level was a negative correlation between originality on Task Y1 and feeling attentive \((r = -0.32)\). A summary of significant correlations between divergent creativity measures and specific mood states pre-manipulation and post-manipulation can be seen in Table 1 and Table 2, respectively. Although we had not predicted any association between affect and convergent creativity, the data revealed a significant correlation between positive affect on the final PANAS and percentage of correct insight problems \((r = 0.33, p < 0.01)\).

Unfortunately, several participants endured technical difficulties or other complications while completing the experiment. If such an irregularity occurred, that participant’s experimenter number was coded in red with a brief description of the problem on the schedule. For example, for some participants the document expired while they were completing the survey, or they were accidentally cut off prematurely during one of the tasks. In total, there were 11 such subjects, making up approximately 14% of our participant pool. As most of the problems were deemed to be fairly minor, these participants were still included in the initial data analysis. In
order to ensure that the inclusion of these participants did not adversely effect our results (particularly since eight of these participants had been assigned to the mindfulness meditation condition, making up nearly 20% of the total group), statistical analyses pertaining to our main hypotheses were re-run with these subjects excluded. Results from the revised participant pool data did not differ significantly from those from the original analyses.

**Discussion**

**Hypothesis support**

The data generally formed a consistent pattern of results that failed to reveal an effect of mindfulness on creativity. Hypothesis 1 stated that mindfulness would lead to an increase in creative thinking. Although in some instances the data trended in the hypothesized direction, analyses did not reveal any significant associations between mindfulness (state or trait) and creativity (divergent or convergent). There was no significant pattern across UUT responses of correlations between trait mindfulness scores—as measured by the MAAS—and divergent creativity across the UUTs, failing to support Hypothesis 1a. The only significant instance of this relationship was a positive association between MAAS scores and originality on Task X. This finding was significant at the .05 level, but as there were no other correlations between trait mindfulness and any other dimension of creativity on any of the UUTs, it carries little weight on its own. This association would have been meaningful had it occurred additionally for originality on Task Y1, as the MAAS measured mindfulness before it was manipulated in any way, and Tasks X and Y1 were both completed immediately after the MAAS, before the manipulation; however, this correlation did not even approach significance.
Hypothesis 1b stated that state mindfulness would be positively associated with performance on novel divergent creativity tasks. The data completely failed to support this hypothesis, as there were no correlations approaching significance between the state mindfulness measurement (completed between the two UUTs following the experimental manipulation) and any dimensions of creativity for Task W, the novel UUT following the manipulation. A t-test between the participants who meditated and the participants who completed the 1-back also revealed no significant differences between those assigned to the mindfulness and control conditions in originality, fluency, flexibility, or elaboration when approaching Task W or on improvements on any of these dimensions from Task Y1 to Task W. Hypothesis 1c was also unsupported, as no relationship was observed between state mindfulness and percentage of correct insight problems, either in terms of correlation with the final state mindfulness measurement or in terms of difference on insight problems between conditions.

We had also hypothesized that state mindfulness would lead to greater improvement on previously encountered divergent creativity tasks, that is, that creative ideas would incubate better during meditation than they would during the control task (Hypothesis 1d). This hypothesis was also unsupported. There was no significant difference between the mindfulness and control conditions in terms of originality, fluency, or flexibility on Task Y2 (previously encountered UUT post manipulation). We did find significantly greater elaboration on Y2 among the mindfulness group than the control group, but further analyses revealed there to be no significant difference between groups in individual improvement from Task Y1 to Y2. The association between condition and Y2 elaboration was not significantly influenced by the effect of condition, but instead by elaboration on Y1. Further analyses confirmed that the correlation...
between the mindfulness condition and Y2 elaboration is due to participants in the experimental condition simply initially elaborating more on Y1 than participants in the control condition, rather than as a result of any unique influence of the mindfulness meditation exercise.

Hypothesis 1e stated that performance on the divergent creativity task would be greater following meditation than following conscious contemplation of the task. The data supported this hypothesis to some extent, but it did not yield any patterns of effects consistent or significant enough to reject the null hypothesis. A paired samples t-test of performance on Task X and Task Y2 trended towards significance in suggesting that participants demonstrated greater fluency and flexibility on the incubation task than on the conscious thought task. The same t-test also revealed that originality was significantly higher on Task X than on Task Y2, the opposite direction from what we would have expected. This finding is more likely a result of the coding process for originality than indicative of an actual effect. The more times a particular use was reported, the fewer points that use received for originality. Originality scores for Y2 likely decreased due to the fact that many of the uses that appeared in Y2 had also appeared in Y1 (participants were instructed to include uses they had previously reported for the same object in their answer). While these analyses suggest that incubation elicited more creative responses than conscious thought, we are unable to attribute the efficacy of incubation to mindfulness meditation, as the control group showed significantly greater improvement in terms of fluency from Task X to Task Y2 following the 1-back than did participants in the mindfulness condition.

Our second main hypothesis posited that stress reduction and improved positive affect would mediate the positive effect of mindfulness on creativity. As there was no main effect of mindfulness on creativity, this hypothesis was untestable due to its underlying assumption before
any analyses of mediation could be conducted. Although mediation could not be assessed, analyses did reveal other significant findings related to stress and negative affect. We found moderate support for Hypothesis 2a--that high levels of chronic stress and negative affect would hinder performance on divergent creativity tasks--in the form of negative correlations trending towards significance between PSS scores and elaboration on UUTs. This trend was identified for elaboration on Task X, Task Y1, and Task W, such that participants who reported higher levels of chronic stress demonstrated less elaboration on those UUTs.

Results were similarly inconclusive for creativity and affect. We did not find any associations of significance between negative affect and any dimension of creativity for any of the UUTs, failing to support Hypothesis 2a. Conversely, positive affect trended towards a significant correlation with flexibility on Task W, but was otherwise unrelated to divergent creativity. When observing correlations between the specific items on the PANAS and all four dimensions of creativity, we identified several correlations that reached significance at the .05 level on certain UUTs, but none that seemed to form any sort of meaningful pattern across the different tasks. We did find a significant negative correlation between distress and elaboration on Task W, such that higher levels of distress were associated with less elaboration. This relationship might be explained in two different ways. One possibility is that higher levels of distress would avail fewer cognitive resources for creative elaboration; however, given the timing of these measures (the PANAS came immediately after Task W), a more likely explanation is that participants who struggled on Task W became more distressed by the experience. Although this association is understandable, as no similar pattern was observed with other UUTs or dimensions of creativity, it is difficult to draw conclusions from this finding alone.
Hypothesis 2b posited that there would be an inverse relationship between current stress and creative performance. To test this hypothesis, we ran correlations between the first (at the start of the experiment), second (post manipulation, before final UUT) and third (after UUTs and insight problems) VAS assessments and all measures of convergent and divergent creativity. The highly significant correlation between the final VAS and percentage of correct insight problems showed a negative association between problem solving and state stress immediately after. This finding supports our hypothesis that state stress would be inversely related to convergent creativity, although we are unable to assess causality. It is possible, for instance, that participants who answered more problems correctly felt less stressed out by the activity, but it could also be the case that participants who were experiencing greater stress were unable to answer as many insight problems as those who were less stressed.

While Hypothesis 2b was supported in terms of convergent creativity, the data failed to support it in terms of the relationship between state stress and divergent creative performance. Our results did not yield an association between any dimension of creativity and change in state stress from the start of the experiment to the end. Results showed no significant correlations between the first or second VAS measures and any dimension of UUT creativity. Strangely enough, we found several correlations that were either significant or approaching significance between the third VAS and the first UUT, Task X. State stress at the end of the experiment was associated with originality, fluency, and approached significance with flexibility on Task X, where more creative responses on the first UUT were related to lower levels of stress at the final measurement.
This is certainly not an effect that we would have predicted. It is possible that participants who began the experiment with a greater sense of ease and success when confronted with the first task found the remainder of the experiment (most of which consisted of tasks at which they were likely similarly adept) to be less stressful by its end than those who struggled more at the start. If this was the case, however, we would expect to see a similar effect between creativity on Task X and the second VAS measurement. One possible explanation for this pattern is that those who began the experiment with a poorer creative performance became increasingly stressed over the course of the experiment, but that this increase in state stress was not significant until the final measurement. All three VAS measurements correlated significantly with one another, but the correlation was stronger between VAS 1 and 2 and between 2 and 3 than it was between 1 and 3. These values suggest that participant stress did not change drastically throughout the experiment, but enough so that the greatest difference in state stress was observed from the start of the experiment to its end.

Hypothesis 3a stated that inducing state mindfulness would decrease current stress and improve affect. This hypothesis appeared to be supported in terms of both stress and affect. Positive affect increased from the start of the experiment to the second PANAS measurement (after the manipulation) for the mindfulness group and decreased for the control group, resulting in significantly different levels of positive affect between conditions. These values were proven to differ significantly between conditions. Although the mindfulness group increased in positive affect, the increase was very minor, and further analyses revealed that when controlling for the 1-back participants’ unexpected decrease in positive affect, the difference between groups became non-significant. This finding weakens, but does not necessarily invalidate, support for
Hypothesis 3a in terms of affect. The difference between groups appears to be driven by the control group’s lowered affect rather than the mindfulness group’s improved affect; however, it is still possible that the mindfulness induction improved affect for the experimental group above what it would have been without meditation. It may have been the case that positive affect would have decreased over the course of the experiment for all participants (due to frustration with the tasks, boredom, etc.), regardless of the 1-back or any other control activity.

Hypothesis 3a was supported in terms of stress reduction. The results indicate that stress was reduced following meditation and very slightly increased following the 1-back, a difference which was significant between groups. As stress remained essentially constant for the control group, we are able to conclude that the difference between groups can be attributed to a significant reduction in state stress for those participants who meditated.

Potential explanations for our data

It is possible that the lack of supportive data does not indicate a lack of association between the mindfulness and creativity, but instead reflects flaws in the study’s methodology. It is plausible, for example, that our data set did not reflect a diverse enough range of results for state stress and affect to enable the observation of significant differences on these measures. Analyses of the data revealed a restricted range of responses for initial state stress and negative affect. Scores on the 10 point VAS ranged from 0 to 9.33, but 75% of participant responses fell between 0 and 4, whereas in a balanced distribution that range would be expected to reflect only about 40% of the total responses (see Figure 2). Most participants reported very low initial levels of state stress, making it difficult to observe a significant decrease in state stress over the course of the experiment. A similar pattern was observed for baseline negative affect.
Responses ranged only from 1 to 3.3, although the scale allowed for scores between 0 and 5 (See Figure 3). Additionally, 82% of the sample received negative affect scores of 2 or below, when this range would only be expected to account for 40% of scores in an even distribution. As with state stress, this distribution made it difficult to measure a reduction in negative affect, when levels were already quite low at baseline.

The study’s setting makes it unsurprising that most participants reported neutral levels of stress and affect. As all participants completed the study within a room by themselves sitting at a computer (a setting with which they are all probably quite familiar and comfortable, as college students), it seems unlikely that many participants would have indicated feeling highly frustrated, anxious, or overwhelmed. In the same vein, it is unlikely that they would have reported feeling very “hostile,” “scared,” “distressed,” or any other strongly negative emotions in such a setting. As most PANAS and VAS scores fell within a relatively constricted range, it is likely the case that meditation was unable to cause a great amount of differentiation between the two groups, as baseline scores did not enable an opportunity for much decrease in stress and negative affect, or for enough of a contrast with the control group to cause a significant effect.

It is possible that our lack of significant findings is due to an insubstantial mindfulness induction. Entering a state of mindfulness requires a pretty significant shift from routine patterns of cognition. Like any other activity or skill, to be able to swiftly ease into a mindful, meditative state requires practice. For individuals who do not have regular experience with meditation or other mindfulness practices (the vast majority of our sample), entering a mindful state within only 12 minutes, especially for the first time, would be a challenge. Our analyses indicated that the meditation exercise did increase state mindfulness from the state mindfulness measurement
before the manipulation to the one immediately afterwards (and did so more effectively than a
control task). Further analyses revealed a minor decrease in state mindfulness within the
experimental group as well as a larger decrease within the control group from that second
measurement to the final state mindfulness measurement at the end of the experiment. The
decrease in mindfulness was significantly greater for the 1-back participants than for those who
meditated, perhaps demonstrating that mindfulness had some enduring effect, although it did not
remain at its peak.

A similar effect appeared between conditions for state stress, where stress decreased post-
manipulation for the participants who meditated, but increased for the control participants. From
the second VAS measurement to the final one, state stress remained essentially constant for the
control group but increased somewhat for the mindfulness group. The mindfulness group’s
initial decrease and later increase in state stress implies that while the mindfulness induction
appears to have effectively reduced stress, it did not have much of a prolonged effect, and had
begun to wear off by the end of the experiment. These results suggest that our 12 minute
manipulation was not substantial enough to elicit statistically significant differences between
groups based upon state mindfulness. This could have been avoided by either utilizing a stronger
mindfulness manipulation (a longer meditation, a series of meditations, a complete mindfulness
workshop, etc.), or intentionally including participants who represented a wider range of
mindfulness experience prior to entering our study.

Had the mindfulness manipulation been stronger, we might have found a significant
effect of condition on insight problem solving performance. Although there was no direct
relationship between mindfulness and creativity, we did find a negative correlation between state
stress and convergent creativity performance. Additionally, the data revealed an unpredicted relationship between positive affect and convergent creativity performance, such low levels of state stress and high levels of positive affect were associated with a high percentage of correct responses to the insight problems. As both of these findings are correlational, we are unable to assess causality between convergent creativity and state stress or positive affect. It may have been the case that excelling at the insight problems caused participants to feel less stressed and more positive overall, while those who were unable to solve many problems felt frustrated and discouraged. On the other hand, these associations could indicate that stress hinders convergent thought processes, while positive affect enhances them.

If these findings are a reflection of the latter relationship, the absence of data supporting our hypotheses might be understood as the result of insufficient mindfulness manipulation. Our data demonstrate mindfulness meditation’s well-documented ability to reduce stress, and the existing research has consistently shown that meditation can improve affect (e.g., Chang et al., 2004). Had the mindfulness manipulation been more effective, previous findings imply that we that participants likely would reported higher levels of positive affect after meditation. The significant difference that we found in terms of affect between conditions suggests the mindfulness meditation may have served as a buffer against negative affect; however, the difference between groups in positive affect was nonsignificant. A stronger mindfulness induction might have significantly enhanced positive affect, and likely would have resulted in a more enduring effect of stress reduction. As both positive affect and lower levels of stress were associated within our data with superior convergent creative thinking, these enhancements might have produced significant results in support of our hypotheses.
The most obvious explanation for our pattern of results is that it reflects a true lack of association between the independent and dependent variables. While the data largely failed to support our hypotheses, by refuting them so thoroughly, it does give some evidence for the idea that brief mindfulness meditation is unrelated to convergent or divergent creativity. We found no consistent pattern of data to suggest that mindfulness had a significant influence on creative thinking. With the recent explosion of research on the cognitive and emotional benefits of mindfulness meditation, it seems logical to predict that mindfulness might enhance creativity. A person who is in a mindful state allows themselves to accept and observe whatever thoughts or feelings might arise. The nature of this state of awareness—which is very different from our ordinary state of attending to many things at once and judging our own experience—allows for new mental connections to be made, and for an individual to acknowledge whatever thoughts and experiences they might have rather than dismissing them. It seems a logical jump, then, to assume that mindfulness would allow individuals to generate more creative ideas than they otherwise might. Plausible as it may seem that mindfulness would enhance creativity—and although previous research has demonstrated such an association (Ostafin & Kassman, 2012; Colzato et al., 2012)—, given the abundance of data failing to support a relationship between the two within the present study, we remain unable to reject the null hypothesis.

**Strengths and limitations**

Our lack of results may have been reflective of some of the weaknesses of the study. One significant flaw in the study’s execution and analysis concerns irregularities in the actual facilitation of the experiment among participants. The study was run by four different experimenters, and while there was agreement beforehand about the general procedure, each
experimenter likely interacted with participants and introduced different parts of the study in
different ways, which could have influenced stress, affect, self-esteem, the extent to which
participants were aware of their role and the goal of the research, etc. This could have been
prevented by providing a more thorough training for the researchers as to how to conduct the
experiment and interact with participants in the exact same way. Had there been sufficient time,
this possibility could have been accounted for by conducting further analyses controlling for
experimenter effects.

Another limitation of the study is that the experimenters did not do more to control and
supervise what participants were doing once inside the testing room. On one occasion, for
example, an experimenter noticed that one participant had been writing her ideas for the
conscious thought UUT on a tissue, when she was only supposed to be thinking about them but
not recording them. This discovery highlighted ways in which the subject environment could
have been better regulated. For instance, researchers could have done a more intentional job of
regulating what was available to the participants during the experiment. It would have been a
good idea to instruct all participants to leave their backpacks outside of the room, to ensure that
they did not have a writing implement except when completing the insight problems and signing
their informed consent, and to ask participants to leave their cell phones outside of the room or to
turn them off. This oversight could have confused our specific measures of creativity, as
participants could conceivably have written down their ideas, texted their friends about creative
uses or insight problems, or spent some of the allotted time on their phones or otherwise
distracted, rather than attending to the task at hand.
In a similar vein, we did not have any way of confirming that participants in the mindfulness condition were actually attending to the recording. Participants in the 1-back condition had to actively engage with the task, and their responses were recorded on the computer. In the mindfulness condition, there was no equivalent measure of accountability to ensure that participants were similarly engaged with the task. As participants were not initially informed that they would be monitored, we could not ethically look into the room to see if their eyes were closed or if they were doing something else during the meditation. Even if we had been monitoring participants, we still couldn’t have known for certain if they were listening to the recording, sleeping, or thinking about something else. As the variable being manipulated was a state of mind, this is one limitation that would be very difficult--perhaps impossible--to significantly improve upon.

The order of our measurements was also limiting. We wanted to measure mindfulness, affect, and state stress after the experimental manipulation, but also did not want to prime the following UUTs (an important measure of our dependent variables) with stress and negative or positive affect. To compromise, we placed these measurements between the two UUTs, such that the participants completed the manipulation, completed one UUT, then were presented with these measurements before completing the final UUT. This placement meant that we could not assume our measurements were purely a reflection of the manipulation’s effect on stress, affect, and mindfulness, as they could easily have been influenced by the participants’ experience (of success, failure, frustration, pride, annoyance, etc.) of completing the UUT.

Another major problem that we did not anticipate was the effect of the 1-back. We employed the 1-back as the control task under the assumption that it would be moderately
cognitively engaging, but neutral in terms of its impact on stress, affect, and state mindfulness. Our results indicated that it was not as neutral as we believed it would be. In fact, many of our findings on differences between conditions were only significant due to unanticipated adverse effects in the control condition (higher stress, lowered affect, lowered mindfulness). It would have been ideal to choose a task that had no effect on any of these variables.

Despite significant limitations and a paucity of results, our study design did have several strengths. First, we had a very high degree of inter-coder reliability for all dimensions of divergent creativity, given the subjective nature of coding for such constructs as “flexibility” and “elaboration,” limited coding instruction, and differences in participant response styles. We also randomized the order of the objects in the UUTs throughout the procedure, such that participants were assigned to one of six different versions of the experiment. This allowed us to rule out the possibility of practice effects, and to more confidently assume that data outcomes were the direct result of our manipulations.

The major strength of our experimental design was its thorough investigation of many different routes for the potential impact of mindfulness on creativity. It was one of the first of its kind to investigate effects on both convergent and divergent creativity measures, and it also looked at trait mindfulness and state mindfulness, in addition to the actual mindfulness induction. Had we found significant results, the design ensured that we would have had some idea as to the underlying mechanism driving the effect of mindfulness on creativity. The variety of UUTs that we employed allowed us to compare the effects of creative incubation vs. conscious thought vs. approaches to novel tasks.

**Directions for future research**
In light of our lack of findings and the numerous factors that may have contributed to it, it is clear that further research is necessary to thoroughly assess the relationship (or lack of relationship) between mindfulness and creativity. Future studies should investigate more effective and enduring ways of manipulating mindfulness. As previously mentioned, our study induced mindfulness during only a 12 minute long meditation session, and the effects appeared to wane by the end of the experiment. Future studies should examine these effects in long time meditators, who are already familiar with the concept of mindfulness, and would likely show the greatest effect in comparison to a control group. Studies using random assignment to conditions could instead look at stronger manipulations, such as long-term meditation interventions, as many of the benefits of mindfulness stem from incorporating it into one’s ordinary patterns of thought. Such manipulations might be presented as a series of mindfulness meditation trainings over time, or giving participants mindfulness exercises to incorporate into their daily lives.

Future research should continue to investigate the nature of the benefits and influence of mindfulness. It is not yet clear what mechanisms explain the effect that mindfulness has been shown to have on various cognitive functions. According to our data, the real benefit of mindfulness is that it reduces stress, which can have broader positive impacts. In light of this well-established finding, future researchers should compare the impact of mindfulness to that of similar relaxation and stress-reduction techniques that do not involve any sort of cognitive restructuring. This would be very helpful in assessing whether the benefits of mindfulness are merely reflections of the benefits of stress reduction, or whether there is something uniquely beneficial about it, and if so, how that difference might be understood.
Future research should investigate other factors that might effectively contribute to creativity. Part of the appeal of a connection to mindfulness is the idea that simply focusing on the breath for several moments could enable the flow of new ideas and new perspectives on familiar situations. Discovering simple ways of enhancing creative thinking could have enormous benefits for society, perhaps even inspiring the restructuring of school and work environments so as to optimize the cognitive functioning of students and workers. Our limited findings, and those from studies preceding ours (Byron et al., 2010), suggest an inverse relationship between stress and creativity. Future research should seek to further understand and strengthen findings on the stress-creativity relationship by finding new and easily accessible ways of reducing stress in order to improve creativity and other cognitive functioning.
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### Tables and Figures

**Table 1**

*Correlations between mood states and dimensions of divergent creativity (pre-manipulation)*

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<th></th>
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<td>-.32**</td>
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<td>Proud</td>
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*Note. *p < .05, **p < .01

**Table 2**

*Correlations between mood states and dimensions of divergent creativity (post-manipulation)*

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<th>Y2.e</th>
<th>W.flx</th>
<th>W.e</th>
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<td>-.28*</td>
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<td>-0.04</td>
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<td>0.10</td>
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<tr>
<td>Strong</td>
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<td>-.26*</td>
<td>0.05</td>
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<td>0.09</td>
<td>0.15</td>
<td>0.69</td>
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</table>

*Note. *p < .05, **p < .01*
Figure 2. State stress at VAS 1 for all participants. Reported state stress was disproportionately low at baseline.

Figure 3. Negative affect at PANAS 1 for all participants. Reported negative affect was disproportionately low at baseline.
Appendix A. Mindfulness Meditation Script

Please follow the instructions on this recording. The aim of this recording is to increase awareness of your body and mind, of your whole self. It is important to be kind with yourself, to be gentle with yourself. You might find that simply becoming more aware of yourself will encourage relaxation. During this time, there is no right way to feel; whatever you feel is fine, because it is the true you. It is important to pay attention to your body and mind, to recognize your thoughts and feelings, and to accept them as they are. During these moments, simply observe yourself and notice the signs that your body and mind give you. Live in the present with any good feelings as well as with your worries and any feelings of discomfort. Now is the time to be with you. Keep in mind that there is no right or wrong way to feel. Even if you are not feeling anything at all, this is alright as well. Just accept your sensations, simply because they belong to you. Give yourself the permission to feel, and let that be just fine.

Sit on the chair provided as comfortably as you can. You may have your legs stretched out in front of you or bend them one next to the other, but keep them uncrossed. You may sit up straight on the chair or sit lower on the chair; choose the body position that makes you feel most comfortable. Allow your eyes to close gently if this feels comfortable, but it is important to stay awake. While listening to these instructions, take note of how your body feels and any thoughts that pass through your mind.

Notice that you’re breathing. Breathe deeply and fully, and notice your breath flowing in and out of your body. Without trying to control it in any way, focus your attention on your breath for some moments; you are breathing. Feel the breath that enters your body by your nostrils or by your mouth if you have it open. Then, become aware of your breath coming out of your body. With every in-breath, notice the sensations in your nostrils, in your mouth, in your lungs, in your chest, or in your abdomen. You may also observe sensations with every out-breath, as the air leaves your body. Observe your chest rising with the in-breath and falling with the out-breath. Become aware of the air that fills in your chest every time you breathe in, and then the sensation of emptiness that follows as the air flows out of your chest.

Now feel the breath in your abdominal area. Notice that very gentle rising and falling of the breath, as it enters and leaves your body. No need to control this in any way, almost letting the breath breathe itself. Notice how your chest gently rises with every in-breath and then falls with each out-breath. Observe the air filling your abdomen and then leaving your abdomen.

Allow your breath to flow naturally in and out of your body, without any control. Just let your breath breathe itself. No need to do anything, simply observing it, watching the breath moving in and moving out. Just let yourself breathe naturally, and be aware of the air that keeps entering your body and then leaving it in a smooth and gentle way. Observe that every in-breath is naturally followed by an out-breath, and that every out-breath is naturally followed by an in-breath. With no control, just let your breath do its natural cycle of in-breaths and out-breaths. Be aware of this movement of breath in and out of your body, and feel it.

Keep in mind that if you become distressed or uncomfortable with your feelings, thoughts, or body sensations at any point during this recording, it is always possible to return to this sensation of the breath moving into the body, the breath leaving the body, letting the breath...
breathe itself, not having to control it. Your breathing can become a safe place where you can return if at any time you feel uncomfortable.

Move your awareness away from your breathing and your chest, and move it down to your abdomen, to your belly and to your stomach. Explore your abdominal area with your awareness. If you do not feel any sensation, this is fine. Feel the muscles in your stomach contracting or keeping still. You may even feel pain. Just let the painful feelings be there, and do nothing to change them. Explore all the sensations in your abdominal area. You may even observe the warmth or coldness of your clothing on your skin. You may realize that you have no sensations in the area of your abdomen or stomach; this is alright too.

Now notice your breath as it enters your body and moves down to your abdomen. You observe the rising of your belly as you breathe in, and then its falling as you breathe out. Imagine that your abdominal area is a safe place, where you can feel all the air entering your whole body, and transferring this air to every part of your body. Your whole body breathes just from your abdominal area. With every in-breath, imagine the air entering your stomach, and from there traveling all the way down to your hips, to your thighs, to your knees, to your feet and toes.

With the next in-breath, imagine the air entering your stomach and from there the air traveling upward towards your chest, your throat, your face, your arms. Do not try to control the breath. Let it flow freely in and out of your body. As you watch your breath, feel a gentle stillness and calmness. Observe any thoughts or feelings, without trying to control them. Just let them be.

As this recording comes to an end, you may start moving your body gently. You may want to stretch your legs and arms, or stretch your neck. Now slowly open your eyes and remain still. You may observe your surroundings, the room that you are in right now. See the shape of the room, and its textures and colors. Let any calmness that you are feeling now stay with you for a little longer. Remember that if you feel uncomfortable at any time, you can always return to this sensation, of the breath moving into the body, the breath leaving the body, letting the breath breathe itself, not having to control it.
Appendix B. Insight Problems

Instructions: You will have ten minutes to complete as many of these logic problems as possible. Please place a check mark next to any problem you have previously encountered. If you finish before ten minutes have elapsed, please notify the experimenter.

1. Show how you can make the triangle below point downward by moving only three of the circles.
   Please draw arrows on the diagram to illustrate which circles you would move and to where.

   ![Triangle Diagram]

2. A prisoner was attempting to escape from a tower. He found in his cell a rope that was half long enough to permit him to reach ground safely. He divided the rope in half, tied the two parts together, and escaped. How could he have done this?

3. A dealer in antique coins got an offer to buy a beautiful bronze coin. The coin had an emperor’s head on one side and the date 544 BC stamped on the other. The dealer examined the coin, but instead of buying it, he called the police. Why?

4. Nine pigs are kept in a square pen. Build two more square enclosures that would put each pig in a pen by itself.

   ![Pigs Diagram]
5. You are standing outside a light-tight, well-insulated closet with one door, which is closed. The closet contains three light sockets each containing a working light bulb. Outside the closet, there are three on/off light switches, each of which controls a different one of the sockets in the closet. All switches are off. Your task is to identify which switch operates which light bulb. You can turn the switches off and on and leave them in any position, but once you open the closet door you cannot change the setting of any switch. Your task is to figure out which switch controls which light bulb while you are only allowed to open the door once. How would you accomplish this? Please explain your answer in writing under the diagram.