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# Mood and Creativity: The Mediating Role of Attention

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**MOOD AND CREATIVITY: THE MEDIATING ROLE OF ATTENTION**

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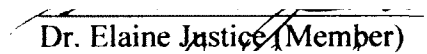
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## **ABSTRACT**

### **MOOD AND CREATIVITY: THE MEDIATING ROLE OF ATTENTION**

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Within literature there are two opposing views regarding the role of emotions in the creative process. The most commonly held view contends that positive emotions enhance creativity, while negative emotions stifle it; yet, some studies show an opposite trend. To help resolve this conundrum, this research examined the mediating effect of attention on the relationship between mood and creativity. The results showed that positive deactivating and negative activating emotions led to broader attention, while positive activating and negative deactivating emotions caused narrowing of attention. Furthermore, the creative process is not uniform in its requirements of attentional breadth; some creative tasks require broad and others narrow attention for their completion. When differential requirements for global versus local attentional focus at the differing stages of creativity were taken into consideration, the influence of emotions become more straightforward; different attentional breadth requirements corresponded to differential stages of creative performance.

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## INTRODUCTION

The current research investigates how emotions affect creativity processes and whether attentional breadth plays a mediating role in that. This question is investigated using a multi-stage creativity model paradigm. To test this question, emotional valence and arousal levels were manipulated and their effect on different measures of creativity and attentional breadth were measured.

First, this paper reviews existing research regarding the relationships connecting mood, attention, and creativity. Second, it discusses how conflicting findings within the literature might be explained by use of a multi-stage creativity model. Third, a study that manipulates mood and arousal, and measures the effect on multiple measures of creativity and attention is reported. And finally, these results are discussed in terms of current theories of creative cognitive processes and attentional breadth.

### *The Role of Emotions in the Creative Process*

The importance of emotions in the creative process has been fully appreciated since ancient times throughout western civilization. The link between emotions and creativity has been well documented through a host of anecdotal evidence, self-reports of prominent artists and scientists alike, as well as empirical research. Despite overwhelming agreement that emotions play an important role in the creative process, little agreement exists as to what type of emotions enhance and what type of emotions stifle creativity. Three distinct views exist. The first holds that positive emotions enhance, while negative emotions stifle creativity (e.g., meta-analytical study by Davis, 2009). The second proposes the opposite, that negative emotions promote creativity, while positive emotions suppress it (e.g., Akinola & Mendes, 2008). Yet, a third view posits that both

positive and negative emotions are necessary for the creative process to occur (e.g., meta-analytical study by Baas, De Dreu & Nijstad, 2008). Consequently, on one hand, there is an overwhelming body of evidence linking positive affect with creativity; many researchers finding evidence of artists and scientists alike experiencing states during the creative process, which are described as “flow” (Csikszentmihalyi, 1990), complete absorption in the present moment (Nakamura & Csikszentmihalyi, 2009), elation, emotional high, and even giddiness (Schuldberg, 1994).

On the other hand, multiple anecdotal evidence suggests that negative emotions are vastly more important for creativity than are positive emotions. Such prominent creators as Robert Shumann, Hector Berlioz, Winston Churchill, Van Gogh, among many others, were diagnosed with mood and personality disorders such as depression, bipolar disorder, and schizophrenia (Bowden, 1994). Yet other evidence suggests that the creative process is marked by both positive and negative affect simultaneously (Shuldberg, 1994). Both artists and scientists report experiencing heightened positive and negative emotions at the same time during peak creative experiences (Shaw & Runco, 1994).

Abele (1992) suggested that there are two ways in which mood affects creativity: one is through affecting task motivation by affecting interest to engage in a task, and another is through affecting cognitive functioning. The current study concentrates on the effects of mood on cognitive functioning. It has been shown that positive mood broadens attention, while negative mood narrows it (e.g., Gasper & Clore, 2002; Fredrickson & Branigan, 2005). A link between attention and creativity has also been established. Breadth of attention has been shown to influence performance on creative tasks (e.g.,



Nęcka, 1999; Mendelsohn, 1976; Kasof, 1997). Thus, it is conceivable that mood can influence creativity through attention, by broadening or narrowing attentional focus, which in turn, affects creative task performance.

In the present study mood was manipulated by presenting the participants with a series of emotion-educing images designed to elicit either positive or negative emotions at differing arousal levels. The effects of emotions across different arousal levels were measured on a set of attention and creativity tasks. Attention tasks were designed to measure the attentional breadth, while creativity tasks were designed to capture different facets of the creative process.

### *Studying Creativity*

Creativity is a multifaceted construct and is generally conceptualized as the “generation of ideas, insights, or problem solutions that are both novel and potentially useful” (Baas, de Dreu, & Nijstad, 2008, p. 780). While novelty and usefulness are necessary, they are not in themselves sufficient conditions for creativity. For example, ideas can be novel, yet nonsensical. Additionally, ideas must be appropriate and valid (Vosburg and Kaufman, 1999). According to Kaufman (1993), validity encompasses the significance and meaningfulness of an idea, the internal consistency of a theoretical model, the esthetic value of an artistic products, functionality of a device, or a novel social practice. Another important component of creativity is the rejection or modification of previously accepted ideas. Boden (1991) described this as “thinking the impossible” or a fundamental departure from “the basic rules of a particular conceptual space” (Vosburg & Kaufman, 1999, p. 20).

Multiple theories have been put forth to explain how creative ideas are developed. Some theorists (Mendelsohn, 1976; Mednick, 1962) proposed that creative individuals differ from those less creative by their ability to access larger amounts of various mental concepts. This ability greatly depends on an individual's ability to control attention. The more stimuli an individual can simultaneously attend to, or the more defocused one's attention is, the more creative the individual (Mendelsohn, 1976).

One of the most important questions in creativity research is how to study and measure it. Different approaches to studying creativity have evolved throughout history: mystical, pragmatic, psychodynamic, psychometric, cognitive, social-personality, and multidisciplinary (Sternberg & Lubart, 1999). Proponents of the psychometric approach (Guilford, 1950) were the first to propose that creativity can be studied employing everyday participants using paper-and-pencil tasks. While this approach was a breakthrough in creativity studies and made it possible to study different components of creativity in the laboratory, it ignored the complexity of the creative process. Researchers applying a cognitive approach to studying creativity tried to understand how mental representations are formed and what cognitive processes underlie creativity. Based on a cognitive approach, Finke, Ward, and Smith (1992) created the Geneplore model, which presents creativity as a two-stage process. The first stage is generative and is associated with the construction of mental representations. The second stage is exploratory, during which the mental representations constructed during the first stage foster the appearance of novel and creative ideas. A social-personality approach looked at personality and motivational variables, as well as the sociocultural environment as triggers of creativity. While both cognitive and social-personality approaches have contributed separately to

creativity research, few studies have sought to integrate the two. Later approaches have attempted to correct this shortcoming by proposing that multiple components need to converge in order for the creative process to occur (Sternberg & Lubart, 1999).

Creativity has been measured using widely different methods, such as divergent thinking and idea generation tasks, insight problems, as well as employing subjective ratings of creativity (Baas, de Dreu, & Nijstad, 2008). A question arises of whether these differing measures are measuring the same construct. For example, divergent thinking tasks are open-ended and measure the ability to produce multiple unorthodox ideas (Mumford, 2001). Whereas, insight problems have only one possible solution, and require restructuring of the problem's mental representation in order to successfully solve it (Simonton, 2003). Yet other studies asked participants to write a poem, draw a picture, or perform another loosely defined task; participants' performance was then subjectively appraised by independent judges using some kind of scale (e.g., Simonton, 2003). Since different psychological processes might be responsible for different aspects of creative performance, it is questionable whether these varying tasks provide a measurement for the same underlying construct (Baas, de Dreu, & Nijstad, 2008). Hence, different emotional and attentional states might differentially influence performance on various tasks.

In the current study, multiple facets of creativity were measured using two problem types: insight and open-ended problems. For insight problems, solution credit was given if the problem was correctly solved. For open-ended problems, there was no right or wrong answer; for these problems, the solution's creative quality was measured using fluency, originality and usefulness measures. For both problem types there were

two subtypes, each requiring either a broad or narrow attentional focus in order to achieve a successful solution. Thus, different problems were selected to represent different stages of the creative process; problems requiring a broad attentional focus were designed to simulate the early stages of creativity, while problems requiring a narrow attentional focus were designed to simulate later stages of the creative process.

### *Defining Affect*

Affective phenomenon is most commonly described as emotion, mood and affect. Emotion is usually directed towards a specific stimulus, and is characterized as being intense, but short lasting. Mood is generally seen as being more durable and persistent, but usually of a lower intensity. Affect is the most general of the three, referring to the most enduring, long-lasting mood states (Baas, de Dreu, & Nijstad, 2008). Despite the distinction, these three terms are often used interchangeably in research. There are numerous dimensions in which mood differs, however, three most studied dimensions are hedonic tone, activation, and approach/avoidance orientation. Hedonic tone refers to the valence of emotions, that is whether it is positive or negative. Activation refers to whether the emotion is calming and deactivating (e.g., calm, relaxed, sad), or activating (e.g., happy, elated, angry, fearful). Based on these two dimensions, moods can be both positive or negative, and activating or deactivating (Baas, de Dreu, & Nijstad, 2008). These two dimensions have applicability to temporary moods as well as trait-related differences in emotional states; such as extraversion being related to positive and activating states. The difference between approach and avoidance orientation is based on the regulatory focus theory (Higgins, 1997; Idson, Liberman, & Higgins, 2000) that distinguishes between promotion focus and prevention focus. Approach/avoidance

orientation has mostly been studied in relation to more enduring traits and personality characteristics.

### *Breadth of Attention*

Kasof (1997) referred to breadth of attention as “the number and range of stimuli attended to at any one time” (p.303). People exhibiting a narrow state of attention focus on a relatively small range of stimuli and filter irrelevant stimuli from their awareness. Conversely, people having a broad state of attention focus on a large range of stimuli and tend to be more aware of irrelevant stimuli. In the field of visual attention research, Navon (1977) pointed out that the breadth of attention corresponds to the way information is processed: broad, or global attention, corresponds to global-to-local, or top-down information processing, which is how humans tend to process information under normal circumstances. Gestalt psychologists posited that humans process information holistically, a view that was later developed into the global-precedence hypothesis that was supported by a multitude of research (Kimchi, 1992). However, later research disputes the inevitability of top-down processing (e.g., Van der Stigchel, Belopolsky, Peters, Wijnen, Meeter, & Theeuwes, 2009). For example, Van der Stigchel et al. argue that initially information is briefly processed in a bottom-up manner, and only then do top-down processes assume control. Top-down processing can also influence the size of attentional window, i.e., broaden or narrow attention based on the demands of the environment. A similar distinction has been made in perceptual processing research between contextually and conceptually driven processing (Reicher, 1969). Contextual processing is guided by sensory information, which corresponds to a narrowing of

attention on a task; while conceptually driven processing is guided by concepts stored in long-term memory, which corresponds to broad attentional focus.

### *Mood and Creative Thinking*

Overall, there is a large body of literature showing the positive relationship between positive emotions and creativity. Conversely, a substantial number of studies demonstrate a positive relationship between negative emotions and creativity, and a negative relationship between positive emotions and creativity. One explanation for these inconsistencies might be that various studies used different methods to induce mood, which would enhance different components of the mood construct. If we treat mood as a multidimensional construct with different correlates (Baas, de Dreu, & Nijstad, 2008), then it is conceivable that diverse mood induction methods activate different segments of the mood construct. The same applies to the creativity construct and its measures: differing tasks might in fact measure disparate aspects of the creative process.

### *Effects of Positive Mood on Creativity*

Overall the effect of positive mood on the creative process is well established throughout creativity literature; multiple studies found that positive mood enhances creativity on an array of differing tasks. Specifically, positive emotions appear to enhance performance on tasks requiring broad, defocused attention more so than on those requiring a narrow, concentrated scope of attention.

A meta-analysis by Baas, De Dreu and Nijstad (2008) examined mood and creativity research conducted between 1984 and 2008. The authors tested whether there were differences between positive and neutral, negative and neutral, and positive and negative moods in their effect on creativity by examining 102 effect sizes. Overall, they

found that positive moods were more conducive to creativity than neutral moods and that there was no significant difference between negative and neutral moods, or positive and negative moods. However, when the authors coded for separate components of creativity, such as eureka/insight tasks, flexibility, fluency, and originality; a more complicated pattern emerged. When examined separately, the authors found a significant difference between positive and negative, and positive and neutral moods for eureka/insight tasks. Positive moods were associated with more creativity than were neutral or negative moods; however, no difference was found between negative and neutral moods. For the flexibility, fluency and originality components of creativity there was significant difference for all three contrasts (between negative and neutral, positive and neutral, and positive and negative moods). Positive mood was associated with more creativity than were neutral or negative moods, and negative mood was associated with more creativity than was neutral mood.

Yet another meta-analysis examined a total of 72 studies in order to evaluate whether positive moods enhance creativity (Davis, 2009). Overall, this study found a significant effect between positive and negative, and positive and neutral moods; with positive mood being associated with higher creativity. No difference was found between neutral and negative moods. Davis' study also found that these effects were dependent on the type of creative task used. The author separated task types into two categories: ideation and problem-solving. The results showed that there was a significant difference for positive versus negative, and positive versus neutral moods for ideation tasks, but not for problem-solving tasks. Thus, problem-solving performance was not affected by differential mood states. Furthermore, there was a more robust difference between

positive and neutral than between positive and negative moods for ideation task creativity enhancement.

In a series of studies, Isen and colleagues investigated the effects of mood on creative performance. In their 1984 study, Isen and Daubman examined the influence of mood on categorization. In a pilot study, aimed at establishing a relationship between positive mood and categorization, the participants were induced with positive deactivating mood. A categorization task, used as a dependent measure, required the participants to pick an exemplar that was the most representative of a given category, and then rate these items based on how closely they represented a category. The results of the study were mixed, only about half the time did participants in the deactivating positive affect condition were more likely to rate unusual exemplars as members of a category. The following study included both positive and negative mood conditions. No information about whether mood was activating or deactivating was recorded. The results showed that participants in the positive mood condition rated more poor exemplars as category members, and likewise rated them higher than controls. A similar trend was found for the negative mood group, however, the effect did not reach the customary significance level. In a subsequent experiment, Isen and Daubman found no difference in the number of categories that the participants created in the positive and negative mood conditions, however, these both conditions created significantly fewer categories than the control group. While a lack of significant effect for the negative mood condition hindered further investigation, the authors' interpretation of these findings was that negative affect might influence categorization in the same manner as positive affect.



In the next study, Isen, Johnson, Mertz, and Robinson (1985) looked at the effect of positive mood on word associations. Creativity was measured by the unusualness of word associations. Results showed that people within the positive affect condition produced a greater amount of unusual word associations than did people in the neutral condition. Thus positive mood led to better performance on divergent thinking tasks, which required a broadening of attention.

In a four-experiment study Isen, Daubman, and Nowicki (1987) looked at mood effects on creativity using candle task (Duncker, 1945) and the Remote Associates Test [(RAT) Mednick, Mednick, & Mednick, 1964)]. The study included positive, negative, and neutral mood groups, as well as high arousal group, in which arousal was induced by asking participants to exercise for two minutes. Participants in the positive mood condition solved more candle problems than any other group. No difference in problem solving time was detected among the groups. A comparison of the positive affect condition (induced by gift giving) with the neutral condition revealed that participants in the positive mood condition solved significantly more medium-difficulty items on RAT, than did participants in the control group. No difference was found for low- or high-difficult items. In another experiment comparing a positive group (shown a comedy video clip) with a control and arousal group (exercise), there was a significant RAT score difference between the positive and control groups, but not between the positive and arousal groups. Thus, while the study found a solid effect of positive mood on solving a candle task across conditions, only in one out of three conditions on the RAT task similar effect was found.

A possible explanation for these results might be that the two tasks were tapping into different components of creativity. While the candle task is universally accepted as a measure of divergent thinking (Duncker, 1945), the question of whether the RAT task is a measure of divergent or convergent thinking still remains open, many consider RAT to be more closely related to convergent rather than divergent thinking (e.g., Taft & Rossiter, 1966). Overall, the study found that positive mood aided performance on creativity measures, however, the effects of positive mood did not differ from the effects of arousal. Finally, since only one out of four experiments in this study used a negative mood condition, a decisive conclusion cannot be reached regarding the effects of negative mood on creativity, or lack of thereof, based on this study.

Abele's (1992) study analyzed the effects of various moods on verbal creativity tasks. The researcher used unusual uses (UU) and fictitious situation (FS) tests as measures of creativity. The UU test was intended as a low instrumental task; herein, participants were asked to produce as many unusual uses as possible for an empty can and ordinary string. The FS test measured "logical extrapolation of experiences into a novel situation" (p.206) and was considered a high instrumental interest task; participants were instructed to produce as many ideas as possible for the fictitious situation of "what would happen if one were able to listen to [another] person's secret thoughts (p. 207). The results showed that positive mood increases ideation fluency across both tasks; whereas negative mood increased ideation fluency on a high instrumental interest task, but not on a low instrumental interest task. In this study, it is possible to compare high and low instrumental tasks in terms of the breadth of attention required throughout the performance of each. The high instrumental task called for narrower attention than did

the low instrumental task, as it asked participants to deal with a concrete situation, and then extrapolate analytically from it to a wider domain, thus engaging “tighter”, more analytical, and “bottom up” processes. Conversely, the low instrumental task entailed broader attention, as it required participants to find *any* unusual use for an object, thus engaging looser, “top down” information processing.

Subramaniam, Kounios, Parrish, and Jung-Beeman’s (2008) study looked at the effects of different levels of mood on insight problem solving. There was no mood induction in this study; participants were separated into three equal groups based on the valence of their moods as measured during the experiment. A top, middle, and bottom groups were created, thus authors treated mood as a uni-dimensional variable. RAT was used as a measure of creativity. The researchers found that participants in the top third mood condition solved more problems than did the participants in the other two conditions. Of interest here, they found that positive mood was related to the strategy that participants used to solve problems. The number of insights was significantly different across the three mood conditions, however, the number of problems solved analytically did not differ. Anxiety had an opposite effect, participants with highest anxiety levels solved fewer problems with insight than participants lowest on anxiety; thus, anxiety was negatively correlated with solving problems via insight. However, anxiety did not affect the raw number of analytical solutions obtained. These findings fall in line with suggestions made by Abele (1992) that “intuitive” problems benefit from positive affect, but not analytical problems. The results of this study also serve to explain why meta-analytical studies (Baas, de Dreu, & Nijstad, 2008; Davis, 2009) found no reliable effect of mood on insight problems. While mood affects what strategy a person may use to

solve an insight problem, because different people might solve insight problems using different strategies; in the end, there will be no difference in the number of problems solved. This study also found that anxiety, activating negative affect, enhanced the proportion of solutions achieved analytically. This effect might also be contributed to a narrowing of attentional focus.

Contrary to the results of other studies, Clapham's (2001) study found no evidence for mood effects on divergent thinking. In this study, mood was induced using a list of statements, each of which corresponded to a treatment condition. In the positive affect condition, the statements grow increasingly positive, ending with statements such as "This is great...I really do feel good. I am elated about things!" and "I'm full of energy!" (Clapham, p. 341). In the negative affect condition, the statements become increasingly negative, ending with expressions such as "All of the unhappiness of my past life is taking possession of me" and "I want to go to sleep and never wake up" (Clapham, p. 341). The study used the TTCT-Figural (Torrance, 1966) as a measure of divergent thinking in which test takers were asked to use abstract sketches to form pictures. For example, test takers were asked to use a circle to draw whatever they choose. The study found that positive mood did not facilitate performance on divergent thinking measures. Conversely, negative mood was not found to impede performance, either. The authors speculated that the failure to find significant differences among treatment conditions may have been due to the fact that mood manipulation was too weak, particularly for the negative mood condition, to produce significant changes.

Vosburg (1998a) examined the effects of positive and negative mood on divergent-thinking tasks. Mood and arousal were assessed at the beginning of experiment

using an adjective checklist. Divergent thinking was measured by tasks that asked participants to respond to various real-life scenarios, which measured two distinct components of divergent thinking: problem finding and problem solving. They found that overall positive mood was positively related, and negative mood was negatively related to the task performance for both problem finding and problem solving. No effect of arousal was detected. In another study using the same measures, Vosburg (1998b) tested a hypothesis that positive mood should foster the amount, but not the quality, of produced ideas. The hypothesis was supported, i.e., positive mood was significantly related to the quantity of ideas factor, encompassing fluency and flexibility components, but not to the quality of ideas factor, which measured originality and usefulness of produced ideas.

In summary, while the prevailing view in mood-creativity research is that positive mood induces creativity uniformly across a wide variety of tasks (e.g., meta-analytical study by Baas, De Dreu & Nijstad, 2008), closer examination of the results of separate studies reveal a far more complicated pattern. Differing results of mood influence on creativity are obtained on different creativity measures. For example, results of mood influence on RAT task are contradictory, with not all studies showing a solid performance improvement (Isen, Daubman, & Nowicki, 1987). Additionally, other studies (Vosburg, 1998b) found that positive mood affects differentially various components of creativity. For example, it is related to the quantity, but not quality of produced ideas. The mood induction technique appears to matter as well, as not all induction procedures produce enough change in mood states to evoke significant change in creative thinking. Some methodological shortfalls of the aforementioned studies might also be responsible for their contradictory results, such as failure to include negative

mood condition within the experiment, limiting comparison to only positive and control groups (e.g., Isen, Johnson, Mertz, & Robinson, 1985), or weak mood induction techniques (Clapham, 2001). Overall, the general conclusion is that positive mood has a consistent effect of benefitting performance on tasks that require broad attentional focus, however, on tasks requiring narrow attentional focus the effects of positive mood are far less clear.

### *Negative Emotions and Creativity*

Not all researchers are in agreement that positive emotions necessarily enhance creativity while negative emotions stifle it. Historical data suggests that many highly creative people suffered from depression as well as other mental disorders. Indeed, multiple studies found links between creativity and mental disorders, in particular bipolar disorder (e.g., Andreasen, 1987; Jamison, 1989; Richards, Kinney, Daniels, & Linkins, 1992), hypomania (e.g., Jamison, Gerner, Hammen, & Padesky, 1980; Schuldberg, 1990), depression (e.g., Slaby, 1992), and schizophrenia (e.g., Keefe & Magaro, 1980; Sass, 2001), thus suggesting that negative affect might be conducive to creative processes.

Among other studies, a study by Akinola and Mendes (2008), [that in fact was excluded from the Baas, De Dreu and Nijstad (2008) meta-analysis, omission justified by asserting that Akinola and Mendes study was singular in its findings], found that higher artistic creativity was associated with negative moods more so than with positive moods. The researchers used the Abbreviated Torrance Test for Adults as a base line measure of creativity. Each participant was asked to make “interesting” and “unusual” pictures using nine triangles. Mood was then manipulated using social approval/rejection task, in which

participants received either positive or negative feedback. During their second creativity task participants were asked to make an artistic collage using a piece of cardboard, a bottle of glue, a bottle of glitter, and pieces of felt and paper of various shapes and size. The participants' creativity was then assessed by experienced artists. Collages created by participants in the social rejection condition were judged as being the most creative, with ratings differing significantly from the control and social approval conditions. Interestingly, ratings in the social approval condition were even lower than those in the control condition, although this difference did not reach statistical significance.

Kaufmann and Vosburg's (1997) research examined the effect of positive and negative moods on creative and analytic problem solving performance. Their study found a negative relationship between positive mood and creative problem solving. They used two insight problems as a measure of creativity. The first problem was a Two String problem, in which the task was to tie two widely separated strings hanging from the ceiling. Since it was impossible to grasp both strings at the same time, the insight into the problem was to tie available tools to the strings, and then use a pendulum movement to grab a hold of both strings. The second insight problem dealt with figuring out the construction a solid rack from two sticks and a C-clamp. The correct solution involved wedging the sticks together and using the C-clamp as a peg. Analytical performance was measured with a standard word-analogy task, and yet another problem required the detection of a rule behind a numbering sequence. Mood was manipulated by showing participants a 10 minute, positive or negative video clip. The results showed that negative mood enhanced performance while positive mood led to significantly poorer performance on both creative problems. Analytic problem-solving performance was not affected by

different affective states. The study's findings that positive mood effects are detrimental to insight problem solving contradict sharply with most research in this domain. The findings particularly contradict with the Isen et al. (1987) study that used very similar task, but which found an exact opposite trend.

Another Kaufmann and Vosburg study (2002) tested the hypothesis that positive and negative moods might have different effect on creative problem solving as a function of constraint on the solution space of a task. Contrary to their previous study, they found that on divergent thinking tasks positive mood enhanced performance overall; yet over time, positive affect caused a decline in creative problem-solving performance, while negative affect was associated with greater idea production later in the process. In their experiment, the authors used a mood induction technique developed by Martin et al. (1993). First, participants were shown video clips to induce either negative or positive emotions, followed by a video clip from the film *Speed*, which was intended to arouse the participants in order to enhance mood induction. No films were shown to the control group. Creativity was assessed using four measures of divergent thinking. One was a problem-finding task, where participants were asked to come up with possible scenarios that lead to a problem described in a vignette. The second task was a problem-solving task where participants had to list all the solutions to the problem in the same vignette. The third task was to list all possible uses for a shoe, and in the last task, participants were presented with an ambiguous visual figure and were asked to list all possibilities of what that figure might represent. The results indicated a crossed interaction between positive/negative mood, and early/late idea production. Positive mood led to better performance in the first minute of problem solving, however, performance in the positive



mood condition declined sharply after that, and at minute four participants in the positive mood condition were performing worse than participants in the negative and control group conditions. Thus, positive mood led to superior idea production initially, however, caused a decline in idea production during the later stages of performance. The flat association gradient that participants showed in the negative condition was similar to the gradient that Mednick (1962) characterized as indicative of creativity. On the other hand, participants in the positive mood condition showed a steep response gradient that Mednick associated with less creativity.

Kaufman stated “[the above] findings are consistent with results showing positive mood to increase fluency in divergent thinking tasks” (Kaufman, 2003, p. 132). However, he added, the argument that positive mood uniformly improves performance on divergent thinking tasks cannot be applied to every instance, and he called for a more complex understanding of creativity. Because creativity is a multifaceted construct, different moods may affect various components of creativity differently.

Jausovec’s (1989) study analyzed whether positive emotions enhanced analogical transfer on insight problems. The study found that positive mood increased analogical problem solving on ill-defined problems, but that positive affect was detrimental to performance on well-defined problems. Creativity was measured with two types of problems: ill-defined and well-defined. Ill-defined problems required participants to relate information given by the problem to other areas of a knowledge base, thus requiring an expansion of their attention, thinking globally, and using a top-down information processing approach in order to successfully solve the problem. The study found that positive affect aided analogical transfer on these types of problems. Well-

defined problems, on the other hand, required participants to focus their attention only on the information given by the problem, no search of other knowledge was required in order to solve the problem. The results indicated that in fact positive affect hurt analogical transfer on well-defined problems.

Wayne and Runco (1994) examined the link between divergent thinking and suicide ideation. Suicide ideation was assessed by questionnaire in a sample of university students. Divergent thinking was assessed by asking participants to respond to scenarios of real-life problems, like late homework, or unplanned pregnancy. Responses were scored for fluency, flexibility and originality. The study found a significant relationship between divergent thinking and suicide ideation. In particular, suicide ideation was positively associated with problem generation fluency, but negatively associated with problem solving flexibility. Thus, suicide-prone participants showed a greater ability in finding problems, which has been shown to be an important component in the creative process (Nickerson, 1999).

Adaman and Blaney (1995) investigated the effects of musical mood induction on creativity. Mood was induced by playing 20-minute audio-clips that were designed to induce elated, depressed or neutral moods, a technique developed by Pignatiello, Camp, and Rasar (1986). Creativity was measured with the subset of the Torrance Tests of Creative Thinking (TTCT; Torrance, 1966). The researchers hypothesized that participants in the elation mood condition would score higher on creativity measures than would participants in the neutral or depression condition. Contrary to expectations, both the elated and depressed groups scored significantly higher than the controls. The authors

speculated that intensity of feeling, or activation might have a stronger influence on creativity than hedonic tone.

Gasper (2004) tested the hypothesis that sad moods inhibit generative thought through affecting an individual's ability to use accessible, old ideas, as well as novel ideas, and by restricting access to available material in a memory. In a series of three experiments, the author tested this hypothesis, using similar method. Mood was manipulated by asking participants to write about either a sad or happy life event. After completing a crossword puzzle designed to prime the participants with a set of solutions for the generation task, they completed the generation task that asked them to come up with as many as possible examples of "things that fly" (Gasper, p. 218). Old ideas were operationalized as the primed words found within the crossword puzzle, while new ideas were operationalized as ideas that had not appeared in the crossword puzzle. Contrary to their prediction, mood did not influence the use of old solutions in the generative task. Participants in a sad mood, however, generated fewer new responses than did participants in the happy mood condition. This was taken as evidence that negative mood alters the use of novel information, but not the use of information already stored in the memory.

Braverman (2005) investigated whether negative moods facilitate data driven information processing, and whether positive moods promote a top-down information processing approach, while decreasing attention to cognitive task. Mood manipulation involved showing the participants either sad or happy video clip. Then each participant was given the task of detecting covariation of facial features with different test scores. The results showed that participants in a sad mood detected a greater amount of correct covariation than did participants in a happy mood. This was taken as evidence of the

tendency of a sad mood to influence more comprehensive scrutinizing of information. A subsequent study also showed that motivation was responsible for differential covariation detection in happy versus sad participants. Negative mood increased participants' motivation to engage in a more thorough thinking process and pay closer attention to details, which in turn led to more frequent correct hits. Thus, the hypothesis that sad mood promotes focusing on a task and facilitates a data-driven information processing approach, while happy mood detracts attention from the task at hand, was supported.

Andrews and Thomson (2009) proposed that negative emotional states serve a valuable adaptive function. Using depression as an example, the authors showed it to be a useful mechanism for the successful solving of complex problems. Depression makes people ruminate over their problems, compelling them to revisit and analyze each problem in excruciating detail. Analysis is a necessary step in problem solving, thus it is advantageous to spend time doing so. However, there are many life distractions that might redirect one's attention from problem analysis. Thus, the analytical rumination hypothesis proposes that depression facilitates problem analysis by minimizing distractions and sustaining analysis towards these problems. Since processing resources are limited, it is achieved by: allocating cognitive resources to problem solving, eliminating distractions by minimizing the appeal of problem-irrelevant activities; and initiating psychomotor changes that minimize the ability to engage in distracting activities.

Gaspar (2003) investigated the hypothesis that people in a negative mood adhere to data more so than do participants in a positive mood. The dependent variable in this study was a mental set task (Luchins, 1942), requiring participants to form a word from a

set of presented letters. Some of problems required a certain mental strategy to solve them successfully (e.g., by using every second letter from a lettering set the solution for GZOQAXT is GOAT), while others could be solved using a direct, more apparent strategy (e.g., the solution for FYROOMG is ROOM). After presenting the participants with a problem designed to break the established mental set, they were given problems that could be solved using either one of the two strategies. The results indicated that participants in the sad mood condition updated their approach to problem solving more often than did participants in the positive or neutral mood condition, thus showing that people in a sad mood adhered to data more so than did people in happy or neutral moods.

Smith, Michael, and Hocevar (1990) examined the effects of test anxiety on creative thinking, predicting that it should interfere with divergent thinking. Anxiety was induced by urging participants, middle school children, to do their absolute best, emphasizing strict grading and the importance of correct responses, imposing a time limit, and announcing monetary rewards for the top performers. The three creativity measures in the study were: the verbal fluency test; the figural fluency measure; and the mathematical fluency measure, which was designed to access the divergent production of symbolic implications. The presence of anxiety did not result in lower verbal fluency and figural fluency measure scores. Contrary to expectation, figural fluency test scores were higher for the anxiety group than for the control group. This difference was only marginally significant for a two-tail test, but would have reached customary significance level for a one-tail test, assuming there was a-priory directional prediction. Anxiety produced lower scores on the mathematical fluency measure as compared to the control condition, however the difference was only significant for males, not for females.

In summary, contrary to the widely held belief that negative emotions hinder creativity, a more detailed examination of the literature revealed surprising results. First of all, there are practically no studies asserting that negative emotions cause a decrease in creativity. An exception was a singular experiment investigating mathematical fluency in which anxiety was found to have negative effect on creativity, however, this effect was significant only for males. More surprisingly, in some cases, negative emotions were related to an increase in creative thinking across a wide variety of tasks. In particular, negative mood was associated with better performance on tasks requiring top-down information processing, focused attention, and data elaboration. Some authors suggest that negative moods help performance through a narrowing of attentional focus on the task at hand. Negative emotions also seem to have a motivational influence on a person's performance by compelling them to pay greater attention to problem details, ignore distractions, and engage in sustained problem analysis. However, the effects of mood on creativity are fragile, and not always discernible in research. One reason for this might be that negative mood manipulations are frequently insufficient in strength in laboratory settings, due to the ethical concerns, among other reasons. Interestingly, some studies found that positive mood hinders creativity, rather than promoting it, as widespread belief suggests.

#### *Mood and Attention*

Early investigative work into the relationship between mood and attention established that high negative emotional arousal causes a narrowing of attention. Eastbrook (1959) speculated that negative affect high in avoidance motivation would narrow attentional focus (Easterbrook, 1959), moreover, later studies supported this

proposition. Baron, Moore and Sanders (1978) found that social stress, which can be conceptualized as a highly activating negative mood, also caused a narrowing of attentional focus. Wachtel (1968) found that participants who were threatened with electrical shock, and had no means of avoiding it, exhibited a longer reaction time to targets in the periphery of their visual field than did non-threatened participants, thus also showing a narrowing of attentional focus. The results of Fenske and Eastwood's (2003) experiment showed that participants exposed to facial expressions displaying negative emotions showed more constricted attention.

Mendelsohn and Griswold (1967) investigated the effects of repression denial and anxiety on the use of incidental cues in problem solving. As predicted, high scores in repression denial were negatively related to the use of incidental cues. Participants with high repression denial scores used fewer cues than did participants with low repression denial scores, yet, there was no difference between participants with regards to the raw number of un-cued solutions. These results were more pronounced for males. Contrary to expectation, anxiety was related to cue utilization in a curvilinear fashion, again for males only, with those participants exhibiting the highest and lowest levels of anxiety using the most cues. A number of key points can be taken from this research. First, it is clear that different negative emotions affect perceptual attention differently. Second, the notion that negative emotions uniformly narrow attentional focus is put to question. Finally, the curvilinear relationship for the effects of anxiety points to the differential effects of arousal on attention.

Chajut and Algom (2003) also found that stress improved attentional selectivity. In their study, stress was manipulated by assigning participants high difficulty tasks,

some of which were unsolvable, imposing time pressure, introducing ego-threat by stating that they would be able to compare their performance to normative standards, and by subjecting them to loud noise. Selective attention was assessed by measuring each participant's ability to filter out irrelevant stimuli in a Stroop task. Narrowing of attention was uniformly observed across various stress manipulations.

Navon (1977) proposed that under normal circumstances we tend to perceive and process visual information in a top-down manner, or in his terminology, go from a global structuring to more-and-more detailed representation of stimuli. In other words, we dismantle the scene, rather than build it up; we go from global to local features. To test his hypothesis, Navon used a task in which participants judged clusters of geometrical figures as being similar or dissimilar to a target cluster. Matching figures based on their global shape, i.e., cluster shape as a whole, was considered an indication of global bias, while matching based on component shape, was an indication of local bias. This idea of broad-narrow, or global-local attention was also used in later research investigating the effects of mood on attention (e.g., Gasper and Clore, 2002; Fredrickson and Branigan, 2005).

Using Navon's figure task as one of their measures, Gasper and Clore (2002) investigated the effects of mood on global-local information processing. The results showed that participants in the negative mood condition were less likely than were the happy participants to match a figure based on its global features. In another experiment, participants in a sad mood condition were also less likely than their happy counterparts to rely on a global concept.



Similar findings were obtained in Fredrickson and Branigan's (2005) study. In this study, participants were initially shown either a positive, negative or neutral video clip. Then, their scope of attention was assessed using Navon's (1977) global-local visual processing task. The hypothesis that people who experience predominantly positive emotions will exhibit a broader scope of attention and will identify figures having greater global resemblance rather than local resemblance to a standard figure was supported: participants who viewed a positively charged film identified more global selections than did the participants who viewed a negatively charged film.

Basso, Schefft, Ris, and Dember (1996) investigated the relationship between personality characteristics, mood, and the breadth of attention. Due to "differences between sexes in affective experience and neuropsychological performance, only men were studied" (Basso et al., p. 250). There was no mood manipulation in this study; participants were administered three questionnaires: a depression inventory, a measure of subjective well-being, and a life-satisfaction scale. Breadth of attention was measured using the Kimchi and Palmer local-global judgment task (1982). The results indicated that positive mood was positively related to global processing, and negatively related to local processing. Anxiety and depression, on the other hand were positively related to local processing and negatively to global processing.

Bless, Clore, Schwarz, Golisano, Rabe and Wölk (1996) found that happy participants relied more on general knowledge structures than did participants in a sad mood. Mood was induced by either asking participants to write about a happy or sad life event, or by showing them a positively or negatively charged video. Following mood induction, participants listened to a story, and were then presented with items that were

either typical or atypical to the story. They were then asked to indicate whether the items were present within the story. The dependent variable was the participants' reliance on either general knowledge, or on the information presented within a story. Happy participants were more likely to judge a typical item as having been previously presented in a story than were sad participants, i.e., they relied more on their general knowledge than on information from within a story. This finding supports the proposition that happy moods aid on tasks requiring broad attention and top-down information processing.

Hicks and King (2007) investigated whether breadth of attention plays a mediating or moderating role between mood and meaning in life. While no support was found for the researchers' hypothesis that scope of attention relates to focus in life, the researchers did find a positive relationship between positive mood and breadth of attention, thus, adding further support for the positive mood/scope of attention relationship.

Gable and Harmon-Jones (2008, 2010) noted the existence of a far more complex relationship between mood and attentional focus. In the 2008 study, they found evidence that positive affect high in approach motivation reduced the breadth of attention. The authors argue that the reason for previous studies finding that positive mood broadens attentional focus is due to the fact these studies manipulated positive affect low in approach motivation. In four studies, participants consistently showed less global attentional focus after they were induced into a positive mood high in approach motivation. Similar to the results of previous studies, positive mood low in approach motivation increased global attentional focus. The authors explained these results in terms of an evolutionary perspective. Positive affect low in approach motivation implies

stability and comfort, which fosters a broadening of attention for play and exploration. Conversely, positive affect high in approach motivation implies desired goal pursuit, in which case, the narrowing of attention serves the function of shutting off irrelevant stimuli that might distract from achieving the main goal.

In 2010 study, Gable and Harmon-Jones argue, that while negative affect high in motivational intensity narrows attentional focus, negative affect low in motivational intensity broadens the attentional span. They suggested the reason previous research found that negative affect narrows the scope of attention is due to the fact that only negative affect high in motivational intensity was investigated. In the first experiment of this study, mood was manipulated by showing participants color photographs that were meant to evoke either a sad mood (low motivational intensity) or a neutral mood; the photographs were selected from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2005). Scope of attention was measured using Navon's letters task (1977); the concept of which was similar to Navon's geometrical figure task. Different from the majority of other research, it was participants' response time, rather than the number of global-local selections that was used as a dependent measure. The results showed that reaction time between global and local targets was larger in the sad mood condition than in the neutral mood condition. Additionally, participants in the sad mood condition showed a slower response time to local targets, while reaction time to global targets was similar across all conditions. This was taken as evidence of sad photographs causing a broadening of attention. In a follow-on experiment, the effects of high-motivation negative affect (disgust) were examined. Mood was manipulated by showing participants pictures that were collected from the internet and were intended to elicit

disgust. The dependent measure was identical to the previous experiment. Participants in the disgust condition responded faster to local targets than to global targets, thus showing a narrowing of attention. These results show that deactivating negative mood states high in avoidance (sadness), broaden attention, while activating negative moods high in avoidance (disgust), narrow attention.

Studies examining the relationship between temperament, affect and attention found that introversion and extraversion correlated with the manner in which attention was directed towards positive or negative cues. Derryberry's research (1987) revealed the phenomenon that introverts pay greater attention to negative cues than do extraverts. In a consequent research, Derryberry and Reed (1994) reestablished that extraverts were slow to shift attention away from positive locations, whereas introverts were slow to shift from negative locations. The researchers also found that negative feedback amplified this effect. These findings bridge the results of research investigating the effects of short-lasting moods on attention with the findings of more global affective states being associated with stable personality characteristics.

In sum, there is agreement in literature that people under normal circumstances and while in a positive mood, will tend to process information in a top-down manner, rely on general knowledge structures and global concepts, and in short, possess broad attentional focus. Conversely, people in a negative mood tend to process information in a bottom-up manner, rely more so on problem relevant information than on general knowledge, and demonstrate local bias, in other words, show a narrowing of attentional focus.

Studies investigating affect associated with personality characteristics also found a similar relationship between mood and attention. For example, introversion, a trait usually associated with narrow attentional focus was found to correlate with attention to negative cues, while extraversion, a trait associated with habitually broad attentional focus, was found to correlate with attention to positive cues (Derryberry, 1987; Derryberry & Reed, 1994). It is conceivable, that the narrowing of attention phenomenon might only be applicable to instances of negative affect high in activation, and not to negative affect low in activation. Only one study to date showed this particular pattern (Gable & Harmon-Jones, 2010). However, because the study design included only negative and neutral mood conditions and failed to include a positive mood condition (thus creating a design that disallows adequate between group comparison), finding of this study should be interpreted with caution.

Theories of why attentional focus narrows under negative activating mood states (such as states associated with the “fight or flight” response), hold that attentional resources are limited, thus selectivity, or localization of attention serves the purpose of allocating limited resources to the most pressing task-at-hand in the most efficient manner. Since “survival” of an individual may depend on the solving of a stressor-related problem, narrowing of attention ensures that resources are not wasted on other tasks (Chajut & Algom, 2003). Broad attention and the global bias associated with positive and neutral moods also make sense from an evolutionary perspective. Positive moods elicit broad attention that facilitates exploration and experimentation (Fredrickson, 2000). While negative emotions and narrow attention take care of survival and problem solving,

positive emotions and broadened attention promote play and exploration, facilitating the growth of an individual.

### *Attention and Creativity*

Attention is linked to creativity in several ways. First, well-known stereotypes portray creative people as absent minded, paying little attention to mundane issues, with their attention wandering in some “higher sphere” (Nęcka, 1999). While stereotypes should not be taken as evidence of any sort, they might point to a consistent phenomenon in some cases. Second, creative scientists report similar changes in their attention during the creative process. With regards to insight, they describe their attention as “diffused” just prior to an insight, and as “scanning” once the insight has been achieved (Ghiselin, Rompel & Taylor, 1964). Last, multiple experimental studies have found evidence of a relationship between attention and creativity (e.g., Nęcka, 1999; Mendelsohn, 1976; Kasof, 1997). While most researchers agree that a relationship between attention and creativity exists, the direction of this relationship has less consensus. Some researchers found that broad attention fosters creativity, while narrow attention impedes it, others have found an opposite trend, and yet others have found that both broad and narrow attention fosters creativity, however this relationship is task dependent.

Mednick (1962) proposed that individual differences in the strength distribution of associative responses are responsible for individual differences in creativity. Mednick distinguished between individuals with steep and flat associative hierarchies. Individuals with steep associative hierarchy tend to be restricted to stereotypical responses, i.e., responses highest in associative strength. The associative strength of responses to stimuli for individuals with a flat associative hierarchy is more equally distributed, thus

increasing the probability of them producing a more remotely associated, and therefore less stereotypical, response. Mednick proposed that the steeper the hierarchy, the less likely an individual to acquire a creative solution. It is those that are more likely to produce less stereotypical responses who are going to be more creative: “It is among these more remote responses that the requisite elements and mediating terms for a creative solution will be lurking” (Mednick, 1962, p.223). Individual differences in associative strength of responses can be viewed as differences in breadth of conceptual attention (Martindale, 1981, 1995; Friedman, Fishbach, Förster, & Werth, 2003), i.e., individuals with a steep associative hierarchy can be described as having a narrow scope of attention, and individuals with a flat associative hierarchy can be viewed as having a broad scope of attention. Thus, individuals with a broad scope of attention will tend to produce the least stereotypical, and therefore, most creative responses.

Mendelsohn (1976) believed that a wide breadth of attention facilitates creative performance. He noted that “the greater the attention capacity, the more likely the combinatorial leap which is generally described as the hallmark of creativity” (p.366). He viewed attention as an important variable in studying creativity, a variable independent of intelligence. In a series of studies, Mendelson and his colleagues showed that a wide breadth of attention aided creative performance (Mendelsohn & Griswold, 1967; Mendelsohn, 1976; Mendelsohn & Lindholm, 1972). Mendelsohn and Griswold’s (1967) study found that anxiety was negatively related to cue utilization, the results, however, generalized only to males. Repression denial scores were also negatively related to cue utilization, once again, the relationship was stronger for males. Mendelsohn and Lindholm’s (1972) study showed that breadth of attention affected priming. In

Mendelsohn's (1976) study, the relationship between attentional capacity and Remote Associates Test (RAT) scores were examined. The findings supported his proposition indicating that participants with higher attentional capacity would score higher on the RAT. The author hypothesized that the results were due to the ability of participants with high attentional capacity to maintain several search strategies simultaneously. However, similar to the previous study, this finding generalized only to the male participants.

Nęcka (1999) found that creativity was associated with impaired functioning of the filter of attention. In his study, participants scoring high on divergent thinking measures had longer reaction time on attention tasks than did participants scoring low on divergent thinking measures, particularly when task complexity increased. In the attention task, participants were asked to identify letters identical to the target letter and ignore all others. Creativity was measured using two tasks: Test for Creative Thinking-Drawing Production (TCT-DP) and Thinking Styles Questionnaire (TSQ). TCT-DP required participants to complete an unfinished picture. TSQ is a self-report measure consisting of items measuring ten scales that the author thought to be associated with creativity: (1) ego strength, (2) flexibility, (3) nonconformity, (4) spontaneity, (5) tolerance to incongruity, (6) internal locus of control, (7) intrinsic cognitive motivation, (8) esthetic attitude, (9) originality, and (10) self-actualization. The results showed that participants who scored higher on the creativity measure had poorer attentional functioning indices, i.e., had weaker filter of attention than did less creative participants. Nęcka explained the confusing results of selective attention impairment in creative individuals by noting "the lack of a strong and efficient filter of attention may make a person susceptible to "irrelevant" stimuli which are normally ignored or suppressed"



(Necka, p. 94). In terms of broad/narrow attention, filter of attention, that gives the ability to filter information, implies narrowing of attention. Thus, participants who had broader attention had better divergent thinking scores, yet, their ability to filter out irrelevant stimuli was reduced. The results also showed that creative individuals' performance deteriorated with time, particularly for individuals who scored high on intrinsic motivation. These findings mirror the findings of Kaufmann and Vosburg (2002) who likewise found a deterioration of idea production in participants within the positive mood condition, a state associated with broader attention.

Kasof (1997) found that breadth of attention was positively correlated with creative performance. Breadth of attention was assessed by the Stimulus Screening Scale, which measures "individual differences in the tendencies to automatically filter irrelevant or extraneous stimuli from awareness and to habituate to salient stimuli (Kasof, p.306)". Narrowing of attention was induced by exposing the participants to loud noise. Creativity was assessed by asking participants to write two semi-structured poems. Creativity was found to correlate positively with breadth of attention. Creative performance was impaired by noise; in particular, noise impaired the creative performance of participants with a wide base-line breadth of attention more so than in those participants having a narrow breadth of attention.

Friedman, Fishbach, Förster, and Werth (2003) found that situationally induced broad attention was related to better performance on divergent thinking tasks. In their study, scope of attention was primed by asking participants to conduct a visual search in either a broad or narrow area of a visual field. Two different tasks were used: one involved identifying the correct digits on a visual display, and the other asked participants

to concentrate on either a broad or narrow area of a map. Originality, one of the components of creativity, was assessed in three ways. The first task required participants to produce as many creative alternative uses for a brick as possible, the second task asked participants to create an original title for a photograph, and the third asked participants to provide the most unusual exemplar to a provided category (e.g., “birds”, “colors”, etc.). Results were consistent across all manipulation conditions and all tasks: participants in the broad attention condition showed greater originality than those participants in the narrow attention condition. In their final experiment the authors tested the hypothesis of whether simply manipulating the body muscles associated with broad or narrow attentional focus would likewise affect creativity in the same manner. They indeed found that when participants were asked to contract the muscles associated with broad attention (frontalis muscles), they produced more original uses for a pair of scissors, than did the participants who were asked to contract muscles associated with narrow attention (corrugators muscles). Thus, the study showed support for the ease of situational changes in the scope of attention, and correspondingly, creativity itself.

In a six-month longitudinal study of sports creativity, Memmert (2007) examined long-term changes in creativity associated with attentional scope. After completion of a six-month training program, creativity was measured with tactical games that used real-life sports scenarios. These narrow and broad attention programs improved different aspects of creative sport performance: broad attentional programs improved complex task performance, while narrow attentional programs improved simple task performance.

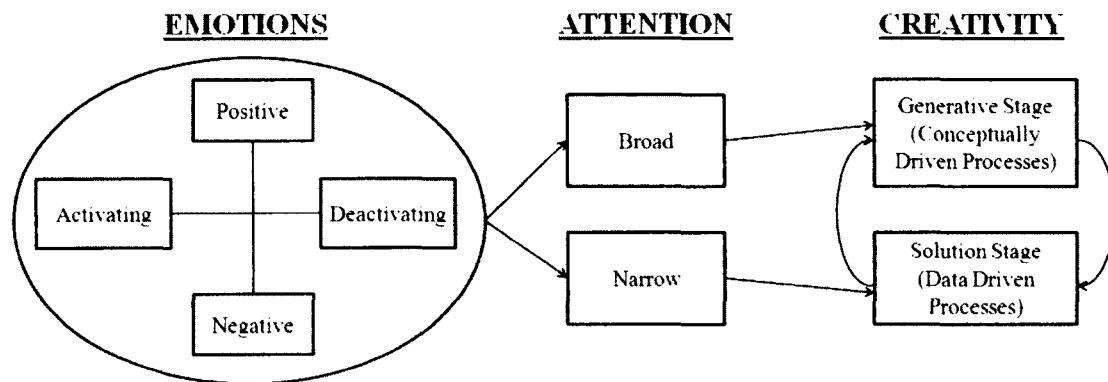
In sum, research shows overwhelming support for the connection between the broad scope of attention and higher divergent thinking scores, particularly when

measured as the number of divergent ideas produced and the originality of ideas. It was proposed that creative people have easier access to remote associates in the semantic network. It was also shown that creative people have impaired filter of attention, which is responsible for information filtering. However, individuals with broad attentional focus tire out faster on idea production than do people with narrower attentional focus. While broad attention training programs improved complex task performance, narrow attention training improved simple task performance, thus raising the question whether narrow attention might be beneficial during some stages of the creative process. Finally, there are no studies to date investigating how other components of creativity are affected by narrowing of attentional focus, and whether they too might realize a benefit.

#### *Resolving the Controversy: Stage Model of Creativity*

Despite the almost rule of law postulate throughout the field of creativity that positive emotions uniformly and undeniably facilitate creative problem solving (Kaufman, 2003), a multitude of evidence contradicting this claim has been uncovered. Not only have negative emotions been found to promote creativity, but evidence suggests that positive emotions hinder creative processes on some occasions. While historical research profiling prominent creators have always noted a link between negative emotions and creativity, little of that notion has found its way into experimental research. Surprisingly, however, while meta-analyses investigating the link between emotions and creativity have been only finding positive relationship between positive emotions and creativity, and no or negative relationship between negative emotions and creativity, multiple separate studies have, in fact, found that negative emotions can promote creativity while positive emotions may stifle it. Why then such a discrepancy in research

findings? Two reasons are investigated in this paper are: (1) the mediating effect of attention on the mood-creativity relationship; and (2) the multidimensional nature of mood and the creativity constructs, with different dimensions of each having different correlates (Figure 1).



*Figure 1.* Stage model of the relationship between mood, attention and creativity.

There appears to be two ways in which emotions affect creativity, one is through affecting motivation to engage in a task, and the second, through affecting cognitive processing, in particular through affecting attentional focus. Creativity, on the other hand, is a multifaceted, multistage process, with different correlates associated with different stages, yet, in laboratory studies it is broken down into its basic components. While such breakdown allows researchers to study creativity experimentally, it does not effectively reproduce all the interactions which occur in the real-life creative process.

Helmholtz (1896) and Wallas (1926) originally suggested that the creative process can be divided into the following four stages: preparation, incubation, illumination or

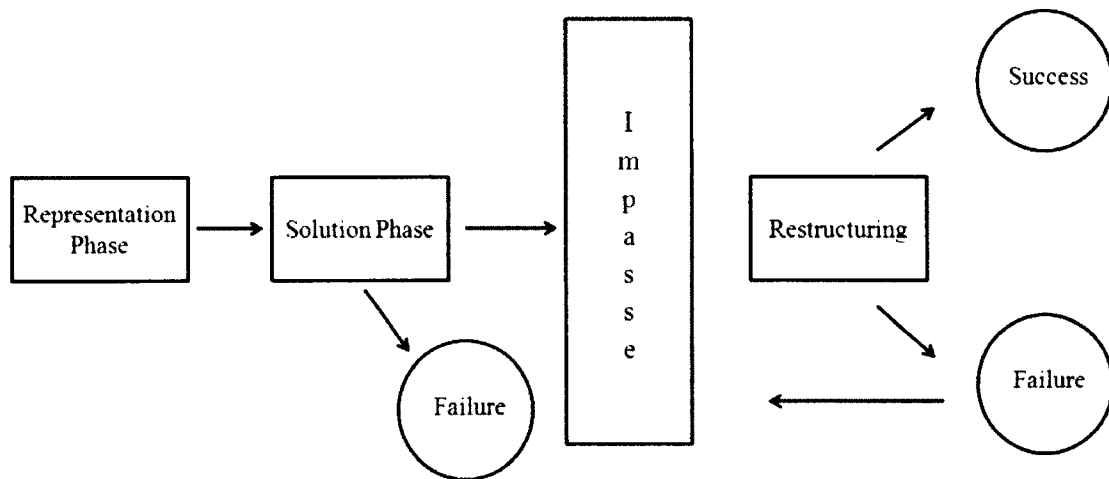
inspiration, and verification or elaboration. Rathunde (2000) proposed that these four stages can be more broadly grouped into two stages: preparation and illumination. Similarly, insight problem research delineates at least two distinct stages in achieving an insight: the first stage is generative, associated with a search through the mental representation space, and the second is associated with finding a solution based on a formed representation (Finke, Ward, & Smith, 1992). The first step in the creative process, during which incubation and preparation occur, is associated with defocused, broad attention. This stage is characterized by divergent thinking, conceptually driven processing, a search for novel and unorthodox ideas, and new ways of problem representation. The second step in the creative process is characterized by focused, narrow attention and is associated with illumination and verification. This stage is characterized by data driven information processing and convergent thinking. In the creative process these two stages alternate in a circular, or more accurately, spiral manner, as a person works through the problem seeking the most optimal solution. Thus, while during the first stage of the creative process, positive emotions may aid in acquiring a broader perspective and an accumulation of information, during the second stage, negative emotions might be as beneficial in the narrowing of one's attention in order to achieve higher concentration on the task at hand (Rathunde, 2000).

These two stages work in opposition to one another, going through multiple iterations during the creative process. Broadening of attention is associated with an exploration stage, when fresh ideas are brought into awareness, attentional focus is broadened to encompass new possibilities, remote, and seemingly unrelated ideas; in short, this stage is most traditionally linked to creativity in most research. During the

other stage, which is associated with narrowing of attention, new ideas that were brought to attention during the previous stage are scrutinized and strictly analyzed, unworthy ideas are discarded, while worthy ideas are retained. If no solution is found, the process repeats itself until a satisfactory solution is achieved or the individual gives up. It is worth noting, that these two stages are quite contrasting in terms of their correlates, and many correlates having a positive relationship with one stage, will have negative relationship with the other stage. For example, the first stage is associated with a higher number of ideas produced, while the second stage is associated with better quality of ideas, originality, and restructuring of mental representations (Kaufmann, 2003a, 2003b; Vosburg & Kaufmann, 1998). Likewise, analytical data scrutinizing and data-driven processing are crucial for the second stage, however, these processes would be detrimental during the first stage, when unusual and unorthodox ideas are important.

More recently, later cognitive models of insight problem solving expanded the initial two stages proposed by earlier researchers. Ash and Wiley (2006) elaborated on earlier models of the insight problem solving by adding stages to these models (see Figure 2). First stage is problem representation, during which the solver forms an initial problem representation. However, in the case of insight problems, prior experience often leads to an incorrect representation of a problem, which in turn fails to yield a correct solution. Next, is the solution phase. As the initial representation was faulty the solver is unable to solve the problem and arrives at impasse, the point where no further progress is possible based on the initially formed representation. At this point the solver either gives up any further attempt to solve the problem, or progresses to the restructuring phase. During the restructuring phase, the solver revisits the initial representation and makes

adjustments, thus forming a new representation of the problem. If the new representation of the problem is correct, the solver successfully solves the problem, if not, the solver either gives up, or one again moves back into the restructuring phase and repeats the cycle until the problem is solved.



*Figure 2.* The stages of insight problem solving (Ash and Wiley, 2006, p. 69).

As with the two-stage model, certain predictions can be made regarding how attentional breadth affects different stages of the Ash and Wiley (2006) model of the insight problem solving process. Broad attention helps during the representation and restructuring phases by bringing in more divergent and “unlikely” ideas that diverge from the original, faulty representation. This can be achieved by activating distant nodes in the semantic network of long-term memory. Narrow attention helps to choose an idea from the multiple ideas that come up, analyze the idea for its potential usefulness, and work it to a solution; in other words it helps to zoom in on one potential solution among many. Without such controlled concentration, even if the right idea presents itself, it may be discarded prior to being properly analyzed.

An overview of studies investigating the relationship between emotions, attention and creativity suggests that looking at emotions as a single positive-negative dimension is oversimplified, and is not representative of all the complexities within the construct. At least two dimensions need to be taken into account when investigating emotional phenomenon with regards to creativity: hedonic tone and arousal. Throughout various stages of the creative process, these dimensions correlate differently with the creative performance. The vast majority of studies analyzing the relationship between emotions, attention and creativity investigate hedonic tone as predictor of creativity. However, when only positive and negative affect are used as predictors of attention and creativity, study results often contradict each other. With the added dimension of high and low arousal, differential predictions appear for different alignments of dimensions. For example, investigation of the activating/deactivating mood axis showed a broadening of attention for both positive and negative deactivating moods (Isen & Daubman, 1984). This differential influence of various mood dimensions on attention allows us to explain the contradictory findings of mood on creativity. If attention stands as a mediating variable between mood and creativity, differential effects of mood on attention will in turn affect differently various components of creativity.

### *Hypotheses*

Positive emotions have been shown to broaden and negative emotions to narrow attentional focus. However, some research suggests that the effects of mood valence on different tasks are conditional on activation or arousal. Thus, the prediction is that mood's effect on attention will interact with arousal.



*Hypothesis 1:* Effects of mood on attention will be dependent on activation, i.e., there will be an interaction between mood and arousal.

There is well-established research showing a relationship between mood and creative task performance. However, the direction of this relationship is controversial. Some research finds that positive mood has a positive influence on creative performance, while negative mood has a negative influence. Other research suggests just the opposite, positive mood having a negative relationship with creativity, while negative mood having a positive relationship with creativity. Based on the multi-stage creativity model, the prediction is that whether or not mood enhances creativity depends on the type of creative task, and further, that the relationship between mood and creative task performance will also be dependent on arousal.

*Hypothesis 2:* On creative tasks that require broad attention for successful performance, mood condition associated with broad attention will enhance performance, while mood condition associated with narrow attention will have a detrimental effect on performance.

*Hypothesis 3:* On creative tasks that require narrow attention for their successful completion, mood associated with narrow attention will have an enhancing effect on performance, while mood associated with broad attention will be detrimental.

*Hypothesis 4:* There will be a three-way interaction between mood, arousal, and problem type.

On insight problems, broad attention will promote a higher solution rate on problems that require multiple restructurings, while narrow attention will lead to a higher solution rate on single restructuring problems.

*Hypothesis 5:* Participants in the broad attention condition will solve more two restructuring problems than will participants in the narrow attention condition.

*Hypothesis 6:* Participants in the narrow attention condition will solve more one restructuring problems than will participants in the broad attention condition.

For an outline of the variables, hypotheses and corresponding analyses please see

Table 1.

Table 1

*Summary of Analyses and Associated Variables*

Measure	Analyses	Design	Independent Variables	Dependent Variables	Hypotheses
PANAS	Between ANOVA	One-Way	Valence (positive, negative, neutral)	PA, NA	Manipulation Check
Stroop	Split-plot ANOVA	2x2x2	Congruency (congruent, incongruent), Valence (positive, negative), Arousal (high, low)	Reaction time	1
Global Selections	Between ANOVA	2x2	Mood (positive, negative), Arousal (high, low)	Number of global selections	1
Rebus Puzzles	Split-plot ANOVA	2x2x2	Restructurings (one, two), Valence (positive, negative), Arousal (high, low)	Number of problems solved	5,6
Fluency (UU & C Problems)	Split-plot ANOVA	2x2x2	Problem Type (UU, C), Valence (positive, negative), Arousal (high, low)	Number of ideas	4
Originality (UU & C Problems)	Split-plot ANOVA	2x2x2	Problem Type (UU, C), Valence (positive, negative), Arousal (high, low)	Originality of ideas	2,3
Usefulness (UU & C Problems)	Split-plot ANOVA	2x2x2	Problem Type (UU, C), Valence (positive, negative), Arousal (high, low)	Usefulness of ideas	No prediction
Squares & Matchsticks	Chi-Square	3x2x2x2	Mood (positive, negative, neutral), Arousal (high, low), Problem type (matchstick arithmetic, squares)	Solved/Not Solved	2,3

## METHOD

### *Participants*

Based on the findings of the previous experiments, power analysis was conducted to determine the sample size necessary to detect an effect, if such existed. Gable and Harmon-Jones (2010) reported effect sizes from two experiments, both of which used photographs selected from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2005). The experiments investigated the effects of emotional states on the breadth of attention. Gable and Harmon-Jones used adapted Navon's (1977) attentional breadth measure, similar to the measure used in the current experiment. One of these studies compared how sad picture condition (negative affect low in arousal) versus neutral condition affects attentional breadth. The associated effect size was  $\eta^2 = .12$ . For this effect size, using  $\alpha = .05$ , and 80% power, as recommended by Cohen (1992), the necessary number of participants per group is  $n = 30$ . Thus, the total number of participants for the five conditions of this experiment (positive low arousal, positive high arousal, negative low arousal, negative high arousal, and neutral) had to be at least  $N = 150$ .

Two hundred seventy Old Dominion University undergraduate students were recruited to participate in this study. The participants were required to be at least 18 years of age in order to participate. The mean age of the participant was  $M = 20.3$ ,  $SD = 3.15$ , with minimum age of 18 and maximum age of 43 years old. There were 174 females and 96 males in this study. Students signed up for the experiment using the university's computerized research system, and they received one point of departmental research credit for their participation. Application for exempt human subject research was

submitted to Old Dominion University's Institutional Review Board and was found to be exempt from IRB review. Ethical guidelines as set forth by the American Psychological Association were followed, and all participants were required to sign a volunteer rights notification form.



Positive Mood Low Arousal



Negative Mood Low Arousal



Negative Mood High Arousal



Positive Mood High Arousal

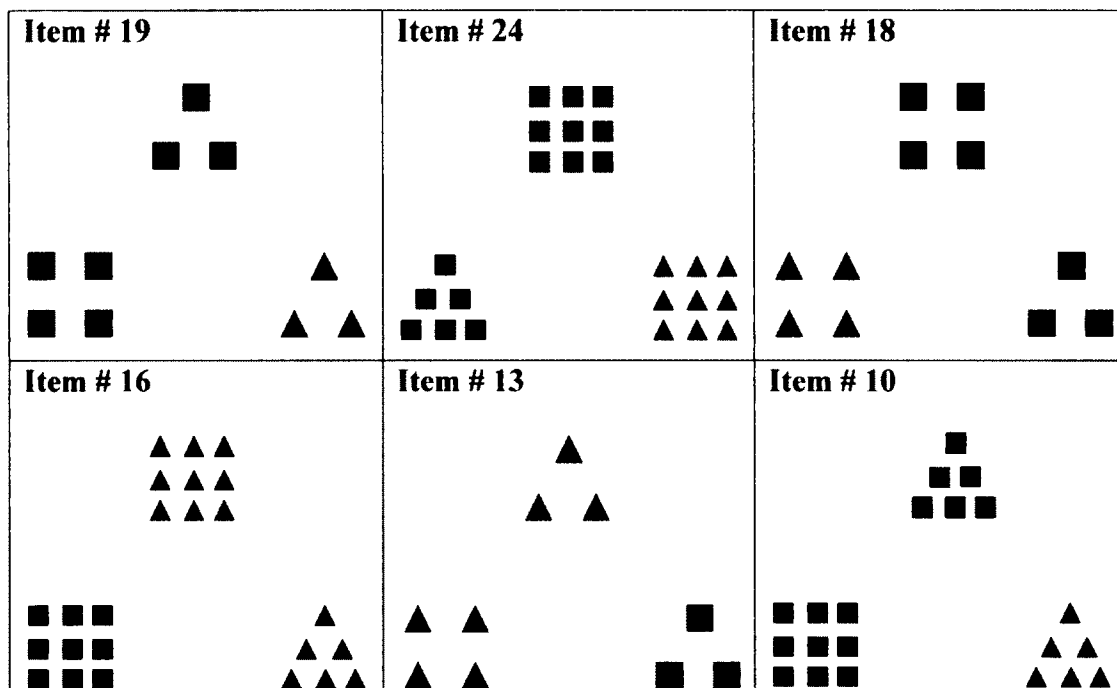
*Figure 3.* International Affective Picture System samples.

### *Materials*

In this study, emotions were induced by using the International Affective Picture System (IAPS). The IAPS has been developed by the *National Institute of Mental Health (NIMH) Center for Emotion and Attention (CSEA)* at the University of Florida as a tool for investigating emotion and attention. The IAPS (Lang, Bradley, & Cuthbert, 2008) is a set of standardized, emotion-inducing color photographs representing a wide range of semantic categories. The IAPS has three major dimensions of emotion: two of these primary dimensions are valence of affect (ranging from positive to negative), and arousal (ranging from calm to aroused). The third is a “dominance” or “control” dimension. (For examples of IAPS images see Figure 3).

Attention was measured using two instruments: Navon’s (1977) global-local processing task and the Stroop task. Navon’s geometrical figure task (Figure 4) uses global-local visual processing paradigms to measure a predisposition towards broad or narrow attentional focus. In this task, participants are given a target figure, which they then compare with two comparison figures. One comparison figure resembles the target figure in global features, while the other is similar to the target figure in detailed, or local elements. Matching figures based on their global shape, i.e., cluster shape as a whole, is considered an indication of global bias, while matching based on component shape, is an indication of local bias. This task is commonly used in research investigating broad-local attentional biases (e.g., Gasper and Clore, 2002; Fredrickson and Branigan, 2005). The Stroop task (Stroop, 1935) is a classic attentional selectivity test. In this task, the names of colors printed in various colored fonts are presented, and the participant’s task is to identify font color while ignoring the printed word. Herein, there are two types of stimuli:

congruent and incongruent. The congruent stimuli have matching word meaning and font color, while the incongruent stimuli have conflicting word meaning and font color. The difference in reaction time between congruent and incongruent stimuli indicates the Stroop effect. Stroop effect indicates poor functioning of selective attention, thus shorter reaction time indicates better selective attention, and should relate to a narrowing of attentional focus. Conversely, longer reaction time indicates poorer functioning of selective attention, and should relate to a broader attentional focus.



*Figure 4.* Examples of global-local items.

Creativity was measured using two types of problems: insight problems (problems with only one correct answer), and open-ended problems (problems having multiple correct answers or no single answer defined as being “correct”). For both types of

problems there are two subtypes, each requiring either a broad or narrow attentional focus.

*Insight Problems.* Two types of insight problems were used: rebus puzzles and matchstick problems.

Rebus puzzles (Figure 5) are widely used throughout insight problem research. A rebus puzzle typically requires the solver to come up with a common phrase based on verbal or visual cues hidden within the presented material (MacGregor & Cunningham, 2009). For example, the solution to “PUNISHMENT” is *capital punishment*, which requires the solver to attend and explicitly interpret the font characteristics of the presented word. A rebus puzzle may require more than one such restructuring, e.g., to come up with a solution for “amUous”, the solver must first, interpret the capitalized letter as “big”, and second, interpret the (big) letter as being part of the word. Hence, amUous can be interpreted as *ambiguous*. As the number of restructurings increase, so does the difficulty of the puzzle. A puzzle’s difficulty also increases as restructuring moves from the supra-word level (relationship between words) to the sub-word level (interpretation of the characteristics of the word). Four types of rebus puzzles were used: sub-word with one restructuring, sub-word with two restructurings, supra-word with one restructuring, and supra-word with two restructurings. Broad attention should be related to better solution rates on problems with multiple restructurings, as it will expand the solver’s solution space, and allow a search for more possible answers after initial impasse is overcome. Alternatively, narrow attention will promote higher solution rates on problems with one restructuring, as it will promote better focus in relation to a single impasse.



Sub-word, one restructuring	<b>AGES</b>	<b>BAD</b> wolf	PUNISHMENT	league
Sub-word, two restructurings	R.P.I.	amUous	XQQME	1t345
Supra-word, one restructuring	<u>somewhere</u> rainbow	a home home	beating beating bush beating beating	rodiamondugh
Word/supra- word, two restructurings	little LARGE little LARGE little little little LARGE	J FRIEND U FRIEND S T	L Y I N G JOB	o r clock c k

Figure 5. Rebus puzzles.

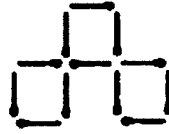
Two types of matchstick problems were used: matchstick arithmetic and geometrical figures. Matchstick arithmetic problems are often used in cognitive research (Knoblich, Ohlsson, Haider, & Rhenius, 1999). These types of problems present a false arithmetic statement written in Roman numerals. The directions to the problem allow for the moving of just one matchstick in order to solve the problem. The primary challenge in these types of problems comes from the difficulty in decomposing chunks of the problem as perceived by the solver (such as a plus sign or numerals such as X, V, etc.). An example of such a problem would be:

$$XI = III + III$$

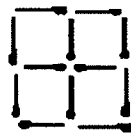
In order to solve the problem, the solver has to slide one matchstick in numeral X to transform it into the numeral V, which provides the solution:

$$VI = III + III$$

Yet another insight problem, the Squares, requires the solver to go beyond the current problem representation in order to solve. In this problem the solver is given directions to move three matchsticks to make five squares from the original three.



The only possible solution is creating four small squares enclosed by a larger square.



The difficulty of this problem lies in recognizing that the larger figure consisting of four smaller squares creates the fifth square.

*Open-Ended Problems.* There were two types of open-ended problems used: problems requiring the production of multiple divergent ideas [Unusual Uses (UU)] and problems requiring extrapolation from a given situation to a different situation [Consequences(C)]. Both problem types were adapted from the Minnesota Tests of Creative Thinking which were developed based on Guilford's and colleagues' materials (Guilford, Wilson, Christensen, & Lewis, 1951). The Unusual Uses problem is commonly used as a divergent thinking measure in creativity research assessing fluency and the originality of ideas (Smith, Michael, & Hocevar, 1990) and is a direct modification of the Guilford Brick Uses Test. In this type of problem, participants are instructed to write as many answers to a question as quickly as they can, e.g., "List as many as possible uses for a shoe".

The Consequences task has been used in research investigating emotions and attention (e.g., Abele, 1992). The Consequences task measures the logical extrapolation

of experiences applied to an impossible situation. In this task, participants were instructed to produce as many ideas as possible for the fictitious situation of “what would happen if one were able to listen to [another] person’s secret thoughts (Abele, p. 207). This task is also scored for the fluency and originality of ideas.

The Positive and Negative Affect Schedule (PANAS) was used as a manipulation check measure. PANAS (Appendix A), a twenty-item scale, is a highly reliable and valid measure of positive and negative affect. Using it, participants indicate, on a 1-5 scale, to what extent they experience the following twenty emotions: interested, distressed, excited, upset, strong, guilty, scared, hostile, enthusiastic, proud, irritable, alert, ashamed, inspired, nervous, determined, attentive, jittery, active, and afraid (Watson, Clark, & Tellegen, 1988).

### *Procedure*

Each participant registered for the study using the university’s computerized research system. This was an on-site study with the participants attending a one-hour session at a laboratory located on the Old Dominion University campus. Upon arrival, each participant was greeted by a researcher. The participants were informed of the study’s purpose and signed a volunteer rights notification form prior to the experiment. A research assistant then read a welcome script to the participants and provided them with instructions for the experiment. Participants used a laboratory personal computer (PC) to complete the experiment. The measures’ presentation order was randomized across the participants. Each participant was debriefed at the end of each session. Experiment protocol was created using E-Prime experimental programming software.

Each experiment session started with the participants reading the directions for the first task. Next, the participants were presented with stimuli blocks: global/local attention measure, Stroop task, rebus puzzles, matchstick problems, and Unusual Uses and Consequences open-ended problems. Stimuli blocks' order of presentation was randomized across the participants. Each block was preceded by a set of directions, followed by two practice trials. For the global/local attention measure, Stroop task, and rebus puzzles, participants were presented with an emotion-eliciting picture for six seconds before each trial. Thus, participants were being continuously induced with emotion-eliciting pictures throughout trials. For the tasks that required longer time for their completion, such as matchsticks problems (4 min.) and open-ended problems (2 min.), participants viewed a block of emotion-eliciting pictures for 30 seconds prior to each task. Presentation of pictures was randomized across trials and tasks, thus each participant within the same emotion/arousal condition viewed pictures in the different order. After completing all the blocks, the participants were asked to complete the PANAS scale, as a manipulation check. At the end, all participants viewed six minutes of low arousal positive pictures and were debriefed by the researcher to ensure that any possible effects of negative induction did not linger.

## RESULTS

For a summary of analyses performed and associated variables please see Table 1.

**Manipulation Check.** The Positive and Negative Affect Schedule (PANAS) was used as a manipulation check measure.

*Positive Affect.* The between-subject ANOVA for positive affect (PA) scores showed a significant difference between three conditions (positive, negative and neutral),  $F(2, 269) = 21.59, p < .001$ , partial  $\eta^2 = .138$ . Post-doc comparisons using Sheffe's Alpha correction showed a significant difference between negative and neutral conditions, 95% CI [.86, 6.13],  $p < .01$ ; negative and positive conditions, 95% CI [-6.03, -1.20],  $p < .01$ ; and between neutral and positive conditions, 95% CI [.03, 5.11],  $p < .05$ .

*Negative Affect.* The between-subject ANOVA for negative affect (NA) scores showed there was a significant difference between three conditions (positive, negative and neutral),  $F(2, 267) = 7.20, p < .001$ , partial  $\eta^2 = .051$ . Post-doc comparisons using Sheffe's Alpha correction showed that there was a significant difference between positive and negative conditions, 95% CI [.45, 4.26],  $p < .01$ ; and negative and neutral conditions, 95% CI [-6.13, -.86],  $p < .01$ . No significant difference was detected between neutral and positive conditions, 95% CI [-3.74, 1.45],  $p = .56$ . For the summary of means and standard errors for positive and negative affect, please see Table 2.

Table 2

*Means and Standard Errors for Positive and Negative Affect*

	<u>PA</u>		<u>NA</u>	
	M	SE	M	SE
Positive	31.47	0.65	14.58	0.53
Negative	25.28	0.69	16.93	0.56
Neutral	28.90	1.12	13.44	0.91

**Stroop Task.** Hypothesis 1 predicted that effects of mood on attention would be dependent on activation that is that there would be an interaction between mood and arousal. To test this hypothesis a 2(mood) x 2(arousal) x 2 (congruency) split-plot ANOVA was conducted on mean reaction time scores. Data were cleaned by bringing in the outliers to the closest non-outlier value, a technique called “winsorizing” (Duan, 1999). There was a main effect for congruency,  $F(1, 234) = 325.30, p < .001$ , partial  $\eta^2 = .582$ , with the incongruent condition taking longer to respond than the congruent condition. There was also a congruency by valence by arousal interaction,  $F(1, 234) = 4.10, p < .05$ , partial  $\eta^2 = .017$ . A follow-up 2-way interaction for the congruent condition was non-significant,  $F(1, 234) = .77, p = .381$ , partial  $\eta^2 = .003$ , while there was a main effect for valence,  $F(1, 234) = 6.01, p < .05$ , partial  $\eta^2 = .025$ , with the negative condition ( $M = 1032.50, SE = 19.41$ ) taking longer to respond than the positive condition ( $M = 966.87, SE = 18.45$ ). Follow-up two-way interaction for the incongruent condition was marginally significant,  $F(1, 234) = 2.86, p = .09$ , partial  $\eta^2 = .012$  (Figure 6).

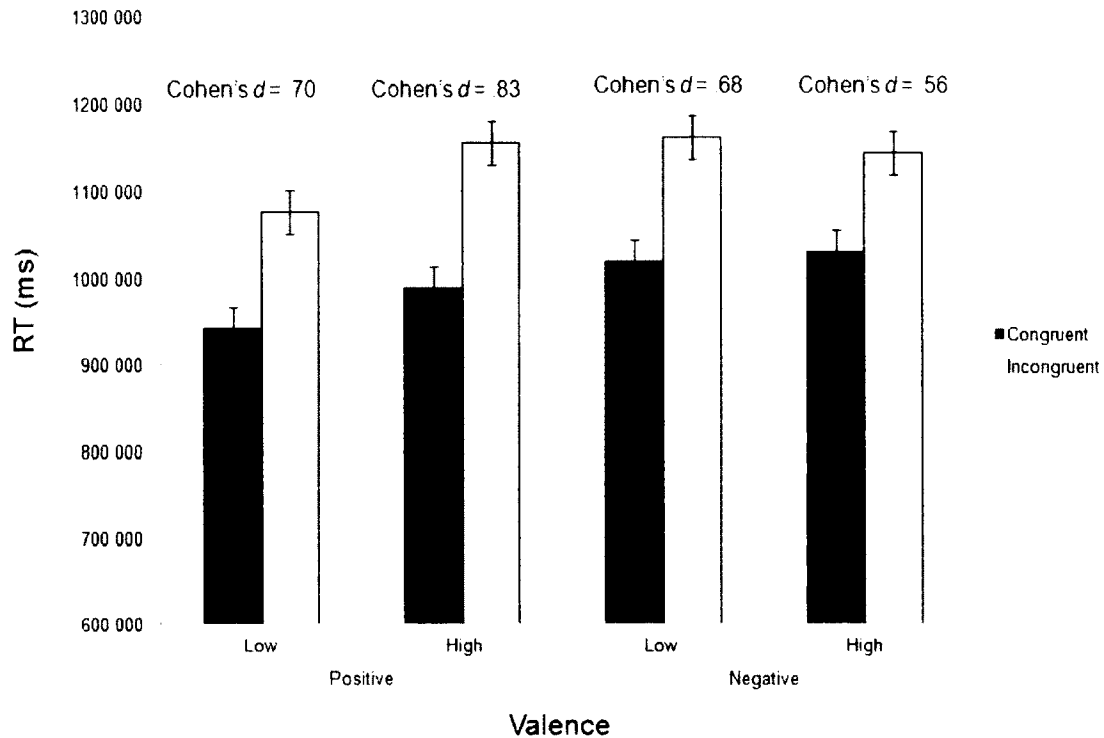


Figure 6. Mean reaction time (milliseconds) for the Stroop task as a function of valence, arousal, and congruency.

Comparison of positive high to positive low was significant,  $F(1, 234) = 4.12, p < .05$ , partial  $\eta^2 = .017$ , with positive high taking longer to respond than positive low. Comparison of positive low to negative low was also significant,  $F(1, 234) = 4.96, p < .05$  partial  $\eta^2 = .021$ , with the negative low condition being slower to respond than the positive low condition. There was also a main between-subject effect for valence,  $F(1, 234) = 3.73, p < .05$ , partial  $\eta^2 = .016$ , with the negative condition ( $M = 1088.50, SE = 17.93$ ) taking longer to respond in both congruent and incongruent conditions than the positive condition ( $M = 1040.73, SE = 17.04$ ). Cohen's *d*s were also computed to

compare between congruent and incongruent conditions for each combination of mood/arousal induction condition (Figure 6). For the summary of means and standard errors for reaction time, please see Table 3.

Table 3

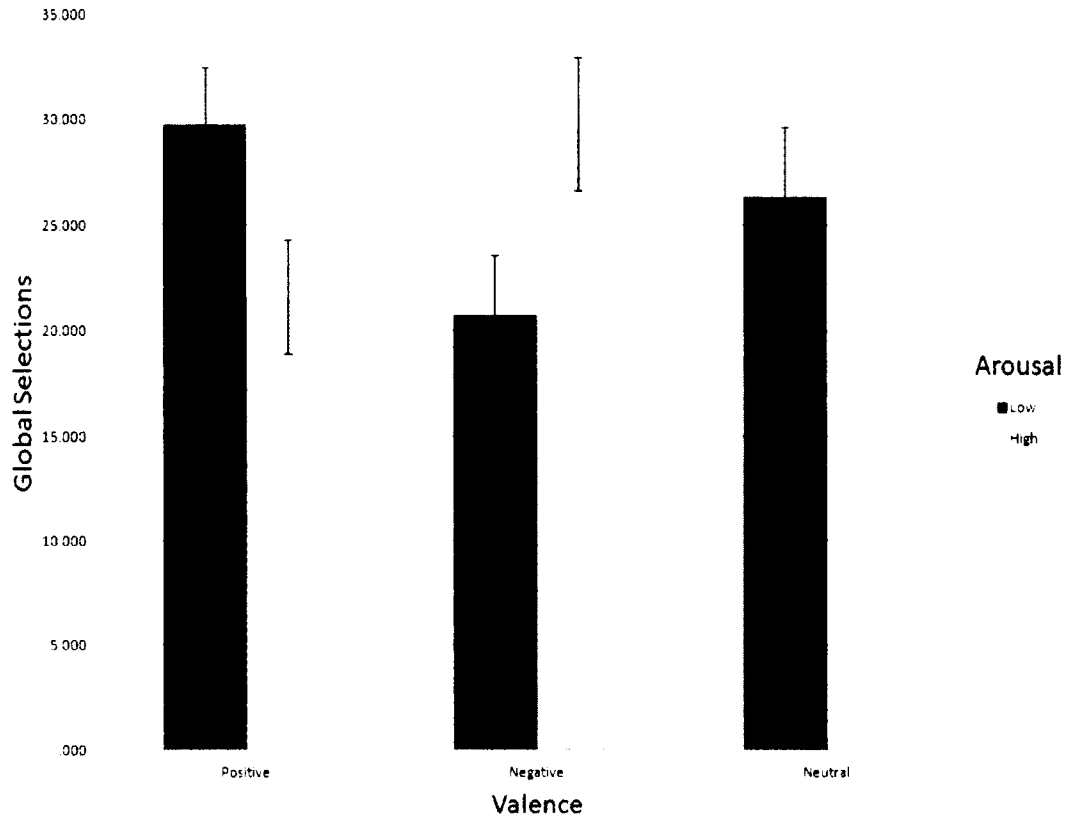
*Means and Standard Errors for Reaction Times (milliseconds) on Stroop Task*

	<u>Congruent</u>		<u>Incongruent</u>	
	M	SE	M	SE
PL	942.41	24.82	1076.01	26.61
PH	986.37	23.85	1155.13	25.57
NL	1018.79	25.03	1161.18	26.84
NH	1030.84	26.17	1143.20	28.05
Total	995.35	13.39	1133.88	12.49

As expected, Stroop effect was observed; participant response time increased when font color differed from word meaning over that when font color and word meaning were the same. Overall, in both font color and word meaning matching and non-matching conditions, participants in a negative mood condition took longer to respond than did participants in a positive mood condition. More interestingly, there was a different response pattern observed for congruent and incongruent conditions. When font color and word meaning matched, participants in a negative mood condition took longer to respond than did participants in a positive mood condition. When font color and word meaning did not match, participants in a positive mood high arousal and negative mood low arousal conditions took longer to respond than did participants in a positive mood low arousal condition.



**Number of Global Responses.** Hypothesis 1 predicted that effects of mood on attention would be dependent on activation that is that there would be an interaction between mood and arousal. Leven's test for homogeneity of variance for the number of global responses was significant,  $F(3, 184) = 3.29, p < .05$ . Checking for the skewness indicated that skewness was within normal range (.20). Also, no outliers were detected for the number of global responses variable. To correct for the violation of homogeneity of variance, the data was transformed using logarithmic transformation as recommended by Maxwell and Delaney (2004, p. 117). After this transformation, Leven's test was non-significant,  $F(3, 184) = 2.29, p > .05$ . A 2 (valence) x 2 (arousal) between-subjects ANOVA for the log-transformed number of global responses detected a valence by arousal interaction,  $F(1, 184) = 9.21, p < .001, \text{partial } \eta^2 = .048$  (Figure 7). Contrast comparing positive low to negative low showed a significant difference between the two conditions,  $F(1, 184) = 5.37, p < .05, \text{partial } \eta^2 = .028$ . Comparison between positive high and negative high showed a significant difference between the two conditions,  $F(1, 184) = 3.96, p < .05, \text{partial } \eta^2 = .021$ . Comparison between a combined positive low and negative high to a combined positive high and negative low was significant,  $F(1, 184) = 9.21, p < .01, \text{partial } \eta^2 = .048$ . For the summary of means and standard errors please see Table 4.



*Figure 7.* Mean number of global selections as a function of valence and arousal.

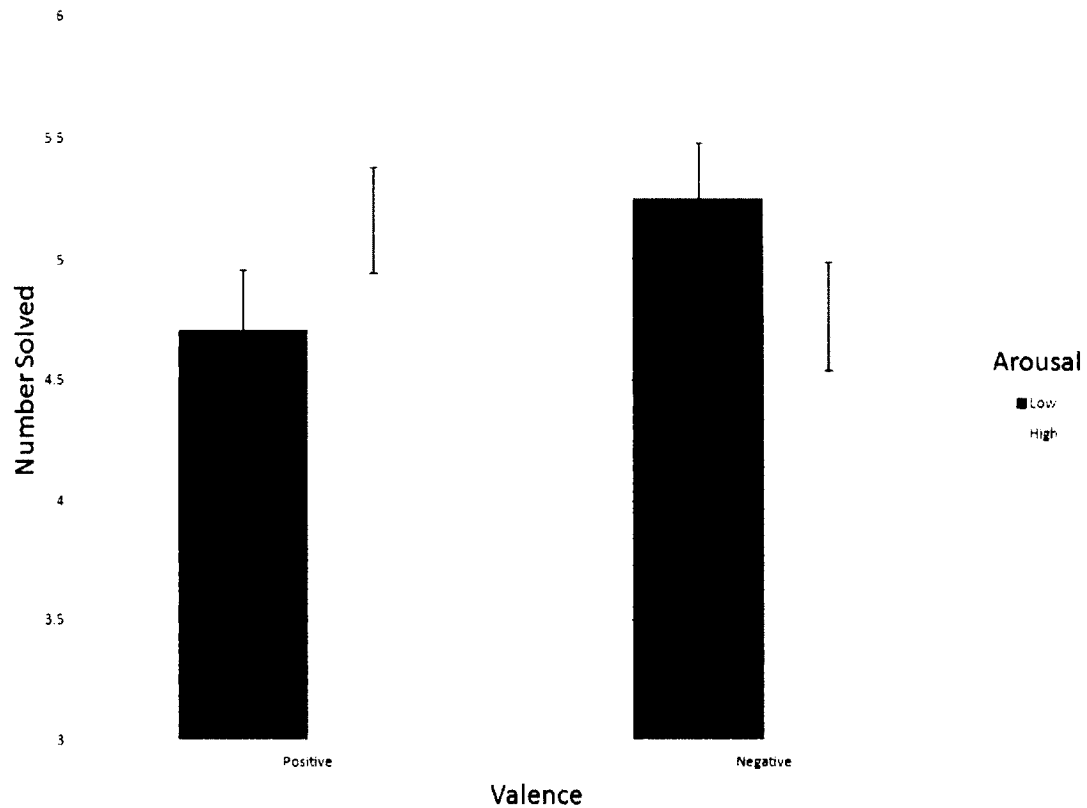
Table 4

*Means and Standard Errors for Number of Global Selections*

	M	SE
PL	29.78	2.71
PH	21.62	2.67
NL	20.78	2.82
NH	29.79	3.13

These results confirmed the hypothesis that valence and arousal interact in influencing attentional breadth. Participants' attention in the positive emotion low arousal

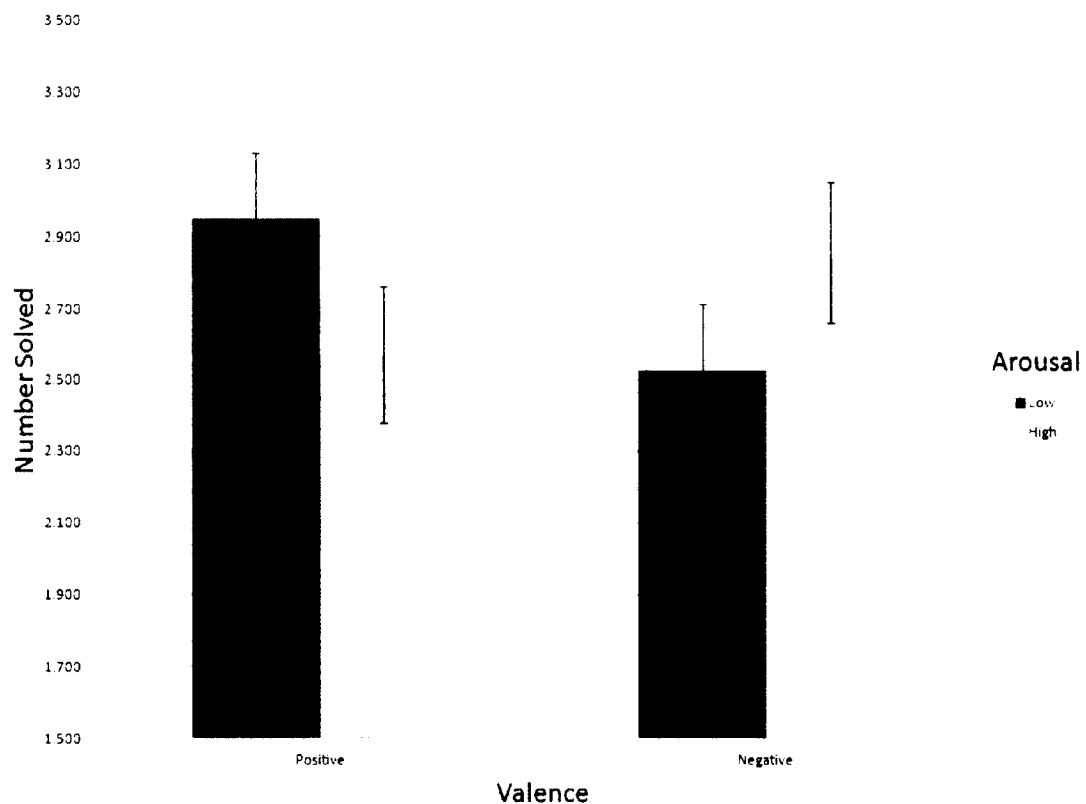
and negative emotion high arousal condition was broader than that in the positive high and negative low conditions.



*Figure 8.* Mean number of solutions for one restructuring Rebus puzzles as a function of valence and arousal.

**Rebus Puzzles.** Hypothesis 5 predicted that participants in the broad attention condition will solve more two restructuring problems than will participants in the narrow attention condition. Hypothesis 6 predicted that participants in the narrow attention condition will solve more one restructuring problems than will participants in the broad attention condition.

A 2 (number of restructurings: 1 vs. 2) x 2(valence) x 2 (arousal) split-plot ANOVA was conducted for the number of problems solved. There was a main effect for the number of restructurings; more one restructuring problems were solved than were two restructuring problems,  $F(1, 231) = 477.52, p < .001$ , partial  $\eta^2 = .674$ . There was also a number of restructurings by valence by arousal interaction,  $F(1, 231) = 16.08, p < .001$ , partial  $\eta^2 = .065$  (Figures 8 & 9).



*Figure 9.* Mean number of solutions for two restructuring Rebus puzzles as a function of valence and arousal.

The three-way interaction was followed up with two way valence by arousal interactions for one and two restructurings. Interaction for one restructuring was

significant,  $F(1, 231) = 4.32, p < .05, \text{partial } \eta^2 = .018$ . Interaction for two restructurings was also significant,  $F(1, 232) = 3.89, p < .05, \text{partial } \eta^2 = .016$ . Follow up comparison for one restructuring problems comparing positive high and negative low combined ( $M = 5.21, SE = .22$ ) to negative high and positive low combined ( $M = 4.74, SE = .23$ ) was significant,  $F(1, 231) = 4.32, p < .05, \text{partial } \eta^2 = .018$ . A comparison of low positive to low negative conditions was marginally significant,  $F(1, 231) = 2.9, p = .09, \text{partial } \eta^2 = .012$ . Follow up comparison for two restructuring problems comparing positive high and negative low combined ( $M = 2.55, SE = .19$ ) to negative high and positive low combined ( $M = 2.92, SE = .19$ ) was significant,  $F(1, 232) = 3.89, p < .05, \text{partial } \eta^2 = .016$ . For the summary of means and standard errors please see Table 5.

Table 5

*Means and Standard Errors for Number of Rebus Puzzles Solved*

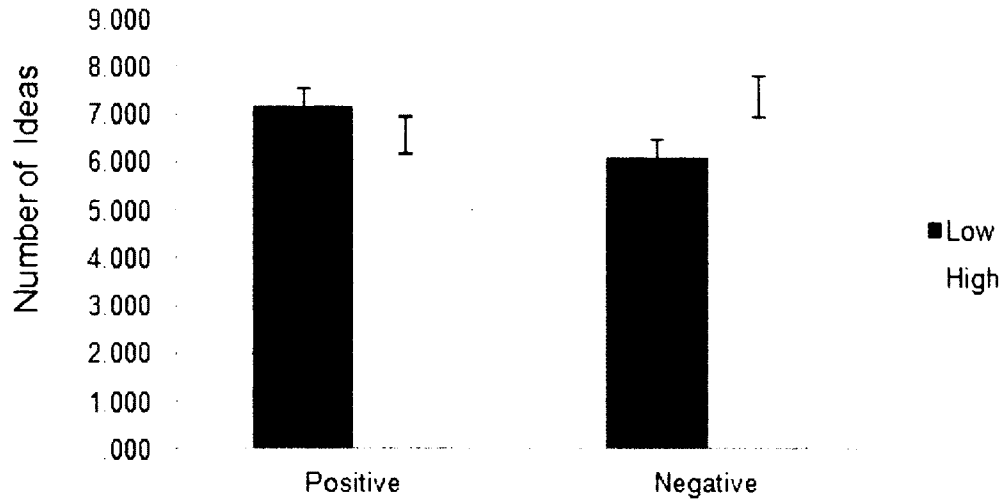
	<u>One Restructuring</u>		<u>Two Restructuring</u>	
	M	SE	M	SE
PL	4.71	.25	2.95	.18
PH	5.16	.22	2.57	.19
NL	5.25	.22	2.53	.19
NH	4.76	.23	2.86	.20
Total	4.98	.23	2.72	.19

In summary, one restructuring problems were easier to solve than were two restructuring problems. Additionally, participants in the positive high and negative low conditions, conditions associated with more local attention, solved more one restructuring problems than did participants in the negative high and positive low conditions, condition

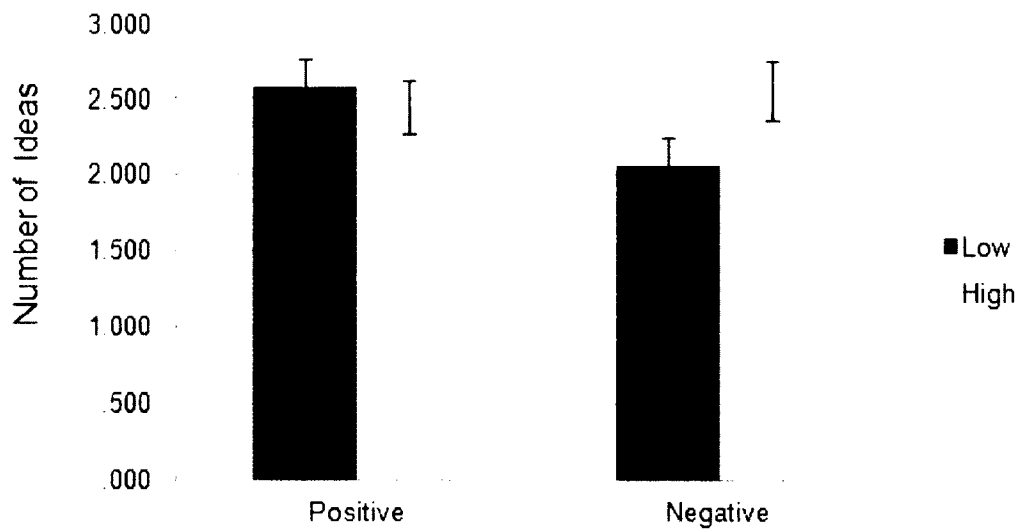
linked to more global attention. The pattern was reversed for the two restructuring problems, participants in the negative high and positive low condition, which is associated with more global attention, solved more two restructuring puzzles than did participant in the negative low and positive high condition, a condition associated with more local attention.

#### **Fluency of Ideas for Unusual Uses (UU) and Consequences (C) Problems.**

Hypothesis 4 predicted that there would be a three-way interaction between mood, arousal, and problem type. The intraclass correlation coefficient (ICC) between two coders for the number of ideas produced was .99 for both types of problems (UU and C). A 2 (problem type) x 2(valence) x 2 (arousal) split-plot ANOVA was conducted for the number of ideas produced for Unusual Uses (UU) and Consequences (C) problems. There was a within-subjects main effect for problem type, with participants producing significantly more ideas for UU problem ( $M = 6.81, SE = .20$ ), than for C problem ( $M = 2.41, SE = .09$ ),  $F(1, 229) = 449.21, p < .001$ , partial  $\eta^2 = .662$ . There was also a valence by arousal between-subject interaction,  $F(1, 229) = 7.15, p < .01$ , partial  $\eta^2 = .030$  (Figures 10 & 11). Follow-up comparisons showed that there was a significant difference comparing negative high and positive low combined ( $M = 4.92, SE = .24$ ) to positive high and negative low combined ( $M = 4.29, SE = .23$ ) collapsing across both types of problems,  $F(1, 229) = 7.15, p < .01$ , partial  $\eta^2 = .030$ . There was also significant difference between negative low ( $M = 4.08, SE = .24$ ) and negative high ( $M = 4.97, SE = .25$ ),  $F(1, 229) = 6.74, p < .01$ , partial  $\eta^2 = .029$ , and positive low ( $M = 4.87, SE = .24$ ) and negative low ( $M = 4.08, SE = .24$ ),  $F(1, 229) = 5.60, p < .05$ , partial  $\eta^2 = .024$ , also collapsing across both types of problems.



*Figure 10.* Mean number of ideas produced for Unusual Uses (UU) problem as a function of valence and arousal.



*Figure 11.* Mean number of ideas produced for Consequences (C) problem as a function of valence and arousal.

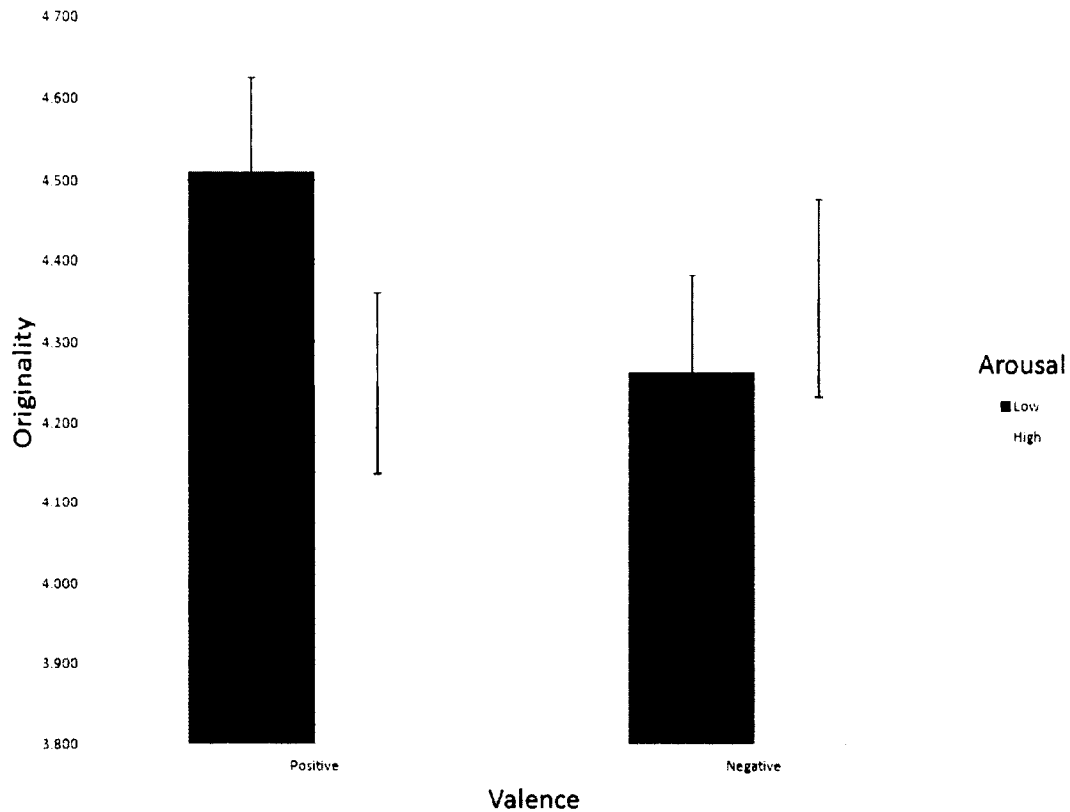
In summary, participants with broader attention (negative high arousal and positive low arousal) showed higher fluency than did participants with narrow attention (negative low arousal and positive high arousal).

**Originality for Unusual Uses (UU) and Consequences (C) Problems.** Analysis of originality of ideas was performed to test hypotheses 2 and 3. Hypothesis 2 predicted that on creative tasks that require broad attention for successful performance, mood condition associated with broad attention would enhance performance, while mood condition associated with narrow attention would have a detrimental effect on performance. Also hypothesis 3 predicted that on creative tasks that require narrow attention for their successful completion, mood associated with narrow attention would have an enhancing effect on performance, while mood associated with broad attention would be detrimental.

The ICC between two coders was 0.75 for the Unusual Uses (UU) problem and 0.84 for the Consequences (C) problem. Coding responses were verified by a third coder, and the coding responses of the initial two coders were averaged for analyses. The task of the third coder was to make sure that there were no major discrepancies between the initial two coders. A 2 (problem type) x 2 (valence) x 2 (arousal) split-plot ANOVA was conducted for the originality of ideas produced for the UU and C problems. There was a main effect for problem type,  $F(1, 225) = 252.02, p < .001$ , partial  $\eta^2 = .528$ , with C problem responses being rated as significantly more original than UU problem responses. Additionally, there was a problem type by valence by arousal interaction,  $F(1, 225) = 9.12, p < .05$ , partial  $\eta^2 = .039$  (Figures 12 & 13). Three-way interaction effect was followed-up with a two-way interaction analyses for each problem separately. Two-way interaction for the UU problem was marginally significant,  $F(1, 231) = 2.91, p = .09$ , partial  $\eta^2 = .012$ . The comparison between positive low versus negative low was marginally significant,  $F(1, 231) = 2.85, p = .09$ , partial  $\eta^2 = .012$ , with positive low



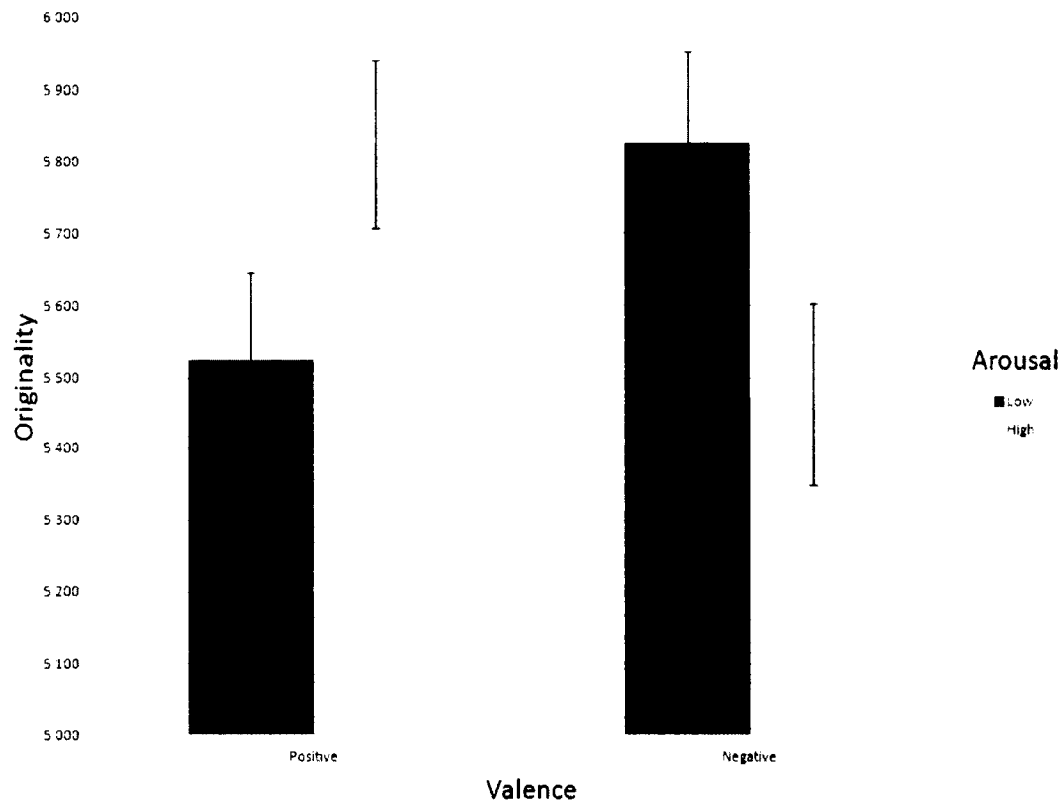
being rated as more original than negative low. Comparison of positive high and positive low was also marginally significant,  $F(1, 231) = 3.07, p = .08$ , partial  $\eta^2 = .01$ , with positive low being rated as significantly more original than positive high.



*Figure 12.* Mean originality ratings for the Unusual Uses (UU) problem as a function of valence and arousal.

Two-way interaction for the C problem was significant,  $F(1, 225) = 9.97, p < .01$ , partial  $\eta^2 = .030$ . The comparison between positive high and negative high condition was significant,  $F(1, 225) = 4.02, p < .05$ , partial  $\eta^2 = .018$ , with positive high rated as more original than negative high. The comparison between positive low and negative low was marginally significant,  $F(1, 225) = 2.99, p = .08$ , partial  $\eta^2 = .013$ , with negative low

rated higher than the positive low condition. The comparison between positive high and low was marginally significant,  $F(1, 225) = 3.16, p = .08$ , partial  $\eta^2 = .014$ , with positive high rated higher than the positive low condition. For the summary of means and standard errors please see Table 6.



*Figure 13.* Mean originality ratings for the Consequences problem as a function of valence and arousal.

In short, problem type, mood, and arousal interacted in determining how original the responses were. For Unusual Uses problem, the most original answers were given in the positive low and negative high conditions, which were associated with broad attention. For the Consequences problem, the most original responses were those

produced in conditions associated with narrow attentional breadth (positive high and negative low).

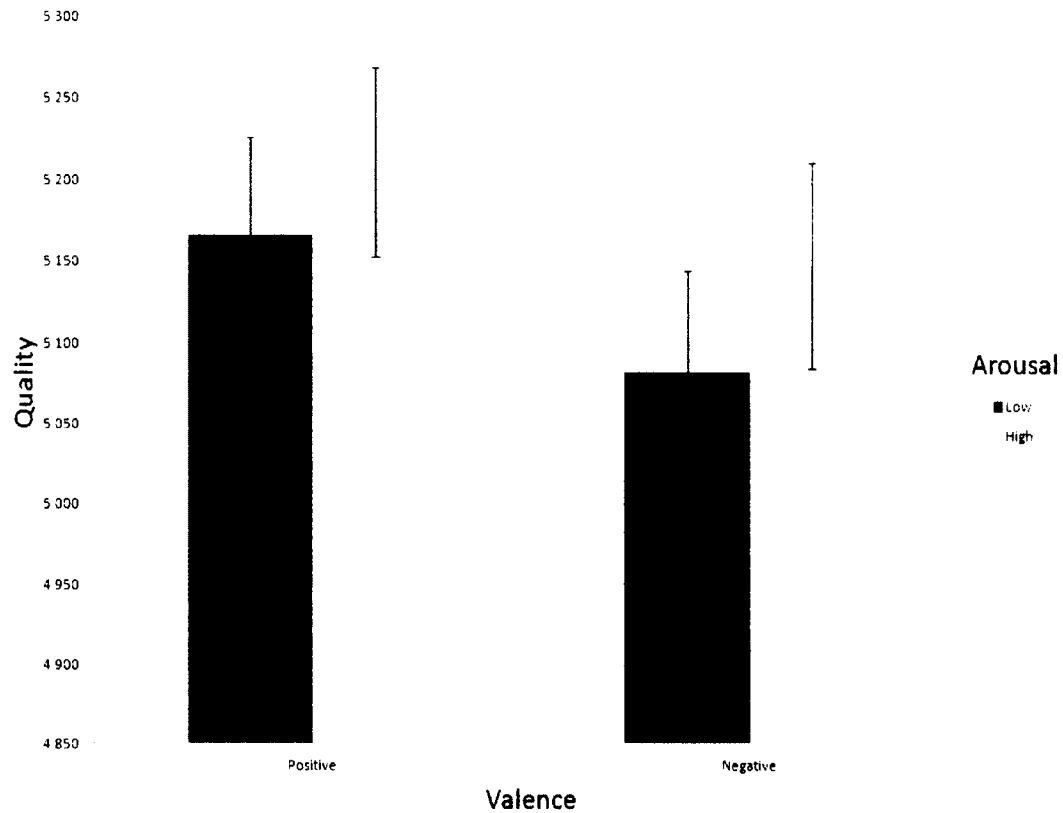
Table 6

*Means and Standard Errors for Originality of Ideas for Unusual Uses and Consequences Problems*

	<u>Unusual Uses</u>		<u>Consequences</u>	
	M	SE	M	SE
PL	4.51	.11	5.52	.12
PH	4.23	.11	5.82	.12
NL	4.24	.12	5.83	.13
NH	4.35	.12	5.48	.12
Total	4.34	.12	5.67	.12

#### **Usefulness of Ideas for Unusual Uses (UU) and Consequences (C) Problems.**

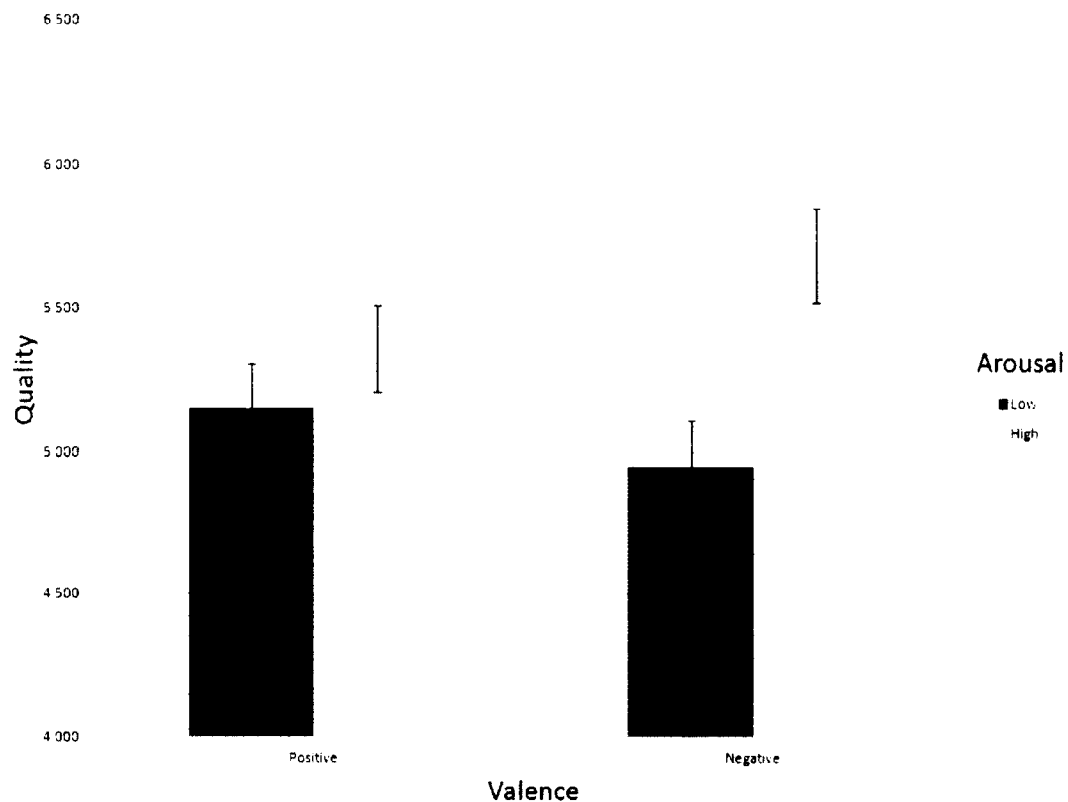
The ICC between two coders for the UU problem was 0.71 and 0.76 for the C problem. Coding responses were verified by a third coder, and the coding responses of the initial two coders were averaged for analyses. A 2 (problem type) x 2 (valence) x 2 (arousal) split-plot ANOVA was conducted for the usefulness of ideas produced for UU and C problems. There was main effect for problem type,  $F(1, 225) = 6.97, p < .01$ , partial  $\eta^2 = .030$ , with the C problem being rated as having significantly higher usefulness of responses ( $M = 5.35, SE = .16$ ) than was the UU problem ( $M = 5.15, SE = .06$ ). There was also a problem type by valence interaction,  $F(1, 225) = 9.56, p < .01$ , partial  $\eta^2 = .041$ , and problem type by arousal (marginal) interaction,  $F(1, 225) = 2.66, p < .10$ , partial  $\eta^2 = .012$  (Figures 14 & 15).



*Figure 14.* Mean usefulness ratings for the Unusual Uses (UU) problem as a function of valence and arousal.

Bonferroni adjustment was made for the follow up comparisons, alpha level of .05 was divided by the number of comparisons, thus leading to a new alpha level of .01. A follow-up comparison between the positive ( $M = 5.19$ ,  $SE = .06$ ) and negative ( $M = 5.11$ ,  $SE = .06$ ) conditions for the UU problem was non-significant,  $F(1, 231) = 1.02$ ,  $p = .315$ , partial  $\eta^2 = .004$ . Comparison between the C problem positive and negative condition was significant,  $F(1, 225) = 7.01$ ,  $p < .01$ , partial  $\eta^2 = .030$ , with the negative condition ( $M = 5.57$ ,  $SE = .12$ ) rated as having higher usefulness than the positive condition ( $M = 5.15$ ,  $SE = .11$ ). Comparison between low and high arousal condition for the UU problem was

non-significant,  $F(1, 231) = .49, p = .49$ , partial  $\eta^2 = .002$ . Further, comparison between low and high arousal condition for the C problem was non-significant with alpha level correction,  $F(1, 225) = 3.95, p < .05$ , partial  $\eta^2 = .017$ .



*Figure 15.* Mean usefulness ratings for the Consequences problem as a function of valence and arousal.

There was also between-subject main effects for valence, averaging across both types of problems,  $F(1, 225) = 3.72, p < .05$ , partial  $\eta^2 = .016$ , with negative condition responses ( $M = 5.34, SE = .07$ ) being rated as having higher usefulness than positive condition responses ( $M = 5.17, SE = .06$ ); and main effect for arousal, averaging across both problems,  $F(1, 225) = 4.26, p < .05$ , partial  $\eta^2 = .019$ , with the high arousal

condition ( $M = 5.35$ ,  $SE = .06$ ) having higher usefulness responses than the low arousal condition ( $M = 5.16$ ,  $SE = .06$ ). Problem type by valence by arousal interaction failed to reach significance.

Overall, Consequences problem was rated as having higher usefulness of responses than was the Unusual Uses problem. Consequences task results indicated that a negative mood condition produced responses that were rated as significantly more useful than responses in the positive mood condition. For the Unusual Uses task there was a trend of positive mood condition responses being rated slightly higher than negative mood responses, however, this effect failed to reach significance. High arousal condition responses were rated overall as significantly more useful than were low arousal responses.

**Square and Matchstick Arithmetic Problems.** Analysis of matchstick problems pertained to hypotheses 2 and 3. Hypothesis 2 predicted that on creative tasks that require broad attention for successful performance, mood condition associated with broad attention would enhance performance, while mood condition associated with narrow attention would have a detrimental effect on performance. Hypothesis 3 predicted that on creative tasks that require narrow attention for their successful completion, mood associated with narrow attention would have an enhancing effect on performance, while mood associated with broad attention would be detrimental.

Table 7

*Percent Solved for Squares and Matchsticks Problems*

	Percent Solved	
	Squares	Matchsticks
PL	19	25
PH	22	22
NL	25	24
NH	17	18

A 2 (valence) x 2 (arousal) logistic regression analyses were performed for the Matchstick Arithmetic and Squares problems. None of the effects of mood or arousal for these problems were significant. For the Matchstick Arithmetic problem the results of the tests were: main effect of valence  $\chi^2(1) = .03, p = .87$ ; main effect of arousal  $\chi^2(1) = .91, p = .34$ ; and valence by arousal interaction  $\chi^2(1) = .01, p = .98$ . For the Squares problem the results of the tests were: main effect of valence  $\chi^2(1) = .18, p = .67$ ; main effect of arousal  $\chi^2(1) = .25, p = .62$ ; and valence by arousal interaction  $\chi^2(1) = .95, p = .33$ . For the summary of problems solved please see Table 7.

## DISCUSSION

Stage model of creativity predicted that effects of mood on attention would be dependent on activation. Global/local selections and Stroop tasks were hypothesized to be parallel measures of the breadth of attention, and were used to test these hypotheses. The results of the global/local task supported the predictions, while Stroop task did not yield the expected results. Stage model also predicted that type of the task would play a role in determining mood effects on creativity. In particular, the model predicted that on creative tasks that require broad attention, mood condition associated with broad attention will enhance performance, while mood condition associated with narrow attention will have a detrimental effect on performance. Furthermore, on creative tasks that require narrow attention, mood associated with narrow attention will have an enhancing effect on performance, while mood associated with broad attention will be detrimental. To test these predictions, the study used three types of tasks: rebus puzzles, open-ended problems, and insight matchstick problems. The results of the rebus puzzles supported the predictions. Fluency and originality measures of the open-ended problems also supported the model, while usefulness measure did not. The results of the insight problems did not support the predictions, either. Finally, manipulation check worked; participants in the positive mood condition reported feeling more positively than participants in two other conditions. Furthermore, participants in the negative mood condition reported feeling more negatively than participants in other conditions.

**Stoop Task.** Stroop task results did not confirm the expectation that Stroop task would be an alternative measure of attentional breadth. Whereas some previous studies associated Stroop effect to attentional breadth (e.g., Chajut & Algom, 2003), this study



did not find support for such relation. While Stroop task is a widely used classic selectivity measure in psychological research, questions regarding Stroop effect's underlying mechanisms continue to receive investigative scrutiny. Originally, Stroop effect was explained by interference (competition between color and word meaning within incongruent trials) and facilitation (convergence of color and word meaning within congruent trials), which were assumed to be two sides of the same coin (e.g., Stroop, 1935), and were traditionally used as a measure of selectivity of attention (MacLeod, 1991). Based on this original view, global/local tasks such as Navon's letters or geometrical figures' task (Navon, 1977) can be viewed as being analogous to the Stroop task (MacLeod, 1991). Later investigations broadened the understanding of the Stroop effect by arguing that interference and facilitation were, in fact, two distinct mechanisms (MacLeod, 1998; MacLeod & MacDonald, 2000; Kane & Engle, 2003). Kane and Engle (2003) go on to argue that goal maintenance and competition resolution jointly determine Stroop task performance, while working memory (WM) capacity and a context-induced task set will determine which one of the two mechanisms will dominate. Individuals with high WM-span showed less interference than did low WM-span individuals across all variations of congruent/incongruent trials. Low-span individuals, on the other hand, committed more errors than did high-span individuals on rare incongruent trials, embedded within multiple congruent trials, thus displaying a deficient competition-resolution mechanism. Based on this latter view, the Stroop task might be considered a poor measure of attentional breadth, which could explain the lack of correlation between the Stroop task findings and the global/local tasks findings within this study.

**Global/Local Attention.** The hypothesis that valence and arousal will interact in influencing the breadth of attention was confirmed. Positive emotions low on activation caused broadening of attention, which was consistent with the generally accepted view in the literature that positive emotions cause a broadening of attention (e.g., Gasper & Clore, 2002; Fredrickson & Branigan, 2005). On the other hand, highly arousing positive emotions caused a narrowing of attention within this study. This finding was consistent with more recent research on mood and attention (Gable & Harmon-Jones, 2008) showing that positive mood high in approach motivation narrows attentional focus. Gable and Harmon-Jones suggested that the reason previous studies found that positive mood broadens attention is due to the fact that low activation positive mood induction was used within those earlier studies. In fact, review of the methodologies used by previous studies strongly supports such a view.

In this study, negative mood low on arousal was found to narrow attentional breadth, a finding consistent with the majority of previous research (e.g., Baron, Moore & Sanders, 1978; Gasper & Clore, 2002; Fredrickson & Branigan, 2005). Finding that negative mood low on arousal, a mood commonly associated with sadness and depression, narrows attentional breadth is also consistent with the analytical rumination hypothesis. Rumination hypothesis (Andrews & Thomson, 2009) suggests that sad and depressed people ruminate over their problems, thus narrowing their focus on problems for which they seek solution, and shutting off all other distractions. In evolutionary terms such a tactic is highly adaptive, since problem solving is an effortful activity requiring a great deal of cognitive resources; thus narrowing one's attention on a problem while

minimizing or ignoring everything else would help to use limited resources more effectively.

On the other hand, highly arousing negative mood was found to broaden attention. This finding was completely new in light of previous research. Similar to previous research on positive emotions, it is conceivable that earlier studies used mood induction materials that were considerably lower on arousal than the manipulation materials used in this study. The current study used images in the highly arousing negative condition picked from the IAPS set of standardized pictures (Lang, Bradley, & Cuthbert, 2008), that were exceptionally graphic in content and were rated as having extremely high arousal rating ( $M = 6.8$  on a 1 to 9 scale). Also, a large body of the previous research used such induction materials as video clips and stories (for review, see Davis, 2009; Baas, De Dreu, & Nijstad, 2008), which have significant time delay between the administration of the material and the dependent measure taken. During this lapse of time, transitory effects of arousal may dissipate, thus even when using measures that were thought to be highly activating, they may not have had the intended effect, or that effect may not have been accurately measured. Recently, however, with the rise of more sophisticated experimental software, well validated materials have been developed, such as the imagery used in this study that allowed for minimal time lapse, measured in the milliseconds, between picture presentation and the dependent measure of interest.

One study of interest is Gable and Harmon-Jones's study (2010) asserting that negative affect high in motivational intensity narrows attentional focus, while negative affect low in motivational intensity broadens the attentional span; results that contradict our findings. While the above study used similar materials, such as IAPS pictures and the

Navon's letter task (1977), the latter being conceptually similar to the global/local figure task used by this study, the choice of their dependent variables is quite surprising. Instead of using a number of global/local selections, the authors instead chose to use reaction time to make selections, a choice that was motivated by the findings of their own previous study, and a choice even more oddly taken considering that no number of global/local selections, the traditional measure used for this type of task, were reported. The authors used slower reaction time to local targets as an indicator of a broadening of attention, and faster reaction time as evidence of a narrowing of attention; however, they do not expound a rationale for its use nor provide a theoretical explanation for it.

The broadening of attention caused by a highly arousing negative emotional state makes sense from an evolutionary perspective; when faced with a potential "fight-or-flight" situation caused perhaps by the sight of a predator, or potential foe, taking-in the entire picture all at once can be viewed as evolutionary adaptive, as it would aid in survival. Such a state of total awareness is known as *zanshin* in the martial arts (Morris, 1992). *Zanshin* refers to having an awareness of one's surroundings, enemies, their weapons, and their next possible action all at the same time, while maintaining a state of alertness that enables quick reaction. Being in a state of broadened attention while being sufficiently aroused for quick response appears to relate to the *zanshin* concept.

**Rebus Puzzles.** All else being equal, one restructuring problems were easier to solve than were two restructuring problems. This finding supported previous findings by MacGregor and Cunningham (2008, 2009), and Knoblich et al.'s (1999) prediction that problems containing more constraints would be more difficult to solve than problems having fewer constraints. Furthermore, participants in the positive high and negative low

conditions, conditions associated with narrow attentional breadth, solved more one restructuring problems than did participants in the negative high and positive low conditions, which are associated with broad attention. The pattern was reversed for the two restructuring problems, participants in the negative high and positive low condition, which is associated with broad attention, solved more two restructuring puzzles than did participant in the negative low and positive high condition, a condition associated with narrow attention (Figures 9 & 10). Thus, for one restructuring problems, narrow attention led to more solutions, while for the two restructuring problems, broad attention facilitated a better solution rate, which supported the hypothesis of differential attentional breadth requirements during different stages of the creative process. The study's pattern of findings supports the idea that broad attention is related to the initial exploratory stage of the creative process, a time when multiple ideas are being considered as candidates for further exploration; while narrow attention is associated with the later stage of the creative process, a time when ideas receive greater attention and scrutiny, and are thus analyzed more closely.

**Fluency of Ideas for Unusual Uses (UU) and Consequences (C) Problems.**

Ideational fluency is a creativity measure originally developed by Guilford et al. (1951) that represents the number of ideas produced in response to a certain task. In this study, participants were asked to write down as many as possible uses for a shoe, and extrapolate what would happen if one were able to listen to [another] person's secret thoughts. If the hypothesis about differential attentional breadth requirements during different stages of the creative process is true, and if fluency of ideas is associated with the exploratory stage of the creative process, then broad attention should be related to

more ideas being produced. This relationship should not be dependent on a task, as broad attention should always be related to better fluency. This in fact, was the exact pattern of results in this study: participants with broader attention (negative high arousal and positive low arousal) showed higher fluency than did participants with narrow attention (negative low arousal and positive high arousal).

### **Originality for Unusual Uses (UU) and Consequences (C) Problems.**

Originality may be considered the truest measure of creativity, as it represents how divergent ideas are. Amassing multiple ideas, or a fluency of ideas, might well be a prerequisite for creativity, but, should those ideas be too commonplace, then the responses cannot be judged as being creative (Torrence, 1962). For example, when asked to list as many as possible uses for a shoe, one can answer with “walking”, “running”, “protect feet”, “buy”, “gift”, etc. However, those categories are hardly considered original. On the other hand, someone may singularly answer with “door stop,” or “hide candy” which could be judged as being a much more original, or creative answer. As such, originality may indeed be considered as the most sensitive measure of creativity.

The results showed that task type, mood, and arousal collectively interacted in determining how original the responses were. For Unusual Uses problem, the problem type that was thought to simulate the early stages of the creative process, such as exploration, the most original answers were given in the positive low and negative high conditions, conditions associated with broad attention. According to the differential attentional breadth requirement hypothesis, this is the expected pattern if the hypothesis were true. The current study’s findings support those findings of previous studies of mood effects on creativity for the low arousal condition, i.e., findings that responses were

judged as being more creative for these problem types in the positive mood condition (broad attention) as compared to the negative mood condition (narrow attention), (Abele, 1992; Baas, de Dreu, & Nijstad, 2008). Within this study there was an opposite trend for the high arousal condition; wherein negative high arousal condition responses (the condition corresponding to broad attention) were judged as having greater originality than positive high condition responses (the condition associated with narrow attentional breadth). Thus, conditions related to broad attention were likewise related to a greater originality of response than those conditions associated with more narrow attention on the problem representing earlier stage of the creative process.

Conversely, responses for the Consequences problem, the problem that was used to simulate the later stages of the creative process, showed an exact opposite pattern. The most original responses were those produced in conditions associated with narrow attentional breadth (positive high and negative low), as compared to conditions associated with broader attention (positive low and negative high). This, again, supported the differential attentional breadth requirement for the different stages of the creativity hypothesis. These findings help explain the contradictions of earlier studies, i.e., not only do mood and arousal interact in influencing creativity, but just as importantly it is the breadth of attention that ultimately predicts its quality .

**Usefulness for Unusual Uses (UU) and Consequences (C) Problems.** While not part of the commonly used creativity measures in and of itself (Torrence, 1962), the inclusion of the usefulness measure in this study was motivated by the very definition of creative ideas, i.e., that in order to be creative, ideas must not only be novel, but also potentially useful (Baas et al., 2008). Since usefulness has been traditionally studied only

as part of the quality component of creativity encompassing both originality and usefulness (Vosburg, 1998b), there were no predictions developed with regards to this measure.

Consequences task results indicated that a negative mood condition produced responses that were rated as significantly more useful than responses in the positive mood condition: this was not the case for the Unusual Uses task. For the Unusual Uses task there was a trend of positive mood condition responses being rated slightly higher than negative mood responses, however, this effect failed to reach significance. These results are consistent with previous research reporting better overall performance on the Unusual Uses task under a positive mood condition, and better performance on the Consequences problem under a negative mood condition (Abele, 1992). High arousal condition responses were rated overall as significantly more useful than were low arousal responses.

There are two ways to hypothesize mood's influence on performance: through changing how we process information, and through motivation (Kaufmann, 2003). The pattern observed with regards to usefulness ratings suggests that usefulness may not be influenced so much by attentional breadth, as it may be by motivation. The motivating effects of negative mood are well documented in the literature (e.g., Akinola & Mendes, 2008; Andrews & Thomson, 2009; Kaufmann, 2003).

**Square and Matchstick Arithmetic Problems.** While based on theoretical predictions, it was expected that attentional breadth would influence performance on these types of insight problems, yet no significant difference was detected. One possible reason for failing to detect a difference might be due to the fact that a one problem per



condition approach is not a sensitive enough measure. Moreover, when compared to other tasks, the Square and Matchstick Arithmetic task had the longest allocated solving time (4 minutes), a long enough time to allow the transitory effects of emotions and arousal to dissipate. Another reason why performance on these problems was not affected as much by our manipulation is that these insight problems might be not as pure in terms of separation into different stages as other problems used in this research. While solving these insight problems, performer goes through the search and restructuring phases multiple times, thus it is difficult to parse out different stages predicted by the stage creativity model in these problems.

**General Discussion.** This research was aimed at clarifying the role of attention in the relationship between emotions and creativity. Stage model predicting that attention plays a mediating role in this relationship was well supported. While there is research investigating how emotions affect creativity, there has been no research to date examining attention as a mediating variable in the emotions/creativity relationship. This research was the first step to empirically investigate the relationship among emotions, attention and creativity simultaneously. New methods were introduced to answer questions regarding this triadic relationship. Differing from previous creativity research that did not differentiate among creativity outcome measures based on attentional breadth requirements, this study used creativity measures that were attention-specific, i.e., tasks that require either broad or narrow attention for their completion.

The stage model of creativity that this research proposed was well supported: both positive and negative emotions were shown to differentially facilitate different stages of the creative process. The finding that positive emotions promote creativity is not new, a

number of previous studies reported similar findings as well. However, other research found that at times negative emotions fostered creativity and positive emotions stifled it, and this was not easy to explain using the traditional theories of how emotions influence creativity. The most widely accepted explanation for positive emotions promoting creativity is the spreading activation model that suggests that greater creativity is exhibited under a positive mood condition when more distant nodes are activated within a network, and more divergent ideas are produced (Isen & colleagues, 1984, 1985, 1987). However, the spreading activation model fails to explain why under some circumstances positive mood does not lead to better creativity, while negative mood could sometimes lead to more creative response. To attempt an explanation of these inconsistencies, others have proposed that the purpose of emotional state is to inform an individual about the task environment, with positive mood signaling an agreeable condition, and negative mood indicating a problematic situation (Schwarz & Bless, 1991; Clore, Schwarz, & Conway, 1994). Thus, negative mood fosters a more analytic, 'tight' information processing mode, where the problem set is treated more systematically and with greater scrutiny, while positive mood leads to a more 'relaxed', heuristic processing mode (Fiedler, 1988, 2000).

With this in mind, bringing attention into the mood-creativity relationship helped to explain the many inconsistencies burdening previous research. In the Stage model, mood and arousal affect attention, causing it to broaden or narrow. In turn, attention influences what information processing mode will be used, narrow (analytic, data driven), or broad (heuristic, conceptually driven). Information processing requirements vary during the different stages of creativity; a more heuristic information processing mode is

associated with the early stages of creativity, while a more analytic information processing mode is associated with the later stages of creativity. In this study, different stages of creativity were simulated by the use of varied tasks that differed in their information processing requirements for their successful completion. As predicted, broad attention induced by means of positive low and negative high moods, promoted performance on tasks requiring heuristic information processing, while narrow attention induced by negative low and positive high mood, was associated with better performance on tasks requiring a more analytic information processing mode.

Introducing differential attentional requirements for the different stages of creativity into the emotion-creativity relationship rehabilitates the spreading activation model explanation. Broad attention is related to the early stage of creativity, and is associated with more conceptual, heuristic processing, when activation of greater number of more distant nodes in a network leads to greater number of more unusual ideas being produced. On the other hand, the activation of too many nodes in a network is detrimental to the latter stage of creativity that is associated with more analytical processing, as it can divert attention from the task needing scrutiny.

**Implications.** Implications of these findings are numerous, and are applicable to those aspects of human endeavor concerned with understanding and nurturing creativity. This research shows that the creative process is dependent on attentional breadth, which in turn is reliant on differing combinations of arousal levels and emotional valence for the fostering of the creative process at its various stages. Accordingly, new, more subtle methods for promoting creativity may be called for. While the generation of multiple, high-quality ideas has been traditionally considered a hallmark of creativity, stage theory

associates idea production with the early stage of creativity, whereas the latter stage requires a more analytical approach. This later stage has often been excluded from the creative thinking models as non-creative. The current research illuminates the necessity of both stages for the creative process to occur, thus emphasizing the need for both global and local attention. Implications for this are such that not only processes requiring broad attention, such as brainstorming, are necessary for the creativity to occur, but also more analytical thinking associated with narrow attention is required. New methods for fostering creativity, based on the stage model, should emphasize the importance of both positive and negative emotions in the creative process as well as different cognitive processes based on more global, or top down along with more local, or bottom up, processing.

**Limitations and Future Directions.** The shortfall of this research is that it uses a convenience sampling of undergraduate university students. Future research needs to parse out the effects of emotions and arousal at the different stages of creativity using a wider range of creativity tasks. The inclusion of people engaged in creativity in their daily lives, such as artists, writers and scientists, may provide a more comprehensive picture of the relationship between emotions and creativity. Future directions stemming from this research that could elaborate on the problem of study may include mediation analysis, investigating the role of attention as a mediator between emotions and creativity; the use of more complex creativity measures that are more applied in their nature; and finally, the use of more precise, physiological measures of emotions.

Overall, the pattern of results of this study provided support for the stage theory of creativity. Both positive and negative emotions were shown to be beneficial in

promoting creativity, though their effect was dependent on arousal. Moreover, attentional breadth was shown to mediate the effect of emotions and arousal on the creative process. Thus, the emotion/arousal conditions that led to a broadening of attention promoted creativity during its early stages, while conditions that narrowed attentional breadth fostered creativity in the latter stages. Consequently, the stage theory of creativity provides a new way of looking at the relationship between emotions, attention and creativity, and helps reconcile the debate of previous research regarding which emotional valence promotes and which stifles the creative process.

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**APPENDIX A****PANAS SCALE**

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what degree you feel this way right now, that is, at the present moment. Use the following scale to record your answers:

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
very slightly or not at all	a little	moderately	quite a bit	extremely

interested  
 distressed  
 excited  
 upset  
 strong  
 guilty  
 scared  
 hostile  
 enthusiastic  
 proud

irritable  
 alert  
 ashamed  
 inspired  
 nervous  
 determined  
 attentive  
 jittery  
 active  
 afraid

## VITA

### VIKTORIA TIDIKIS (A.K.A. TIDIKYTE, TIDIKYTE-DAY)

#### EDUCATION

Ph.D. 2012	Ph.D. in Applied Experimental Psychology with concentration in Cognitive Psychology, Old Dominion University
M.S. 2009	M.S. in Applied Experimental Psychology, Old Dominion University
M.F.A. 2003	M.F.A. in Media Arts Production City College of New York, CUNY
B.A. 1998	B.A. in TV Directing, Lithuanian Theater and Music Academy

#### RESEARCH INTERESTS

My research interests lie in the areas of human creativity, problem solving and decision making. My previous research investigated how gender and working within a group versus working alone affects creative performance. My latest research investigated the mediating role of attention on the relationship between creativity and emotions.

#### PROFESSIONAL EXPERIENCE

Fall 2012-Present	Instructor, Human Cognition, Old Dominion University
Spring 2011-Present	Instructor, Theories of Personality, Old Dominion University
Summer 2010-Fall 2010	Instructor, Quantitative Methods, Old Dominion University
Fall 2009-Spring 2010	Teaching Assistant, Quantitative Methods, Old Dominion University

#### UNDERGRADUATE RESEARCH

Fall 2009-Present  
Supervised and directed undergraduate student research. Trained undergraduate students in participant running procedures, coding protocols, data management and analyses, experimental/statistical software, and other data collection and analyses related tasks.

#### SERVICE

Spring 2012	Peer reviewer for Creativity Research Journal
Spring 2011	Peer reviewer for the Journal of Educational Psychology
Fall 2009-present	Peer mentor
Fall 2009-present	Member of Applied Experimental Psychology Student Association (AEPSA)

**COMPUTER SKILLS:** Microsoft Office, SPSS (PASW), AMOS, HLM, LISREL, EQS, R, E-Prime

#### PROFESSIONAL MEMBERSHIPS

Spring 2010-present	Association for Psychological Science
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**LANGUAGES:** Fluent in English, Lithuanian, and Russian, basic French and Spanish.