BRIDGING ATTENTION ACROSS SPACE AND TIME: DO POSITIVE EMOTION GENERATED SHIFTS IN SPATIAL ATTENTION LEAD TO CHANGES IN ATTENTION ACROSS TIME?

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Bridging Attention Across Space and Time: Do Positive Emotion Generated Shifts in Spatial Attention Lead to Changes in Attention Across Time

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

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ABSTRACT

Previous research has demonstrated that positive emotion influences various aspects of attention including spatial attention and attention across time. Research has commonly focused on how emotion influences one aspect of attention at a time. Recently a study was done that showed how one's natural global or local spatial attention bias predicts subsequent performance of attention across time. This study proposed to use a similar mechanism to investigate how positive emotion might influence the link between spatial attention and attention across time. It was hypothesized that individuals who are experiencing positive emotion during a spatial attention task will have a more global attention bias and perform better on a subsequent attention across time task in comparison to those in a neutral or negative emotion. The data were inconsistent with this hypothesis. There were no significant differences between emotion conditions. Limitations and future directions are discussed.

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LIST OF ABBREVIATIONS

AB .....Attentional Blink

HST .....Hierarchical Shape Task

RSVP.....Rapid Serial Visual Presentation

BRIDGING ATTENTION ACROSS SPACE AND TIME: DO POSITIVE EMOTION GENERATED SHIFTS IN SPATIAL ATTENTION LEAD TO CHANGES IN ATTENTION ACROSS TIME?

Emotions influence what we attend to and how (Aquino & Arnell, 2007, 2007; Mathewson, Arnell, & Mansfield, 2008). It has been reliably demonstrated that positive emotion broadens the scope of cognitive processing in a variety of ways including spatial attention, thought-action repertoires, thematic associations, and in attention across time (Fredrickson & Branigan, 2005; Rowe, Hirsh, & Anderson, 2007). Despite this range of influence, most of the effects of emotion on attention have been studied with only one task or form of attention having been measured at a time. There are few examples in which different kinds of attention have been measured and compared within the same study. In the following paragraphs I will review the literatures on the influence of emotion on spatial attention and the influence of emotion on attention across time. Then I will propose a means by which these two aspects of attention might be studied together in order to expand our understanding of the role that emotion plays in attention.

Spatial attention is the type of attention we use to fixate on space in our visuo-spatial field. It is sometimes thought of as an "attentional spotlight." The attentional spotlight can fall anywhere on the visual field. Where it falls determines what the current locus of attention is. The size of the attentional spotlight determines whether a global or local attention bias is adopted. In other words, are you seeing the forest or the trees? This spotlight of attention can be either broadened or narrowed depending on one's emotional state. Fredrickson and Branigan (2005) investigated the ways in which positive emotion influences breadth of attention using the Kimchi and Palmer (1982) Hierarchical Shape Task (HST). Each trial presents a standard shape with two

comparison shapes below it. All three shapes in the triad are made up of smaller shapes. Participants are asked to identify which comparison shape best matches the standard shape. One comparison shape is made up of the same smaller shapes as the standard and serves as the local response. The second comparison shape is the same overall shape as the standard and serves as the global response. Participants completed this task under one of five emotion conditions including amusement, contentment, neutrality, anger, and anxiety. The data suggested that positive affect, as operationalized by the amusement condition, broadened breadth of attention by resulting in a more global bias relative to the neutral condition on the HST.

Similar findings were obtained by Rowe and colleagues (2007) using a flanker task (Eriksen & Eriksen, 1974). The flanker task consists of responding to a central letter while it is flanked by either response-compatible or response-incompatible letters. The distance between the target and flankers was varied to assess for differences in breadth of attention. The flanker task was completed under three emotions including happy, sad, and a neutral condition. The data suggested that positive affect seemed to broaden breadth of attention relative to negative affect or a neutral condition, as distractors decreased performance on the flanker task, suggesting that a broader visuospatial spotlight of attention was being processed. The authors propose that positive affect broadens the attentional spotlight by decreasing inhibitory control, changing how attention resources are allocated.

The finding that positive affect broadens breadth of attention is considered "one of the most robust and widely confirmed findings in the affect literature" (Isen, 2002, p. 57). To extend our understanding of how positive emotion influences attention beyond the visuospatial domain, researchers have also used the rapid serial visual presentation (RSVP) paradigm (Olivers & Nieuwenhuis, 2006; Rokke, Arnell, Koch, & Andrews, 2002). Just like everyday life, where

stimuli come and go and events unfold over time, the RSVP task requires attention to multiple stimuli during sequential events. Specifically, the RSVP task consists of presenting a participant with a rapid "stream" of stimuli. These stimuli are presented one at a time, with no inter-stimulus-interval (ISI). There are two targets, commonly referred to as T1 and T2, which are unique in some way to the distractors that make up the rest of the RSVP stream. Across trials, T2 is presented in different positions following T1. This allows investigators to determine how one's ability to detect T2 following the accurate detection of T1 changes across time. The "attentional blink" (AB) is the period of time, approximately 500 ms in length, where the ability to detect the second target is impaired after attending to the initial target.

In Oliver and Nieuwenhuis' (2006) study, participants were simply asked to identify digit targets (T1 and T2) from a stream of uppercase letter distractors. It was shown that positive affect, relative to neutral and negative, resulted in a significantly smaller AB. Vermeulen (2010) conducted a study in which emotion was not induced, but measured. Participants were asked to attend to a neutral word that served as T1 while T2 was either a neutral, low arousal, or high arousal word among distractors consisting of random strings of symbols and digits. Regardless of type of T2, the author found that when participants reported positive affect a smaller AB resulted compared to when participants reported negative affect.

These authors proposed different explanations for their findings. Olivers and Nieuwenhuis (2006) offer a variety of potential explanations. The one that they favor proposes that positive affect increases cognitive flexibility. By increasing cognitive flexibility one enters an exploratory state of mind. This leads to environmental scanning and a more flexible responding style. By decreasing the intensity of focus on the task, the ability to focus on multiple targets is increased, resulting in a smaller AB. Vermeulen (2010) offers a Broadened Processing

Style explanation. In other words, he proposes that positive affect serves to reduce distractor inhibition. That is, when distractor inhibition is high, T2 is more likely to be inhibited as it is among the stream of distractors. By weakening distractor inhibition, one is more open to selectively allowing items from the stream of distractors to enter awareness, allowing more accurate identification of T2 which results in a smaller AB. Both explanations seems consistent with broadening theories of positive affect, proposed for spatial attention, which may extend across different domains of attention and cognition (Fredrickson, 2001).

Dale and Arnell (2014) were among the first to link these two domains of attention. In their study participants completed multiple breadth of attention tasks, including the flanker task and HST, followed by a RSVP task. It was found that participants' natural level of global or local attention bias was predictive of their subsequent RSVP performance. Specifically, those with a more global attention bias performed better on an RSVP task, suggesting that similar attention mechanisms might be underlying both tasks.

The following experiments aim to explore whether the relationship between spatial attention and attention across time is influenced by positive emotion. In the review above I have argued that positive emotion influences attention independently in both the visuospatial and temporal domains. I have also pointed out that there is a link, unrelated to emotion, between these two domains of attention. Thus, I conducted two experiments. In the first, participants completed the HST under positive or neutral emotion conditions. In the second, participants completed the HST under positive or negative emotion conditions. In both studies, directly following the HST, participants completed an RSVP task. It was predicted that participants in the positive emotion condition would show a more global attention bias on the HST in comparison to those in the neutral or negative conditions. Beyond that, it was predicted that the RSVP task

following the positively primed HST would result in a smaller AB relative to the neutral or negative conditions.

Experiment 1

Methods

Participants. Sixty-six undergraduate students were recruited to participate in this study. Five participants were excluded due to missing data, leaving sixty-one participants (38 women) in the final sample. The mean age of the final sample was 18.82 (*SD* = 1.51) years old. Participants were awarded course credit for their involvement. A minimum age of 18 years old was required for participation. Informed consent was obtained prior to participation and each participant was debriefed following the experiment. Participants were treated in accordance with the American Psychological Association's ethical code of conduct and guidelines.

Materials

Manipulation Check. The Affect Grid is a single item scale used to assess two dimensions of emotion. Participants respond by placing a single mark on a 9 x 9 grid in which the horizontal dimension represents very negative to very positive affect and the vertical dimension represents low to high arousal. The Affect Grid has been shown to have strong reliability, convergent validity, and discriminant validity as a measure of affect (Russell, Weiss, & Mendelsohn, 1989). Participant responses are translated into two scores from 1 to 9, one representing pleasure and one arousal. This measure served as a means to assess the effectiveness of the emotion induction prior to the HST and throughout the remainder of the experiment.

Kimchi Palmer Hierarchical Shape Task. The Kimchi Palmer Hierarchical Shape Task is adapted from Kimchi and Palmer (1982) and Fredrickson and Branigan (2005). This task

consists of presenting the participant with 24 trials of shape triads. There is a standard shape on top with two comparison shapes below. On each trial, participants are asked to respond as to which comparison shape they feel best matches the standard shape as quickly as possible. See *Figure 1* for an example trial.

Eight trials serve as experimental trials while 16 are fillers. A standard shape in a test triad consists of 3 or 4 small (5 x 5 mm) triangles or squares (local) that create a larger (15 x 15 mm) triangle or square (global). The comparison shapes both match the standard, one at the local level and one at the global. Filler triads consist of triangles or squares formed from smaller triangles, squares, circles, or crosses. In the filler trials only one comparison shape matches the standard and global and local matches appear in a random order with equal frequency.

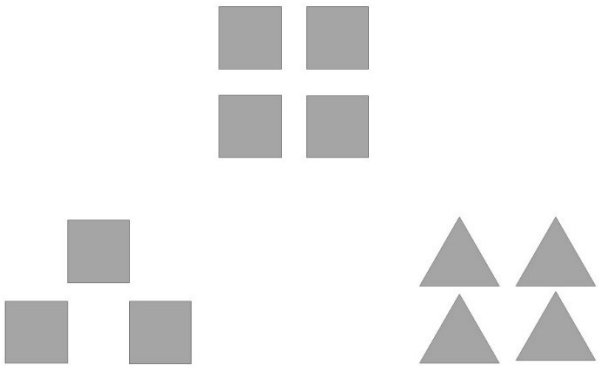

Figure 1. An example of a single trial of the Hierarchical Shape Task.

For each of the eight critical trials the number of trials in which a global response is made is counted. Thus, participants are assigned a score from zero to eight that reflects the level of global attention bias. A score of zero indicates full local attention bias, a score of four indicates

no attention bias, and a score of eight indicates full global attention bias. Filler triad responses are not used to determine global/local attention bias.

Rapid Serial Visual Presentation Task. A dual-task version of the RSVP paradigm was used in this study. All stimuli in the stream were letters. T1 was always a red letter and T2 was always a black X. Seventeen black letters will serve as distractors during the stream. T1 and the distractor letters were drawn without replacement from every letter in the alphabet, excluding B, K, X, and Y. A typical RSVP trial is illustrated in *Figure 2*.

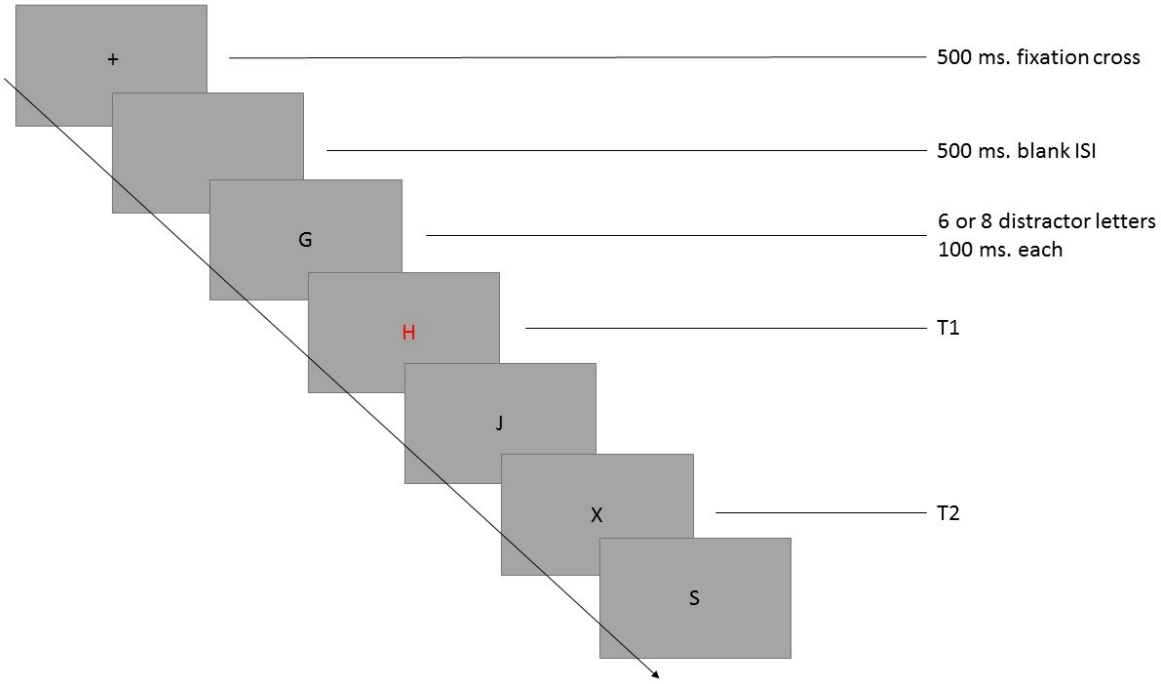

Figure 2. An example of a Rapid Serial Visual Presentation task trial.

The RSVP stimuli were presented in the center of a gray background. Each trial consisted of 19 letters total. During the RSVP stream, all distractor letters were capitalized in black, size 18 Courier New font. T1 was displayed the same, except in red. T1 always appeared in position

seven or nine of the RSVP stream. T2 was present in 2/3rds of the total trials and appeared in one of eight lag positions (*i.e.*, 100, 200, 300, 400, 500, 600, 700, or 800 ms) following T1. At least one distractor letter always followed T2. Whether T2 appeared, and in what position, was determined randomly with all possible combinations occurring within each block of trials. T2 was presented 10 times at each location resulting in a total of 120 trials for each condition. T2 scores were only counted as correct contingent on accurate identification of T1.

Each trial began with a 500 ms fixation cross. Following that, there was a blank 500 ms ISI. Then the RSVP stream began. Each letter in the stream was presented for 100 ms with no ISI. Following each RSVP stream, the participant was asked, "What was the red letter?" followed by, "Was the letter X present or absent?" To respond to the first question, participants simply pressed the letter key that represented the answer. To respond to the second question, participants pressed the "1" key for present and "0" for absent. After answering both questions, the next trial began.

Emotion Induction. Positive emotion was induced by presenting a video clip prior to the HST. The video was nine minutes and two seconds in length and consists of three segments shown to result in the induction of positive emotion. The first segment is a scene from *Along Came Polly* where Ben Stiller's character wrestles with a dog (Schaefer, Nils, Sanchez, & Philippot, 2010). The second segment is the restaurant scene from *When Harry Met Sally* (Schaefer et al., 2010; Schuch & Koch, 2014). The third segment is a scene consisting of cute animals who are playing happily (Fredrickson & Branigan, 2005; Johnson, Waugh, & Fredrickson, 2010).

Neutral emotion was also inducted by presenting a video clip prior to the HST. The clip was matched for length, at nine minutes and two seconds, and was comprised of a "first-person"

view of an individual walking through a busy street. The clip was selected as it is similar in content to other film clips used to induce neutral emotion and was similar to the positive emotion clips in terms of the presence of people, objects, and relative action (Schaefer et al., 2010).

Demand Characteristics. To assess for the influence of demand characteristics, participants were given the Perceived Awareness of the Research Hypothesis (PARH, Rubin, Paolini, & Crisp, 2010) scale immediately before they were debriefed. The PARH is a five item scale. The first four items consist of 7-point Likert-type questions that range from "Strongly Disagree" to "Strongly Agree." Each of these items assess whether or not the participant had a good idea about what the hypotheses were. The fifth item is an open ended item where participants can write in what they perceived the main hypothesis of the study to be. Each of these items were scored and analyzed separately.

Procedure. Participants were randomly assigned to complete either the positive or neutral emotion condition. To reduce interruptions in the sequence of events, participants were given instructions and practice on each task of the experiment (Affect Grid, HST, and RSVP) prior to beginning the experimental trials. Following training, each participant viewed the appropriate video clip for that emotion condition. Directly following the video clip, the participant completed the Affect Grid. Following that, the HST was the first cognitive task to be completed. Participants were instructed as follows, "We are interested in learning about the ways in which people attend to both the environment and specific items. In this task, you will first be presented with three figures. Your job is to select the figure below that best matches the figure on top. There is no right or wrong answer. Try to respond quickly and trust your gut instinct." This task was completed on paper. Participants were simply asked to circle the shape below that they felt best matched the shape above.

Directly following the HST, participants completed another Affect Grid prior to beginning the RSVP task. For the RSVP task, participants were told to treat the identification of the red letter, T1, as their primary task, but to do as well as possible at detecting both targets. Participants were told not to rush, as accuracy, not speed, was the most important factor. Participants then began the experimental trials. Following the RSVP task, the Affect Grid was administered again. Lastly, participants were given the PARH questionnaire and then debriefed.

Results

Manipulation Check. Separate 2 (emotion: positive and neutral) X 3 (time) mixed design ANOVAs, with time serving as a repeated measures factor, were conducted to assess for mean differences in pleasure and arousal ratings. The analysis of pleasure ratings revealed a main effect for emotion $F(1, 59) = 4.852$, $p = 0.03$ where the positive emotion condition ($M = 6.37$, $SD = 1.98$) resulted in a higher mean rating of pleasure than the neutral condition ($M = 5.67$, $SD = 1.98$). The analysis also revealed a main effect for time $F(2, 118) = 17.92$, $p < 0.001$. Post hoc analyses revealed that Time 1 ($M = 6.61$, $SD = 1.83$) and Time 2 ($M = 6.50$, $SD = 1.42$) did not significantly differ from one another ($p = 0.62$) but both significantly differed from Time 3 ($M = 4.70$, $SD = 2.26$; both ps < 0.001). The emotion X time interaction was not significant $F(2, 118) = 2.62$, $p = 0.08$.

The analysis of arousal ratings did not reveal a significant main effect for emotion $F(1, 59) = 1.70$, $p = 0.20$. The main effect for time was also not significant $F(2, 118) = 3.12$, $p = 0.05$. The emotion X time interaction was significant $F(2, 118) = 4.42$, $p = 0.01$). Post hoc analyses revealed that at Time 1, arousal ratings in the positive emotion condition ($M = 6.27$, $SD = 1.63$) were significantly greater than those in the neutral emotion condition ($M = 4.75$, $SD = 2.23$); $t(59) = 2.98$, $p = 0.004$.

HST Score. A one-way between subjects ANOVA was used to assess for mean differences in global or local attention bias between the two emotion conditions. The results were not significant $F(1, 59) = 0.02$, $p = 0.956$.

RSVP T1 Performance. A one-way between subjects ANOVA was used to assess for mean differences in T1 performance. The analysis was not significant, $F(1, 59) = 1.02$, $p = 0.32$. Differences in T1 performance between the positive and neutral condition was not expected. However, should T1 differences have existed, this may have spoken to methodological problems or differences in T2 that we may want to consider further. As only trials in which T1 is accurately identified are used to determine T2 detection, this analysis ensured that a reasonable sample of performance was available. T1 differences could also be suggestive of the influence of emotion on attentional performance beyond the "broadening" of the attentional window.

RSVP T2 Performance. A 2 (emotion: positive and neutral) X 8 (position: 100, 200, 300, 400, 500, 600, 700, and 800 ms) mixed design ANOVA was used to assess for mean differences in T2 performance. A main effect for position was present, $F(7, 413) = 24.70$, $p < 0.001$, indicating the presence of the typical attentional blink. The mean level of performance for positions one through four ($M = 0.44$, $SD = 0.25$) was significantly lower than for positions five through eight ($M = 0.71$, $SD = 0.25$; $t(120) = 6.20$, $p < 0.001$. The main effect for emotion, $F(1, 59) = 0.365$, $p = 0.55$, and emotion X position interaction, $F(7, 413) = 1.59$, $p = 0.14$, were not significant.

Prediction of RSVP from HST. A linear regression analysis was run to examine the relationship between HST score and RSVP performance for both emotion conditions. RSVP performance across positions was transformed into AB magnitude. AB magnitude is calculated

by taking the mean of positions seven and eight and subtracting the mean of positions two through four.

Table 1 lists the correlations among pleasure, arousal, HST, and AB magnitude. It should be noted that pleasure is not correlated with the HST. Although the HST is very modestly and positively correlated with AB Magnitude, it is not a significant correlation.

Table 1. *Experiment 1 Pearson correlations*

	Pleasure	*Arousal*	*HST*	*AB Magnitude*
Pleasure	1.00			
Arousal	-0.40**	1.00		
HST	-0.02	0.08	1.00	
AB Magnitude	0.04	-0.01	0.18	1.00

Note. Pleasure and Arousal refer to the values obtained from the Affect Grid at time 2. HST is the level of local or global attention bias as assessed by the Hierarchical Shape Task. AB Magnitude is a value that represents overall performance on the Rapid Serial Visual Presentation task. $p < 0.05$.

It was my intention to run a regression analysis to determine whether AB magnitude could be predicted from the HST score. However, the correlation table above clearly indicates that there was no meaningful relationship between the two variables.

Demand Characteristics. There were no significant differences between the positive and neutral emotion condition on the first three items of the PARH questionnaire (all *p*s > 0.05). There was a difference on the fourth item, "I was unclear about exactly what the researchers were aiming to prove in this research." Participants in the neutral condition perceived themselves to be more unclear ($M = 4.14$, $SD = 1.48$) about what we were aiming to prove in this research than those in the positive condition ($M = 3.31$, $SD = 1.47$; $t = -2.38$, $p = 0.02$). Responses on the

open-ended fifth item commonly revolved around describing the task in terms of how humor, or distraction, influenced concentration. As the study used a between subjects design, participants were only exposed to one of the two emotion manipulations which limited their understanding of the study's hypotheses. It seems unlikely that demand characteristics significantly influenced performance in this experiment.

Discussion

The goal of the first experiment was to determine whether positive emotion would generate a shift in spatial attention bias that would influence a subsequent task requiring attention across time, relative to an emotionally neutral state. The data suggest that there was not a significant difference in spatial attention bias between the positive emotion and neutral conditions. As such, there were no significant differences in performance on the subsequent RSVP task.

Experiment 2

The second experiment was designed to compare positive emotion to negative emotion, as opposed to a neutral state. One potential explanation for the insignificant difference found in Experiment 1 was that the differences in attention under positive and neutral states was too subtle to have an impact on these tasks. As such, participants were asked to complete the same procedure with the exception of comparing positive emotion to negative emotion to increase the contrast between the emotion conditions. In addition, the film clips previously used in the positive condition were changed to reflect a more content, contemplative positive state of mind as opposed to the amused state induced in Experiment 1.

Methods

Participants. Fifty-eight undergraduate students were recruited to participate in this study. One participant was excluded due to missing data, leaving fifty-seven participants (36 women) in the final sample. The mean age of the participants was 19.00 (*SD* = 1.77) years old. Participants were awarded course credit for their participation. They were required to be 18 years or older to participate. Informed consent was obtained prior to participation and each participant was debriefed following the experiment. Participants were treated in accordance with the American Psychological Association's ethical code of conduct.

Emotion Induction. In Experiment 2, positive emotion was once again inducted by presenting a video clip prior to the HST. The clip was two minutes and five seconds in length. The video clip came from the 1982 film *An Officer and a Gentleman* and consisted of a man meeting a woman, kissing her, and carrying her out of a factory. This clip has been successfully used as a mechanism for positive emotion induction in previous research (Hewig et al., 2005).

Negative emotion was also induced by presenting a video clip prior to the HST. The negative film clip was slightly longer than the positive at three minutes and twenty-three seconds in length. The clip comes from the 2000 film *Vertical Limit* and consists of a scene with multiple rock climbers struggling not to fall. The clip has been successfully used in the induction of negative emotion in previous research (Fredrickson & Branigan, 2005).

Design and Procedure. Experiment 2 adopted an identical design to Experiment 1. Participants were randomly assigned to complete either the positive or negative emotion condition. Participants were given instructions and practice on each task of the experiment (Affect Grid, HST, and RSVP) prior to beginning the experimental trials. Following training, each participant viewed the appropriate video clip for that emotion condition. Directly following the video clip, the participant completed the Affect Grid. Following that, the HST was the first

cognitive task to be completed. Directly following the HST, participants completed another Affect Grid prior to beginning the RSVP task. Following the RSVP task, the Affect Grid was administered again. Lastly, participants were given the PARH questionnaire and then debriefed.

Results

Manipulation Check. Separate 2 (emotion: positive and neutral) X 3 (time) mixed measures ANOVAs were conducted to assess for mean differences in pleasure and arousal ratings. The analysis on pleasure ratings revealed a main effect for emotion $F(1, 55) = 51.19$, $p < 0.001$ where the positive emotion condition ($M = 6.26$, $SD = 2.07$) resulted in a higher mean rating of pleasure than the negative condition ($M = 4.22$, $SD = 2.00$). The analysis also revealed a main effect for time $F(2, 110) = 20.87$, $p < 0.001$. Post hoc analyses revealed that Time 1 ($M = 5.22$, $SD = 2.89$) and Time 2 ($M = 6.13$, $SD = 1.72$) and Time 3 ($M = 4.37$, $SD = 1.67$) all significantly differed from one another (all ps < 0.01). The emotion X time interaction was also significant $F(1, 55) = 285.02$, $p < 0.001$. At Time 1, mean pleasure ratings were significantly higher in the positive ($M = 7.68$, $SD = 1.02$) than the negative ($M = 2.76$, $SD = 1.85$), $t(55) = 12.40$, $p < 0.001$. At Time 2, mean pleasure ratings were also significantly higher in the positive ($M = 6.71$, $SD = 1.70$) than the negative ($M = 5.56$, $SD = 1.57$) condition, $t(55) = 2.69$, $p = 0.01$.

The analysis on arousal ratings did not reveal a significant main effect for emotion $F(1, 55) = 0.19$, $p = 0.67$. Time 1 ($M = 5.82$, $SD = 2.11$) was significantly different than both Time 2 ($M = 4.42$, $SD = 1.97$; $p < 0.001$) and Time 3 ($M = 4.67$, $SD = 2.11$; $p < 0.001$) which were not significant from one another ($p = 0.50$). The main effect for time was significant $F(1, 55) = 9.08$, $p = 0.004$. The emotion X time interaction was insignificant $F(1, 55) = 0.03$, $p = 0.86$).

HST Score. A one-way between subjects ANOVA was used to assess for mean differences in global or local attention bias between the two emotion conditions. The analysis was insignificant $F(1, 55) = 0.71$, $p = 0.40$.

RSVP T1 Performance. A one-way between subjects ANOVA was used to assess for mean differences in T1 performance. The analysis was insignificant, $F(1, 55) = 0.82$, $p = 0.37$.

RSVP T2 Performance. A 2 (emotion: positive and negative) X 8 (position: 100, 200, 300, 400, 500, 600, 700, and 800 ms) mixed design ANOVA was used to assess for mean difference in T2 performance. A main effect for position was present, $F(7, 371) = 19.32$, $p < 0.001$, indicating the presence of the typical attentional blink. The mean level of performance for positions one through four ($M = 0.52$, $SD = 0.27$) was significantly lower than for positions five through eight ($M = 0.76$, $SD = 0.25$; $t(112) = 4.87$, $p < 0.001$. The main effect for emotion, $F(1, 53) = 0.828$, $p = 0.37$, and emotion X position interaction, $F(7, 371) = 0.99$, $p = 0.44$, were insignificant.

Prediction of RSVP from HST. A linear regression analysis was run to examine the relationship between HST score and RSVP performance for both emotion conditions. RSVP performance across positions was transformed into AB magnitude. AB magnitude is calculated by taking the mean of positions seven and eight subtracted by the mean of positions two through four.

Table 2 lists the correlations among pleasure, arousal, HST, and AB magnitude. It should be noted that pleasure is not correlated with the HST. Beyond that, the HST is not correlated with AB Magnitude. Arousal is weakly correlated with HST in this study, although HST performance did not vary across conditions.

Table 2. *Experiment 2 Pearson correlations*

	Pleasure	*Arousal*	*HST*	*AB Magnitude*
Pleasure	1.00			
Arousal	-0.22	1.00		
HST	-0.12	0.32*	1.00	
AB Magnitude	0.03	0.03	0.06	1.00

Note. Pleasure and Arousal refer to the values obtained from the Affect Grid at time 2. HST is the level of local or global attention bias as assessed by the Hierarchical Shape Task. AB Magnitude is a value that represents overall performance on the Rapid Serial Visual Presentation task. $p < 0.05$.

It was my intention to run a regression analysis to determine whether AB magnitude could be predicted from the HST score. However, the correlation table above clearly indicates that there was no meaningful relationship between the two variables.

Demand Characteristics. There were no significant differences on the first four items of the PARH questionnaire (all *p*s > 0.05). Responses on the open-ended fifth item primarily referenced some link between emotion and concentration with the explanation being similar across the two conditions. It seems unlikely that demand characteristics significantly influenced performance in this experiment.

Discussion

The primary aim of Experiment 2 was to determine whether positive emotion would result in a more global spatial attention bias on the HST shifting subsequent performance on an RSVP task relative to a negative emotion condition. The positive emotion induction film was changed to reflect a more content, relaxed, contemplative positive state as opposed to the more humor focused positive state from Experiment 1. In addition, a negative emotion condition was used for comparison as opposed to a neutral condition. This was done to help elicit any potential

differences by comparing the positive emotion condition to an emotionally state that is more thematically different than the neutral condition from Experiment 1. Overall, there was no significant difference in spatial attention bias as assessed by the HST, size of the AB as assessed by the RSVP, nor a significant linear regression equation between the two.

General Discussion

Positive emotion has been reliably shown to influence spatial attention (Fredrickson & Branigan, 2005; Huntsinger, 2012; Rowe et al., 2007) and attention across time (Olivers & Nieuwenhuis, 2006; Vermeulen, 2010). Studies of this nature often focus on emotional influences on a single type of attention. Recently, it was shown that these two forms of attention are linked, such that a natural global or local bias within spatial attention predicts attention across time on a RSVP task (Dale & Arnell, 2014). The current study was proposed as a means to further examine the relationship between these two types of attention through the lens of positive emotion.

I offered two primary predictions for this study. The first was that participants in the positive emotion condition would have a significantly more global attention bias on the HST in comparison to those in the neutral or negative condition. The second prediction was that participants who completed the positive emotion HST would have a smaller AB than those who complete the HST under a neutral or negative emotion condition. The data collected did not support either hypothesis. In both experiments, there was no difference in spatial attention bias between the positive emotion condition and the comparison emotion condition (neutral for Experiment 1, negative for Experiment 2).

It is particularly puzzling that there were no differences in spatial attention bias between emotions on the HST, as this effect is regarded as "one of the most robust and widely confirmed

findings in the affect literature" (Isen, 2002, pg. 57). One explanation is that it is possible that there was some unforeseeable flaw in the methods or procedure. The most likely methodological problem could be related to the emotion induction procedures. The chosen video clips have been successfully used to induce emotions in this way before (Gross & Levenson, 1995; Schaefer et al., 2010), but with so few trials it is possible that the shift in emotion, although captured by the Affect Grid, was too subtle or brief to create significant differences in spatial attention bias.

Although Dale and Arnell (2014) demonstrated a link between spatial attention and attention across time, they did so using participants' natural spatial attention bias. It is possible that an artificially produced spatial attention bias does not share the same relationship with attention across time. Beyond that, it could be possible that the findings of Dale and Arnell (2014) was related to some third unknown mechanism linking spatial attention and attention across time that is not related to emotion.

It's clear that emotion influences attention. Be it engaging students with humor in an otherwise boring lecture topic, day dreaming with a cup of hot chocolate in front of the fireplace on a cold winter night, or not being able to look at the screen during the scariest parts of a horror movie, emotion influences different aspects of attention in potentially different ways. The exact nature of these influences is not yet fully understood. Unfortunately, these findings do not further illuminate these influences or relationships. The aim of this study was to examine the link between spatial attention and attention across time, specifically by introducing positive emotion into the picture. Theoretically, it seems possible that positive emotion still plays a role in the relationship between attention across space and time. Future studies should explore alternative means of inducing positive emotion as well as examining the relationship between one's baseline spatial attention bias and the way that positive emotion might influence that baseline.

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