The power of positivity; Do emotions influence attentional breadth?

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Abstract

Fredrickson's (2001) broaden and build theory describes how experiencing positive emotions, such as happiness, broadens our 'thought-action repertoire' leading us to be more likely to go out and act on our positive emotions. This results in the building of new relationships, resources and skills, which we can draw on in times of need throughout life. In contrast, the experience of negative emotion is thought to narrow our 'thought-action repertoire', leading to specific actions to aid in survival (Fredrickson, 2001). The current experiments aimed to explore the effect of briefly presented schematic faces (happy, sad, and neutral) on attentional scope using the flanker task. Based on the broaden and build theory it was hypothesised that there would be an increase in reaction time in trials primed with a happy face due to a broadening of attention, leading to increased flanker interference. A decrease in reaction time was predicted for trials primed with a sad face, due to a narrowing of attention leading to less flanker interference. Results lend partial support to the broaden and build hypothesis, with reaction times being slower following happy primes in incongruent flanker trials in Experiment 1. Recent research is discussed in regards to potential mediators of the relationship between emotion and attention.

Keywords: emotion, attention, broaden and build, flanker task

Emotions Influence on Attentional Breadth

From the age of two we can identify happiness, sadness, anger and fear in ourselves and in others (Dunn, Bretherton, & Munn, 1987). We need emotion knowledge early in life as our emotions help us make sense of what is going on in the world around us (Widen & Russell, 2008). Our fight or flight response demonstrates an evolutionary example of the importance of emotion (Porges, 1997). The experience of anxiety or fear sends a message to the amygdala in our brain, which triggers off several physical changes in the body to prepare us to fight a potential threat or escape and survive. We experience an increased heart rate, increased breathing rate, muscle tension, cold extremities as blood moved to our organs, and a narrowed attenional focus (Tooby & Cosmides, 1990). This adaptive survival strategy is initiated by our experience of emotion. Emotions are described by Fredrickson and Branigan (2005) as "short-lived experiences that produce coordinated changes in people's thoughts, actions, and physiological responses" (p. 313). It seems intuitive that positive emotions are beneficial for wellbeing, and in the growing field of positive psychology, emotion is receiving increased attention from researchers (Seligman & Csikszentmihalyi, 2000; Sheldon & King, 2001). Furthermore, Fredrickson (2004) argues that experiencing positive emotions can cause long term changes to how we act, react and experience our life.

Our experience of emotions is connected to our memory, attention, and concentration, and different emotions appear to facilitate or impair our capacity in these cognitive areas (Gray, 2004). For example, Gray (2001) examined the effect of emotion on working memory using a spatial and verbal working memory computer task where participants played a video game while keeping a list of three changing items in mind. Prior to playing the game participants were induced to feel either amusement or anxiety by watching comedy and horror videos respectively. Participants in the amusement condition showed enhanced verbal working memory, but impaired spatial working memory. In contrast, those in the anxiety

condition showed the opposite effects, with enhanced spatial working memory and impaired verbal working memory. Viewing emotions as being action oriented helps explain these findings (Cacioppo, Gardner, & Berntson, 1999; Carver, Sutton, & Scheier, 2000). Some emotions lead us to approach and others to withdraw. For example, we may want to approach a situation when feeling happy or angry, but withdraw when feeling scared or embarrassed (Carver et al., 2000). Gray concludes that it is the approach function of amusement and the withdrawal function of anxiety that may act to enhance the cognitive processes typically required during these emotions (Gray, 2001). Those feeling amusement may wish to act on this emotion by engaging in social activity requiring verbal skills, in contrast those feeling anxious will need a clear escape route drawing on their spatial memory. Emotions clearly influence our cognition and discussion of the benefits of positive emotions begins with a discussion of Fredricksons (2001) broaden and build theory of emotion.

The broaden and build theory

The broaden and build theory maintains that the experiencing of positive emotions, such as happiness, encourages exploration and interest in the environment (Wadlinger & Isaacowitz, 2006). This momentary broadening of what is named an individual's 'thought-action repertoire' is thought to broaden the array of thoughts and actions that come to mind in any given situation (Fredrickson, 2001) causing us to be more likely to act on our positive emotions. Our actions following positive emotions encourage the building of relationships, experiences, skills, and resources, which can be drawn on in times of need throughout life (Fredrickson, 2004). For example, the experience of joy in childhood which can lead to play, builds mental resources such as theory of mind and problem solving (Leslie, 1987; Panksepp, 1998). Play with others helps to build secure attachments, bonds, and social resources (Aron, Norman, Aron, McKenna, & Heyman, 2000). Animal research has shown that physical play prepares primates for using physical resources needed for survival (Pellegrini, Dupuis, &

Smith, 2006). Thus positive emotions are not simply beneficial in offering a pleasant momentary experience, they also increase our resources for coping with negative experiences in the future, increasing our resiliency. It appears the capacity to experience positive emotions may be fundamental to human flourishing (Fredrickson, 2001). The following section examines evidence for the broaden and build theory in relation to the cognitive function of attention.

Evidence for the broadening of attention

The broaden and build theory provides a theoretical explanation for the broadening effect that positive emotions have on attention (Moriya & Nittono, 2010; Rowe, Hirsh, & Anderson, 2007). Research in this area has typically manipulated participant's mood using a variety of different mood induction procedures. For example, Wadliner and Isaacowitz (2006) gifted candy to half of 58 college participants to induce a positive mood immediately prior to measuring their visual attention using an eye-tracking task. Gaze fixation was measured while participants viewed a series of emotional photographs presented at varying peripheral distances to examine the effect of mood on attentional breadth. Consistent with the hypothesis, the positive mood induction group viewed peripheral photographs for longer than those in the control group, indicative of broadened attention (Wadliner & Isaacowitz, 2006).

Various different measures of attentional focus have been employed to examine the broaden and build effect. Visual attention can focus on the overall picture (global focus) or focus on the small components that make up a scene (local focus), put another way we can view the forest, or the trees (Fink et al., 1996). An example of global versus local visual processing tasks is the Navon letters task (Navon, 1977), which shows large global letter shapes constructed from smaller letters (for example; T made of small H's) and participants are asked to identify either the large letter or the small letter. These tasks have shown positive

emotion results in a broader global approach (Fenske & Eastwood, 2003; Sagiv & Bentin, 2001; Schwarz & Clore, 2007). For example, Fredrickson and Branigan (2005) manipulated mood using films that elicited amusement, contentment, anger, or anxiety, compared to a control condition. Attention was measured using a global-local geometric task, which assessed the extent participants attended to the global configuration of an object, versus local details. In addition, thought-action repertoires were measured using a written questionnaire containing twenty open-ended statements (Kuhn & McPartland, 1954), such as *'I would like to _'* if the emotion previously elicited by the film were to arise. A higher number of statements generated reflected a larger thought-action repertoire. The positive emotion conditions (amusement and contentment) showed greater global choices in the visual task, and a greater number of responses on the open-ended statements task relative to the negative emotion conditions (anger and anxiety). Consistent with the broaden and build theory this reflected broadened attention and broadened thought-action repertories following induced positive mood (Fredrickson & Branigan, 2005).

The Flanker task is a commonly used method of measuring attentional scope (Eriksen & Eriksen, 1974) and demonstrates broadened attention via increased susceptibility to distracting flankers. Rowe, Hirsh, and Anderson (2007) induced mood by requiring participants to listen to happy or sad music for ten minutes prior to participants completing the flanker task. In this task participants were required to attend to a central target letter while ignoring flanking distractors which were either compatible or incompatible to the target letter, and were presented either close to or far from the target. An example of an incongruent no space display would be HHHHNHHHH. An example of a congruent two space display would be: H H H H H H H H H. Typically, target letters are faster to detect when flankers are congruent and spaced further from the target . A broadening of attention is inferred when there is a slowing in response to the central target when flanked by

incompatible flankers, and when targets are spaced apart from the target for a happy group compared with a sad group. Consistent with the hypothesis, Rowe et al. (2007) found that the happy group had slower reaction times during the flanker task compared with the sad group.

Pictures have also been used to induce mood prior to a flanker task. Moriya and Nittono (2010) had participants view, emotionally positive, negative or neutral pictures prior to each trial of the flanker task. Trials primed by a negative picture showed a greater incongruence effect with near flankers, however in the positive condition the effect of incongruent flankers was the same for both distances. This is consistent with positive pictures causing broadened attention resulting in interference from both near and far flankers, compared to negative pictures where a narrowed attentional scope resulted in interference by only near flankers, supporting the broaden and build theory.

The broadening of attention with positive emotions has been linked to improvements in other cognitive abilities. Positive emotions have been thought to improve how people organise information and ideas (Estrada, Isen, & Young, 1997; Isen & Daubman, 1984), increase creativity (Isen, Daubman, & Nowicki, 1987), and improve problem solving ability (Isen, Johnson, Mertz, & Robinson, 1985). Increased problem solving ability was demonstrated by Isen, Daubman, and Nowicki (1987) where participants viewed a comedy film and were gifted a bag of lollies prior to completing the Duncker (1945) candle task. Participants in this task are given a box of matches, a box of drawing pins, and a candle, and are instructed to attach the candle to a pin board so that no wax will drip onto the floor. Participants in the positive mood condition considered a greater number of ways of utilizing the materials, and considered more unusual approaches than those in the control condition. It appears that experiencing positive emotion increases associations between stimuli and ideas, facilitating creative solutions to problems (Isen et al., 1987).

An increase in problem solving ability has also been found in clinical populations (Joiner et al., 2001), where suicidal clients who were more prone to experiencing periods of positive mood during treatment displayed greater problem solving attitudes following treatment, and partly as a function of this, had better treatment responses (Joiner et al., 2001). Research supports both induced and naturally occurring positive emotions resulting in broadened attention, among other beneficial effects. The reverse appears true for negative emotions.

Evidence for the narrowing of attention

Negative emotions have been shown to narrow people's attentional focus (Easterbrook, 1959). An example of this is weapon focus (Derryberry & Tucker, 1994), the high levels of anxiety experienced during an attack or a robbery may cause the victim's attention to be focused on the attacker's weapon rather than broader information such as the attackers defining features (Loftus, Loftus, & Messo, 1987; Tyler & Tucker, 1981). Although the victim may not retain information that would help police in detecting the attacker, the focus of attention on the immediate threat, the weapon, holds survival value. The broaden and build theory of emotion maintains that negative emotions promote specific action tendencies through narrowing a person's thought-action repertoire (Fredrickson, 2001), for example, specific urges to attack when angry, or escape when afraid (Tugade & Fredrickson, 2004). The reduction in attention to irrelevant aspects of the environment aids in engaging quick and decisive action in threatening situations, thus promoting survival (Fredrickson, 2001).

Research has examined the effect of negative emotions causing individuals to 'miss the forest for the trees' (Derryberry & Reed, 1997; Easterbrook, 1959). Gasper and Clore (2002) manipulated mood by requiring participants to spend approximately ten minutes writing about a happy or sad life event they had experienced. Following this, participant's

completed a serial-reproduction paradigm where they were shown a drawing of an African shield which, following a delay, they were asked to reproduce from memory. The shield was ambiguous in that globally it could also be interpreted as having face-like elements and was entitled ‘portrait of a man’. Consistent with a narrowing of attentional scope, participants in the sad condition were less likely to rely on the global information of the picture when recreating it, compared to those in the happy condition. Those in the sad condition did not utilize the facial resemblance and title, and instead focused on the small details of the shield. This suggests that the experience of negative emotion causes attention to narrow to smaller details rather than viewing images as wholes, consistent with the broaden and build hypothesis.

In addition to research showing that mood induction procedures result in changes in attention, it is thought that naturally occurring negative mood, namely anxiety and depression, are also linked to narrowed attention (Bradley, Mogg, & Lee, 1997; Gotlib, Krasnoperova, Yue, & Joormann, 2004; MacLeod & Mathews, 1991). Basso, Schefft, Ris, and Dember (1996) examined this using questionnaires to measure individual’s mood states. Participants completed the Beck Depression Inventory (BDI: Beck et al., 1988), as a measure of negative mood, and the Satisfaction with Life Scale (SWLS: Pavot & Diener, 1993), as a measure of positive mood, the State Trait Anxiety Inventory (STAI: Metzger, 1976), as a measure of anxiety, and the Life Orientation Test (LOT: Scheier & Carver, 1985), as a measure of optimism. Attentional breadth was tested using a global-local judgement task where judgements of similarity are made based on either singular elements (locally) or on an image as a whole (globally). Depression and anxiety scores were positively correlated with the processing of local stimuli, and negatively correlated with the processing of images globally, suggesting that those with higher levels of negative emotions attended to smaller details of the images rather than the overall picture. Positive mood scores showed the

opposite results, lending support to the broaden and build theory in naturally occurring non-induced mood states.

It has been suggested that depressed mood, and narrowed attention and thinking influence each other reciprocally, leading to worsening mood and greater depression (Peterson & Seligman, 1984). However, research is beginning to suggest that the experience of positive emotions can serve to 'undo' the narrowing effect of negative emotions (Fredrickson, 2001).

The undoing hypothesis

It is widely accepted that positive emotions broaden attention and our thought-action repertoire (Fenske & Eastwood, 2003; Moriya & Nittono, 2010; Rowe, Hirsh, & Anderson, 2007; Schwarz & Clore, 2007), and that negative emotions have the opposite effect narrowing an individual's attentional scope and range of actions (Derryberry & Tucker, 1994; Easterbrook, 1959; Tugade & Fredrickson, 2004). The question has arisen as to whether positive emotions can serve to 'undo' the narrowing effect of negative emotions and reverse the changes to mind and body (Fredrickson, 2001).

Fredrickson and Levenson (1998) and Fredrickson, Mancuso, Branigan, and Tugade (2000) examined this idea by measuring participants cardiovascular activity during an experiment in which anxiety was induced in participants by informing them that they had one minute to prepare a speech on the topic of 'why you are a good friend' which they would then present and be evaluated on. Participants were then randomly assigned to view either one of two positively valenced films (joy or contentment), a neutral film, or a sad film. Participants in the positive film conditions had faster cardiovascular returns to baseline than those in the neutral and sad conditions. Although the positive and neutral films had no effect on baseline cardiovascular activity, the positive films had the effect of undoing the cardiovascular

reactivity to the anxiety inducing speech task. It is suggested that broadened thinking at a cognitive level may mediate 'undoing' at a cardiovascular level, reversing the physical effect of negative emotional experience, consistent with the broaden and build hypothesis (Fredrickson & Levenson, 1998).

The upward spiral

Resilient people are described as those who bounce back from stressful experiences quickly and effectively (Fredrickson, 2001). The undoing hypothesis would propose that these are the people who cultivate positive emotions to 'undo' the psychological and physiological effects following negative events (Fredrickson, 2001), however research is suggesting positive emotions and resiliency may create an upward spiral.

Fredrickson and Joiner (2002) measured positive and negative emotions using the Positive And Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), and broad minded coping, using the Coping Responses Inventory (CRI; Moos, 1988), in 138 participants over two time points, five weeks apart. People who experienced more positive emotions at time one had greater resiliency and used greater broad minded coping at time two. Additionally, resiliency and broad minding coping predicted more experience of positive emotions over time. The results point towards an upward spiral where positive emotions and resiliency build upon one another. This is consistent with the broaden and build theory, that the momentary experience of positive emotion builds resources that lead to long term wellbeing (Fredrickson & Joiner, 2002).

Examining the relationship between emotional experience and resiliency, Tugade and Fredrickson (2004) measured mood using the PANAS (Watson, Clark, & Tellegen, 1988), psychological resilience using the Ego-Resiliency Scale (Block & Kremen, 1996), and cardiovascular activity. Participant's mood was manipulated by informing them that they had

one minute to prepare a speech which would be videotaped and evaluated by their peers. Resilience did not predict levels of anxiety reported during the speech task or level of cardiovascular reactivity, however it did predict amount of happiness and interest participants reported experiencing during the speech task and a faster return to baseline levels of cardiovascular activity. Consistent with the broaden and build theory the time taken to return to baseline cardiovascular activity was mediated by the experience of positive emotions during the task. Broadened thinking may allow people to find more positive meaning when experiencing negative events, and to put the negative events into a broader perspective within their life (Fredrickson, 2001). The relationship between positive emotions and finding positive meaning is considered reciprocal in nature. Finding positive meaning increases positive emotions, and as positive emotions broaden our thinking they increase the likelihood of finding positive meanings, creating an upward spiral in well-being and resilience over time (Fredrickson, 2000).

Additional factors found to be related to resiliency have been examined to establish how the experience of positive emotion fits into the picture. For example, Cohn, Fredrickson, Brown, Mikels, and Conway (2009) measured 86 participants' emotions daily over one month using an online diary to rate 18 different emotions on a five point scale. Life satisfaction was assessed using the Satisfaction with Life Scale (SWLS; Pavot & Diener, 1993), and resilience was measured using the Ego Resiliency 89 (Block & Kremen, 1996). Positive emotions predicted increased life satisfaction and resilience. In addition positive emotions mediated the relationship between initial and follow-up resilience, suggesting that the moment to moment experience of positive emotions, rather than the overall evaluation of satisfaction with life, led to resiliency, consistent with the broaden and build theory.

Taking advantage of a disastrous event, Fredrickson, Tugade, Waugh, and Larkin (2003) had administered the Ego-Resiliency Scale (Block & Kremen, 1996) and measures of

trait affectivity and psychological resources to research participants prior to the September 11th terrorist attacks on the World Trade Centre. Early data collection following the attacks found that a large proportion of people felt depressed, had cried, were having trouble sleeping and concentrating, and were feeling anxious and fearful. Fredrickson et al., followed up the same participants after the attack, assessing; current mood, problems experienced, the extent of positive meaning found, level of positive and negative emotions experienced, depressive symptoms, and psychological resources. Although participants reported experiencing high levels of negative emotions following the attacks, the level of positive emotions experienced revealed the greatest effects on wellbeing. Those scoring high on trait resilience experienced more positive emotions following the attacks, and levels of positive emotions experienced following the attacks fully accounted for the relationship between trait-resilience and later development of depressive symptoms, suggesting that positive emotions act as a buffer for resilient people against depression. Levels of positive emotion also fully accounted for the relationship between resilience and growth in psychological resources, suggesting that in a natural setting resilient people use positive emotion as a way to rebuild resources that negative events drain, consistent with the undoing hypothesis and the broaden and build theory.

The experiencing of positive emotion has even been linked to longevity of life, for example, early life autobiographies from 180 catholic nuns were scored for emotional content, and results showed that nuns with a greater number of positive emotional experiences lived longer, even when controlling for; family history, social activities, support, drug and alcohol use, occupation and socioeconomic status (Danner, Snowdon, & Friesen, 2001). Research on the broaden and build theory is providing support for it an explanation for many real world occurrences.

The current studies

The current studies will investigate the influence of emotion on attention in relation to the broaden and build hypothesis. The studies aim to determine whether similar attentional changes that have been found to occur using lengthy mood induction procedures (Rowe, Hirsh, & Anderson, 2007; Wadliner & Isaacowitz, 2006), can occur simply by priming participants with a briefly presented schematic face. As research has shown the link between the broadening of attention and building resiliency (Fredrickson, 2004; Fredrickson & Joiner, 2002), discovering the minimal level of emotional manipulation required to produce change enhances the real world value of results. Mood induction procedures by necessity require a between group design, whereas the current experiment adopts a within group design in which all participants will receive both positive and negative stimuli. A standard flanker task (Eriksen & Eriksen, 1974) will be used to measure attentional breadth. This will be examined in three experiments. In the first experiment participants are primed with a happy face and a sad face, the second where participants are primed with a happy and a neutral face, and the third where participants are primed with a sad and a neutral face. The first experiment will attempt to replicate an unpublished experiment, which used the same methodology of the flanker task and briefly presented happy and sad facial primes, and found slower reaction times in incongruent trials following a happy prime than a sad prime (Forman, 2010, unpublished manuscript), suggesting broadened attention. The second and third studies will determine the individual effects of the happy and sad faces compared to the neutral face. It is of course possible to examine the effects of happy, sad, and neutral primes in a single experiment. One possible disadvantage of this approach is that presenting all three primes in a single experiment might, in some way, result in overall slowing of reaction times in a way that could add noise to the data and influence any effect that might otherwise be demonstrated. It is hypothesised that in Experiment 1, when primed with a happy face, there will be an increase in reaction times to the target when flanked by incompatible flankers, and

when flankers are spaced far apart from the target compared to the sad group. It is predicted that in Experiment 2 there will be a similar pattern with reaction times increasing following a happy face compared to a neutral face. The opposite pattern is predicted in Experiment 3, with a decrease in reaction times to the target following a sad face compared to a neutral face, due to a narrowing of attention leading to less processing of spatially adjacent flankers.

Experiment 1

Method

Design

This experiment used a 2 (Face Valence: Happy, Sad) x 2 (Flanker Congruence: Congruent, Incongruent) x 2 (Distance: Far, Near) within subjects design with reaction time as the dependent variable.

Participants

Participants were 45 first year psychology students from Victoria University of Wellington participating as part of their course requirement. Participation was voluntary and participants were informed that they could leave the study at any time without penalty.

Materials

Two schematic faces (happy and sad) were used as affective primes (see appendix) each one presented for 500 milliseconds at the beginning of each trial. The Flanker task involved identifying a central target letter ('H' or 'N') amongst four flanking distractors ('H' or 'N'). A central fixation cue (^) was presented to indicate the target letter. Flankers were manipulated in terms of congruence (Congruent: e.g. HHHHH or Incongruent: e.g. NNHNN) and distance to target (space equivalent to two letters or no space). There were 200 trials, half primed with a happy face and half with a sad face. All stimuli were in Times New Roman size 12 font and stood 0.5cm high on the screen. The computer program was designed using E-Prime and the Statistical Package for Social Sciences (SPSS) edition 17.0 was used to analyse all results.

Procedure

The experiment was conducted in a computer lab within the School of Psychology at Victoria University of Wellington, with a maximum of 20 participants at any one session. Participants were seated at individual computers with dividers on either side to reduce distraction in the testing environment. A verbal briefing on the task was given and then participants read and completed an information and consent form. Participants then completed the flanker task where they are instructed to attend to the central target and ignore flanking distractors, using the corresponding keys on the keyboard (‘H’ or ‘N’) to identify the target as quickly and accurately as possible. Upon completion participants were verbally debriefed and thanked for their participation.

Analysis

Data were analysed using SPSS. A 2 (Valence: Happy, Sad) x 2 (Flanker Congruence: Congruent, Incongruent) x 2 (Spacing: Far, Near) ANOVA was used to identify initial patterns. Reaction times for all incorrect responses were removed and any RT below 300msec and over 1200msec were removed.

Results

Mean reaction times for each Experimental condition are shown in Table 1.

Table 1. *Means and standard deviations of reaction times in milliseconds across all conditions.*

Valence		Happy		Sad	
Congruency		Congruent	Incongruent	Congruent	Incongruent
Spacing	Near	468.31(69.78)	552.77(105.96)	485.94(79.09)	533.22(86.29)
	Far	454.64(67.83)	514.79(110.63)	455.74(64.36)	498.27(75.32)

The magnitude of the flanker task incongruence effect is typically measured by subtracting congruent RTs from incongruent RTs. Consistent with happy stimuli broadening attention, the flanker incongruence effect was greater for trials primed with a happy face versus trials primed with a sad face, $t(44) = 2.64$, $p < .05$. This is shown in Figure 1.

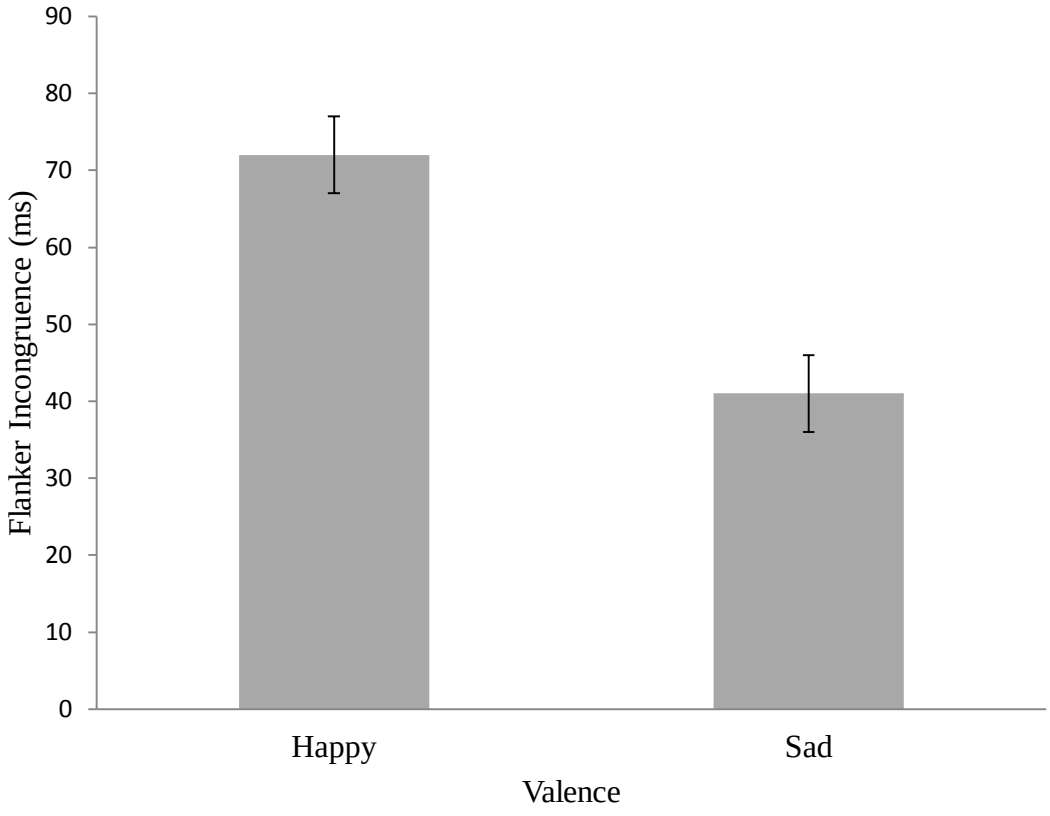

Figure 1. Reaction times for incongruent trials minus congruent trials in the happy and sad conditions.

A 2 (Valence: Happy, Sad) X 2 (Congruence: Congruent, Incongruent) X 2 (Spacing: None, Two) repeated measures ANOVA found no main effect of Valence (F<1). There was a main effect of Congruence, F (1,43) = 90.73, p <.001, reflecting faster RT to congruent trials (M=466, SE=8.22) than to incongruent trials (M=522, SE=10.94). There was a main effect of Spacing, F (1,48) = 23.77, p <.001, reflecting slower RT for near trials (M=510.06, SE=10.47), than for far trials (M=478.61, SE=9.00). There was a significant interaction between Valence and Congruence, F (1,43) = 8.10, p <.01. This interaction is shown in Figure 2 and shows a significantly slower RT for incongruent trials in the happy condition compared to the sad condition, t (50) = 2.03, p <.05. There was no difference in RT for the congruent trials. There was no interaction between Congruence and Spacing, F (1,43) = 2.60,

p >.05, nor Valence and Spacing, *F* (1,43) = 1.03, *p* >.05, nor any significant three way interaction, *F* (1,43) = 1.43, *p* >.*05.*

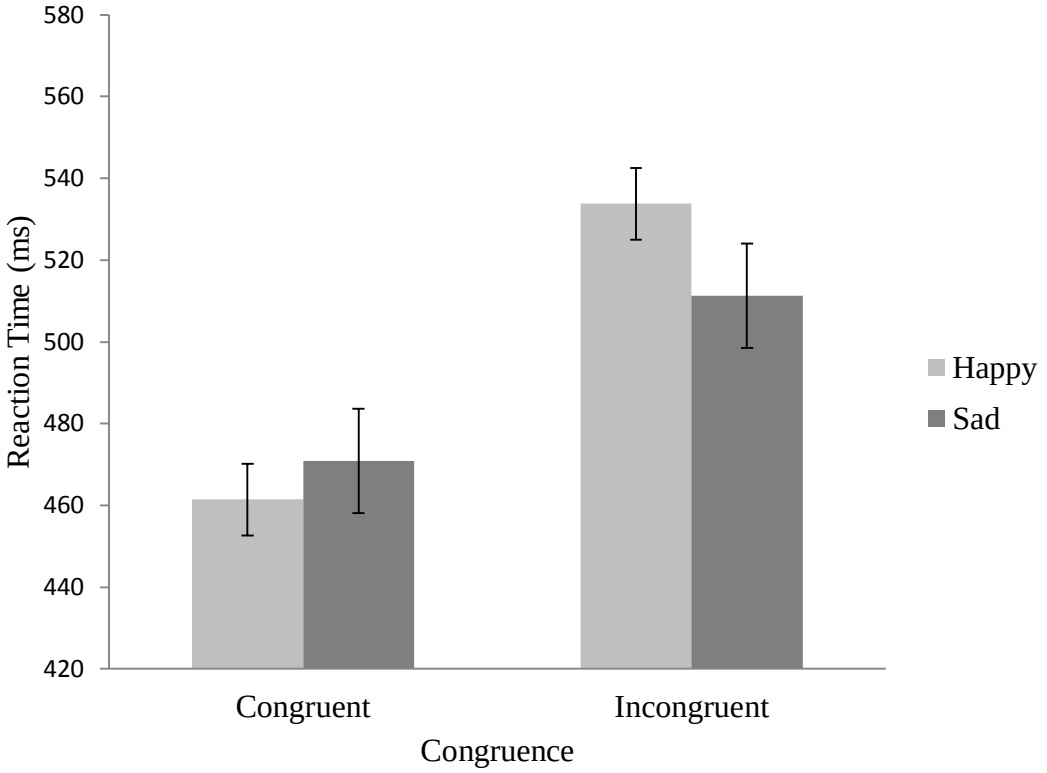

Figure 2. Interaction between Congruency of target and flankers (congruent, incongruent), and Valence of facial primes (happy, sad) for Experiment 1. Error bars represent the standard error for each condition.

Overall the results lend partial support to the broaden and build hypothesis as reaction times were slower in incongruent trials when primed with a happy face than a sad face, reflecting greater interference of incongruent flankers due to broadened attention. In addition there was greater flanker interference in trials primed with a happy face and less interference in those trials primed with a sad face. However there was no expected interaction between Valence and Spacing that would have been demonstrated in slower reaction times following far spaced flankers than near flankers when primed by a happy face compared to a sad face.

To examine the individual effect of the happy face on attention it was compared to a neutral face prime in Experiment 2.

Experiment 2

Experiment 2 had 46 participants and the procedure was identical to Experiment 1 except that half the trials were primed with a happy face and half with a neutral face.

Results

For mean reaction times for all conditions see Table 2.

Table 2. *Means and standard deviations of reaction times in milliseconds across all conditions*

Valence		Happy		Neutral	
Congruency		Congruent	Incongruent	Congruent	Incongruent
Spacing	Near	484.79(74.70)	466.07(77.52)	528.35(107.91)	545.42(116.99)
	Far	446.84(65.70)	460.03(118.52)	467.26(70.62)	475.43(106.85)

The flanker incongruence effect did not differ for trials primed with a happy face versus trials primed with a neutral face, $t(45) = 1.48$, $p > .05$ This is shown in Figure 3.

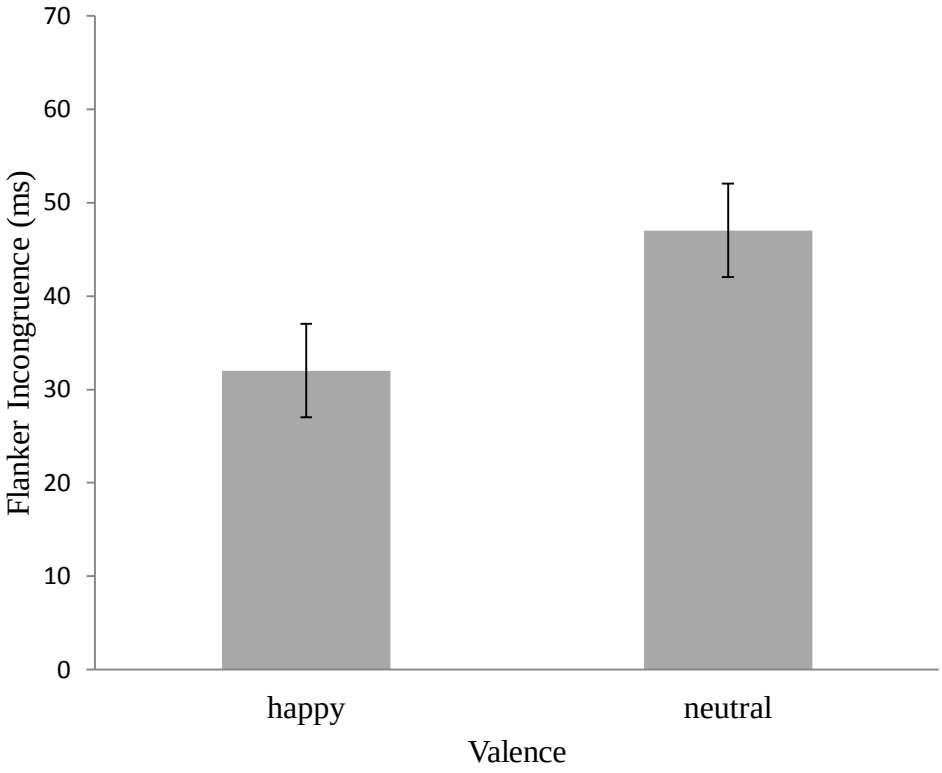

Figure 3. Reaction times for incongruent trials minus congruent trials in the happy and neutral conditions

A 2 (Valence: Happy, Neutral) X 2 (Congruence: Congruent, Incongruent) X 2 (Spacing: Near, Far) repeated measures ANOVA found no main effect of Valence (F<1). There was a main effect of Congruence, $F(1,44) = 25.14$, p<.01, reflecting faster RT to congruent (M=464.43, SD=10.63) than incongruent trails (M=504.12, SD=12.24). There was a main effect of Spacing, $F(1,44) = 61.81$, p<.01, reflecting slower RT for near trials (M=506.16, SD=11.47), compared to far trails (M=462.39, SD=10.74). There was a significant interaction between Congruence and Spacing $F(1,44) = 10.71$, p<.01. In the near spacing condition incongruent trials were significantly slower than congruent trials, t (45) = 6.39, p <.001. There was no significant difference between incongruent and congruent trials in the far space condition, t (45) = 1.09, p <.05. There was no interaction between

Congruence and Valence, $F(1,44) = 2.20$, $p>.05$, nor Valence and Spacing $F(1,44) = .858$, $p>.05$, nor any significant three-way interaction, $F(1,44) = 2.52$, $p>.05$.

Overall the results do not support the hypothesis that when primed with a happy face, compared to a neutral face, reaction time would be slower in incongruent far trials which would have implied greater interference of incongruent flankers due to broadened attention. In addition there was no interaction between Valence and Spacing as would have been predicted by the broaden and build model.

To examine the individual effect of a sad face on attention it was compared to a neutral face prime in Experiment 3.

Experiment 3

Experiment 3 had 42 participants and the procedure was identical to Experiment 2 except that half the trials were primed with a sad face and half with a neutral face.

Results

For mean reaction times for all conditions see Table 3.

Table 3. *Means and standard deviations of reaction times in milliseconds across all conditions*

Valence		Sad		Neutral	
Congruency		Congruent	Incongruent	Congruent	Incongruent
Spacing	Near	503.84(130.97)	488.75(70.30)	546.34(130.11)	542.01(79.97)
	Far	460.82(71.71)	463.33(85.02)	475.03(74.14)	482.48(99.37)

The flanker incongruence effect did not differ for trials primed with a sad face versus trials primed with a neutral face, $t(45) = 1.28$, $p > .05$. This is shown in Figure 4.

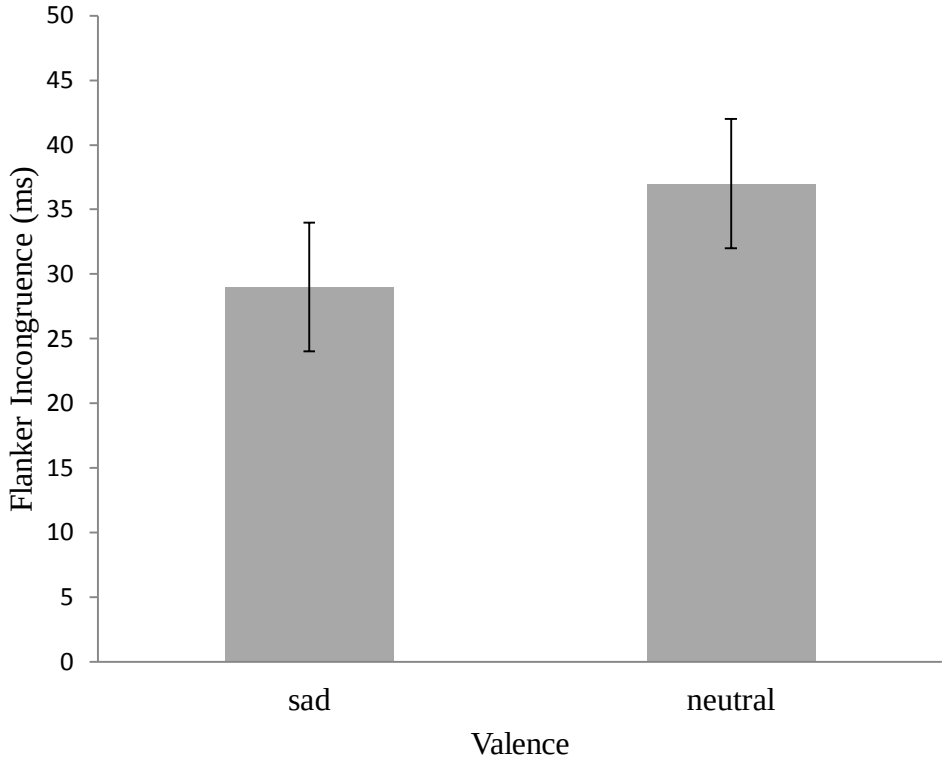

Figure 4. Reaction times for incongruent trials minus congruent trials in the sad and neutral conditions

A 2 (Valence: Sad, Neutral) X 2 (Congruence: Congruent, Incongruent) X 2 (Spacing: Near, Far) repeated measures ANOVA found no main effect of Valence (F>1). There was a main effect of Congruence, $F(1,40) = 5.48$, p<.05, reflecting faster reaction times to congruent (M=479.18, SD=11.96) than incongruent trails (M=511.46, SD=13.04). There was a main effect of Spacing, $F(1,40) = 57.16$, p<.01, reflecting slower reaction times for near trials (M=520.24, SD=11.80), compared to far trails (M=470.41, SD=10.02).There was a significant interaction between Congruence and Spacing $F(1,40) = 10.32$, p<.01. This revealed significantly faster RT for incongruent trials in the Near Space condition compared to the Far Space condition, $t(41) = 2.14$, $p < .05$. There was no difference in RT in the Congruent Trials as a function of Spacing. There was no interaction between Congruence and

Valence, $F(1,40) = .473$, $p>.05$, nor Valence and Spacing, $F(1,40) = .924$, $p>.05$, nor any significant three way interaction, $F(1,40) = .037$, $p>.05$.

Overall the results do not support the hypothesis that when primed with a sad face, compared to a neutral face, reaction time would be faster in incongruent far trials suggesting less interference of incongruent flankers due to narrowed attention. In addition there was no main effect of Valence nor did Valence interact with any other variable.

Combining Experiments 2 and 3.

The failure to replicate any effect of valence, as found in Experiment 1, was unexpected. One possibility is that there may indeed be reliable differences between RT to trials primed by happy and sad faces, but that neither differ significantly from neutral faces. Put another way it may be that RT performance for happy trials in Experiment 2, differ significantly from RT to trials primed with sad faces in Experiment 3, but that neither differ relative to trials primed by a neutral face. In order to examine this, data from Experiment 2 and 3, restricted to happy and sad trials were combined and analysed.

A 2 (Congruence: Congruent, Incongruent) X 2 (Valence: Happy, Sad) X 2 (Spacing: Near, Far) repeated measures ANOVA revealed no main effect of Valence, F (1,41) = 1.05, p >.05. There was a main effect of Congruence, F (1,41) = 8.19, p <.01, reflected in faster RT to congruent trials (M = 473.17, SE = 7.68), than incongruent trials, (M = 503.46, SE = 9.93). There was a main effect of Spacing with near trials responded to slower (M = 514.74, SE = 9.51) than far trials, (M = 461.90, SE = 6.31). There was a Congruence X Spacing interaction, F (1,41) = 4.17, p <.05. Post-hoc measures showed that while there were no significant differences between congruent and incongruent trials in the far condition, incongruent trials were significantly slower than congruent trials in the near condition. Most importantly for the purpose of this thesis Valence did not interact with any other factor.

Discussion

Before discussing the findings of the current study it is important to note that the predicted and typical main effects of the flanker task (congruency and spacing) were supported by the data across all three experiments; participants were slower to respond when flankers were incongruent to the target and when there was no space between flankers and target, suggesting that the flanker task was reliable.

It was hypothesised that in Experiment 1, when primed with a happy face, there would be an increase in reaction time when the target was flanked by incompatible flankers, and when flankers were spaced far from the target, reflecting increased processing of spatially adjacent flanking distractors relative to the sad condition. This was partially supported by the results in that reaction times were slower in incongruent trials when primed with a happy face rather than a sad face. However, far flankers did not lead to slower responses in the happy condition as predicted. In Experiment 1 the flanker incongruence effect was greater following happy face primes, than sad face primes again supporting a broadening of attention in the happy prime condition.

It was predicted that there would be a similar pattern found in Experiment 2, with reaction times increasing following happy faces compared to neutral faces. The opposite pattern was predicted in Experiment 3, with reaction times decreasing following sad faces compared to neutral faces due to a narrowing of attention leading to less processing of spatially-adjacent flankers. However when happy and sad facial primes were separately compared to neutral primes, as in Experiment 2 and 3, the effect of valenced primes on reaction time was no longer apparent. These conflicting findings of the effects of valence merit discussion.

The broaden and build theory (Fredrickson, 2001) has provided a theoretical explanation for research finding that positive emotions broaden attentional scope (Moriya & Nittono, 2010; Rowe, Hirsh, & Anderson, 2007) and research using the flanker task has found support for the broaden and build theory (Moriya & Nittono, 2010; Rowe et al., 2007). The results of Experiment 1, comparing the effect of happy and sad primes on reaction time, also lend partial support to the theory. However, when a happy prime was compared to a neutral prime, as was done in Experiment 2, there was no significant effect of the happy prime on reaction times in the flanker task, suggesting attentional scope was no broader in the happy than the neutral condition. Additionally, when a sad facial prime was compared to a neutral prime in Experiment 3 there was also no difference.

It is possible that when participants are presented with a happy or sad prime and a neutral prime, as in Experiment 2 and 3, the effect of the happy prime (broadened attention) or the sad prime (narrowed attention) may not be significantly different to the neutral prime, as the neutral prime is not exerting any influence on attention in either direction. However, comparison of reaction times following happy primes from Experiment 2 and reaction times following sad primes from Experiment 3 also found no difference. It may be that the presentation of both contrasting facial primes (happy and sad) together, as in Experiment 1, is needed to cause enough change in an individual's attentional focus to lead to measurable differences in reaction time.

Additionally, the current findings may be a by-product of the within groups design, as previous research providing support for the broaden and build theory has used between group designs with each group of participants participating in separate mood induction procedures (Fredrickson & Branigan, 2005; Wadliner & Isaacowitz, 2006;) or, have alternated mood induction with attentional task to space out the happy and sad mood

induction (Rowe, Hirsh, & Anderson, 2007). This may result in more accurately induced stable mood states, resulting in larger effects on attention.

Research has found that negative emotions serve to narrow attentional focus (Derryberry & Reed, 1997; Easterbrook, 1959; Gasper & Clore, 2002), such as the high anxiety experienced during an attack leading to the phenomenon of weapon focus (Derryberry & Tucker, 1994). The broaden and build theory maintains that negative emotions promote specific action tendencies through narrowing the 'thought-action-repertoire' (Fredrickson, 2001) and suppressing irrelevant information to promote survival. Results of Experiment 1 lend support to this view of negative emotions, as reaction times in incongruent trials following sad facial primes was faster than following happy facial primes, suggesting a narrowing of attentional focus resulting in less interference from distracting flankers. However, when sad facial primes were compared to a neutral prime (Experiment 3) there was no significant effect on reaction time. It would seem that certain negative emotions would require more immediate decisive action for survival than others, for example, the experience of fear or anxiety is linked to the fight or flight survival response (Porges, 1997), however the experience of sadness has less need for immediate action for survival. The current experiment used a sad facial prime as the negative emotion condition; however, sadness may not initiate the required level of threat needed to narrow the 'thought-action-repertoire' and cause changes in attentional focus. This may explain the lack of a greater effect of near flankers on reaction time in Experiment 1, and the lack of any influence of sad compared to neutral valence on reaction time in Experiment 3.

The current conflicting findings may also have been influenced by the task used to measure attentional broadening. Bruyneel et al. (in press) suggest that the relevance of the interfering peripheral information to the task the participant is required to complete is a potential mediating factor in the emotion-attention relationship. For example, in the global-

local processing task the relevant local information is structurally integrated with the irrelevant global information, making it more likely to impact on reaction times when attention is broadened (Bruyneel et al). However in the flanker task the flankers are separate from the target and are task-irrelevant as the participant is asked to identify only the target letter, Bruyneel et al. suggest that this may make the peripheral information in the flanker task easier to ignore, causing broadened attention to show little effect on reaction time. This may have contributed to the conflicting results, as the effect of broadened attention may not have been accurately captured. However, across all 3 experiments there were main effects of the congruence and spacing of flankers to target, showing that incongruent flankers and near flankers caused longer reaction times. This suggests that the flanker task was reliably measuring attentional scope and the peripheral flankers were impacting reaction times and not simply being ignored.

Recent research is suggesting the relationship between mood and attention is more complex. Bruyneel et al. (in press) conducted three experiments using various mood induction procedures (music, retrieving an autobiographical memory, a performance task with positive and negative feedback, film clips, and velten mood induction statements) and different measures of attentional scope (the flanker task, and the attentional network test), and found no evidence of positive mood broadening attention. A potential explanation for the null results was that the motivational intensity of the information used may be a mediating factor of the relationship between emotion and attention (Bruyneel et al., in press). Research suggests that only information which is low in approach motivation (does not cause desire to approach or avoid behaviours, e.g. sadness) will cause a broadening of attention, and highly motivating information is thought to narrow attention as there is a strong desire to act in a particular way in response to the emotional information (e.g. fear) (Gable & Harmon-Jones, 2010). Bruyneel et al. used mood induction which was low in approach motivation, as did the

current experiments, where sad was the negative prime. Research comparing sad and disgust mood induction prior to the Navon letters task (Navon, 1977) task found that sad mood induction resulted in a broadened processing style compared to disgust where attention was narrowed (Gable & Harmon-Jones, 2010). The absence of the expected narrowing of attention in Experiment 3 may be attributed to the low approach motivation stimuli used. Further research may find greater effects with the use of high motivational intensity stimuli, such as fearful faces.

Research manipulating attentional focus prior to mood induction is suggesting that emotion may not be the driving force for this relationship. Huntsinger (2012) manipulated not only emotion but also global and local focus prior to participants completing the flanker task. When a global focus was primed participants in positive moods displayed greater flanker effects than those in negative moods, and when a local focus was primed the reverse was found, with those in negative moods displaying greater flanker effects than those in positive moods. Additionally, when neither global nor local focus was primed, the relationship between emotion and attention disappeared. Working from the affect-as-information model Huntsinger (2012) proposed that the relationship between emotion and attention is responsive to changes in the dominance of global or local focus. This may be a possible mediating factor in the current conflicting results as focus was not measured or controlled for prior to participants completing the flanker task.

At a theoretical level the current results are conflicting. Experiment 1 lends partial support to the broaden and build theory as there were longer reaction times to targets with incongruent flankers, when participants were primed with happy face compared to a sad face. However when happy and sad facial primes were each compared to a neutral prime in separate experiments there was no difference in reaction times. Although there is much research in support of the broaden and build theory, as discussed above there now appears to

be not yet understood mediating processes involved that may explain the conflicting findings. Tan, Jones, and Watson (2009) suggest a different way of conceptualising the relationship. Two experiments were conducted, where participants completed a global-local perceptual task (large global shapes made up of smaller local shapes) prior to and following positively valenced primes. Positive primes served to encourage the perceptual underdog. In participants who naturally had a global focus, positive primes promoted local processing, and in participants with a local focus their non-preferred global focus was promoted. This suggests that positive mood is not directly related to global or broadened attention, but promotes attentional flexibility. Future research could explore this within the current methodology by conducting the flanker task prior to presenting valenced facial primes to measure any change in attentional focus following happy or sad primes.

Individuals with depression and anxiety, and those induced into feeling depressed moods, have been found to show a negative bias when evaluating facial expression, that is they are more likely to perceive negative emotions in neutral faces (Bouhuys, Bloem, & Groothuis, 1995). Further research could determine how depressed individuals perform on the flanker task, as the negative bias may result in an increased effect of negative facial primes, resulting in less distractibility and faster reaction times than control groups. Including positive, negative and neutral facial primes may result in narrowed attention following the neutral prime also reflecting a negative bias. Research suggests that the narrowed attention and negative bias present in those suffering from mood disorders is a maintaining factor for low mood (Peterson & Seligman, 1984), therefore development of screening tools for negative bias may hold clinical value.

Future directions may explore the different effects of various negative emotions, such as fear and anxiety, as well as sadness, in the flanker task. This would allow for exploration of the influence of motivational intensity. Additionally, it appears that conducting all mood

conditions separately or with appropriate space between different mood inductions may provide a clearer picture of the effects of both happy and sad primes compared to neutral. Inclusion of measures to gain a base rate of participant's mood and to measure the influence of briefly presented schematic faces on mood will also strengthen results. It appears there needs to be a shift in focus to clarifying the possible mediating factors of the relationship between emotion and attention, such as the motivational intensity of valenced information, the task relevance of the peripheral information used in measures of attention, and the manipulation of attentional focus itself. This broader approach will provide a fuller understanding of conflicting results in this area.

The current experiments aimed to examine the effects of briefly presented schematic faces (happy, sad and neutral), on attentional scope using the flanker task, and to extend the research in this area which has previously used lengthy mood induction procedures. Based on the broaden and build theory (Fredrickson, 2001) it was hypothesised that when primed with a happy face there would be an increase in reaction time when the target was flanked by incompatible flankers, and when flankers were spaced far from the target, reflecting increased processing of spatially-adjacent flanking distractors relative to the sad condition. A similar pattern was predicted comparing happy primes to neutral primes, and the opposite pattern was predicted when comparing sad primes to neutral primes, due to a narrowing of attention leading to less processing of spatially adjacent flankers. Results partially support the predictions as reaction times were slower in incongruent trials when primed with a happy face than a sad face with no difference between near and far flankers. However, when happy and sad facial primes were compared to a neutral prime, the effect of valenced primes on reaction time vanished. It appears there are yet to be understood mediating factors of the relationship between emotion and attention and future research is adopting this position.

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Appendix

Happy, sad, and neutral facial primes used in the flanker task