The Effect of Valenced Facial Expressions on Vertical Selective Attention

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Abstract

Research using mood induction (Wapner, Werner & Krus, 1957) or positive/negative word stimuli, (Meier & Robinson, 2004) as well as studies using participants pre-existing neurotic/depressive symptoms (Meier & Robinson, 2006) have documented the ability of emotional stimuli and states to shift attention upwards (positive emotion) or downwards (negative emotion) in space. This study aimed to investigate whether this impact of emotion on vertical attention extended to briefly presented facial expressions. A within-subjects, modified version of Meier and Robinson's (2004) Study 2 formed the design for these experiments. Experiments 1- 4 tested the ability of arrows, shapes and emotional facial expressions to shift vertical attention. Results indicate that for both schematic (Exp.2) and real (Exp. 4) faces, positive valence (happy expression) shifted attention upwards, but there was no evidence of the negative valence (sad expression) shifting attention downwards, giving partial support to the conceptual metaphor theory. No evidence of positive valence broadening - or negative valence narrowing - vertical attention was found in support of Fredrickson's broaden-and-build theory (Exps.2 & 4). The current research has provided partial further support for the conceptual metaphor theory and advanced knowledge in the area of emotion and vertical attention using pictorial stimuli such as facial expressions. It also provides some direction for future research in this area, highlighting key issues to be resolved.

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Both positive and negative emotions affect our cognitive processes (Anderson, 2005; MacLeod, Mathews & Tata, 1986; Oaksford, Morris, Grainger & Williams, 1996; Rowe, Hirsh & Anderson, 2007). A particularly interesting area in this field is that of vertical attention. Studies using mood induction (Wapner, Werner & Krus, 1957) or positive/negative word stimuli, (Meier & Robinson, 2004) as well as studies using participants pre-existing neurotic/depressive symptoms (Meier & Robinson, 2006) found that these stimuli and states shifted attention upwards (positive emotion) or downwards (negative emotion) in space. The following research reviews some of the literature on both the more general area of emotion and cognition before focussing on the area of emotion and vertical selective attention. The experiments conducted in this study fit into the latter field of research and attempt to further pinpoint the effect of viewing positive/negative images - and smiling/sad faces specifically - on vertical selective attention. The results of the current experiments are reviewed and discussed in relation to previous literature, including the implications and possible applications of the findings.

Attention

Definitions of attention vary, however a definition given by Blair and Mitchell (2009) captures the general concept well. They define attention as “the process by which stimuli are selected for further processing and control over behaviour.” (p.543).

Working memory (in which we hold information as we are consciously thinking about it) is a limited resource; we can only attend to a certain number of stimuli at a time (Gray, 2002). Although we can process basic features of a large number of stimuli at one time before being consciously aware of it through ‘preattentive processing’ (Gray, 2002), we must somehow select which of these stimuli enter conscious working memory and are processed further. Attentional selection thereby stems from the brain’s limited capacity and is used to select which stimuli will be attended and processed further and which are ignored (Anderson, 2005).

Within both auditory and visual attention, there exists the ability to direct attention spatially. It is this spatial attention – and specifically vertical selective attention - that is of particular interest in the current research.

It appears that certain stimuli can be processed more automatically than others, with less tax on central executive processes and less requirement for effortful attention, as evidenced by classic cognitive tasks such as the Stroop task (Stroop, 1935). In the Stroop task, naming the ink colour of a word is significantly impaired when the word itself describes an incongruent colour. It has been suggested that this is due to the automaticity of a well-practiced activity such as reading a word interfering with a less-practiced task such as naming ink colour. The fact that the reading of the word requires less cognitive resources and thereby occurs so automatically means it needs to be repressed in order for the response of naming ink colour to be given. Interestingly, a number of the studies described in this review (e.g. Anderson, 2005) also indicate that emotionally significant stimuli seem to require less cognitive resources to be processed.

Emotion

Collaboration between the various arms of psychological research is slowly but surely putting together the complex puzzle that is our emotion. The areas of social, cognitive, developmental and clinical psychology as well as neuroscience are all contributing to our growing knowledge of our emotions (Cacioppo & Gardner, 1999).

Evolution and adaptation offer an explanation of the function of emotions as a system to help us determine whether certain stimuli should be approached or avoided (Cacioppo, Gardner & Berntson, 1999; Lang & Bradley, 2009). Not only are emotions useful to aid survival and reproduction directly - such as fear or disgust, which cause us to avoid dangerous stimuli, or sexual passion, which causes us to approach a potential mate - they also aid our survival by allowing us to form social groups and coexist with other humans.

Emotion is extremely important for humans as we exist in highly social environments and are better able to survive in groups than alone. Interacting with others usually results in positive emotions. For example affection for others encourages us to seek out company. Even negative emotions can be indirectly useful in helping us to get along in our social group. Behaviour which is detrimental to our cohesion with our social groups will result in various negative emotions; experiencing these motivates us not to repeat these behaviours. Feelings such as shame, guilt or loneliness, which may result from a fall out with a member of our social group for example, usually leave us with a desire to mend the relationship and not to repeat the behaviour which caused the fall out.

In fact, emotion is so important that thinking about the emotional aspects of any object, person or situation - or ‘evaluative’ processing as it is referred to by Crites and Cacioppo (1996) - is a process which involves different neural circuits from ‘non-evaluative’ processing, or processing non-emotional aspects of stimuli. For example, in an event-related potential (ERP) study, Crites and Cacioppo reported that categorising food items as positive or negative involved larger areas of the right compared to the left hemisphere, than categorising the same items in terms of other, non-emotional characteristics (e.g. vegetable or non-vegetable).

An important issue that researchers face is the lack of consensus in the definitions of emotion. Attempts have been made to define a set of basic emotions which usually include: happiness, sadness, fear, anger, disgust and surprise, and emotions have also been classified according to valence and level of arousal (Gray, 2002). Valence refers to whether the emotion is positive or negative, while arousal concerns the level of physiological response (e.g. increase in heart rate, perspiration) associated with the emotion. Emotions can vary independently according to both these factors. For example, fear is both negative in valence, and high in arousal, while sadness is negative in valence but low in arousal. Unfortunately however, there are still many variations on definitions, which can make it difficult to compare results between studies, and even results between participants in the same study. There are also various terms which arise from the literature in this field, all of which refer to emotion in some sense or another. Besides ‘emotion’, other common terms include ‘mood’ and ‘affect’. Again, there are varying definitions of each of these terms. For the purposes of the current research, these terms are used in a general sense unless stated otherwise, and all refer to a more general idea of emotion. These terms will not be used to discriminate between different durations or stabilities of emotional experience. Furthermore, emotions in general in this text will be classified mainly according to their valence; whether they are considered positive (e.g. happy, excited) or negative (e.g. sad, angry, fearful).

It seems that emotions are so important in our day-to-day lives that we display a number of interesting phenomena that serve to show how ingrained and automatic emotions and their expression are in our existence. The section below reviews the main theories which attempt to explain how emotions impact on our cognition.

Theories of Emotion and Cognition

The field of linguistics lends possible insight into the effects of emotion on specific elements of cognition such as vertical selective attention. From early cognitive psychology, the idea that concepts were abstract, amodal representations has been plagued by a symbol grounding problem (Crawford, 2009). How are such representations connected to their meanings if each of these concepts is connected to and explained by another abstract concept? Lakoff and Johnson’s (1980) theory of metaphoric representation attempts to find a way around this symbol grounding problem. This theory posits that we first learn concrete concepts during our development, concepts such as spatial position, brightness or size for example. By then structuring abstract concepts (such as emotion) based on these concrete concepts using metaphors, we are more easily able to learn, understand and express to others the abstract ideas by tying them to physical dimensions. Metaphors enable the transfer of information about a familiar object or concept (the source domain) to another less familiar concept (the target domain), to allow a better understanding of this (Grant, 2001). The use of these conceptual metaphors (often physically grounded) to structure, understand and communicate concepts such as emotion and many other abstract ideas is widespread in the English language (see Lakoff and Johnson, 1980, for a full discussion of common conceptual metaphors).

Orientational metaphors are those which structure concepts such as emotion linearly; most commonly in respect to vertical space. The most common orientational metaphor used for the concept of emotion is that 'Good is Up' (and therefore 'Sad is Down'). Positive valence is represented as being upwards in space while negative emotion is represented as being downwards in space, for example 'His spirits rose', or 'Her mood sank'. There are also other physical attributes related to emotion and emotional experience through metaphors, these include; brightness (light=positive, dark=negative) (e.g. Meier & Robinson, 2005; Meier, Robinson, & Clore, 2004; Meier, Robinson, Crawford & Ahlvers, 2007), proximity (close=positive, distant=negative) (Crawford, 2009), and size/amount (big/more=positive, small/less=negative) (e.g. Meier, Robinson, & Caven, 2008).

The existence of these metaphors is obvious, however it is less clear how pervasive these representations are in terms of impacting on our cognition. While Lakoff and Johnson's (1980) theory seems promising, there is debate over some of Lakoff and Johnson's ideas. One could argue for example that the evidence from the literature which appears to support Lakoff and Johnson's theory is actually only evidence that concepts of emotion are merely associated with, rather than structured by, concrete concepts of sensorimotor experience

(Crawford, 2009). A criteria of metaphoric representation is that the relationship between the concrete (source domain) and abstract (target domain) concepts is asymmetrical; to think about the abstract concept (emotion) it is necessary to think about the sensorimotor dimensions (up/down) but not vice versa. For example, it would be impossible to think about emotion without also activating our concept of vertical space (up/down). Evidence from the literature, such as Meier and Robinson's (2004) study supports this idea of asymmetry. Meier and Robinson found that emotional evaluation of positive/negative words affected attention to space upwards or downwards. They did not find however, that shifting attention upwards or downwards impacted evaluation of the words. Crawford cautions that such findings, although supporting the asymmetric criteria of the metaphoric representation theory, can also be explained by an associationist account, such as Bower's (1981) network model, which proposes that events, emotions and verbal labels are associated by links between them, formed when we experience them simultaneously. For example, an event such as receiving a gesture of affection from a loved one would be associated with the emotion (happiness) felt when this event occurred. The asymmetric nature of findings that emotion impacts vertical attention but not vice versa can also be explained by such models. Consider that we may often experience emotion in relation to vertical space (e.g. positive emotion is usually combined with an upright body position, negative emotion with a slumped posture), creating a strong link from emotion to vertical space. On the other hand, vertical space may be associated to emotion, but also associated to many other concepts, thus diluting the activation from the concept of space over many other concepts, reducing the activation of the concept of emotion to a level so low that it is not measurable. For example, when thinking about vertical space, this may activate links to emotion, but also to elevators, staircases, temperature, bank balance and any other subjects we commonly experience in relation to the idea of 'up/down'.

Another concern that Crawford has with Lakoff and Johnson's theory is the reasons they give for why emotions need to be represented metaphorically. The first of these is that emotion is more abstract than physical domains. According to Lakoff and Johnson, sensorimotor experience related to physical domains allows us to clearly define such concepts, which then can form the basis for conceptual metaphors of emotion. Crawford argues however that emotions themselves have their own physical experiences closely connected to them (e.g. a racing heart during fear), and so by Lakoff and Johnson's reasoning should be clearly definable on their own. While the basic principles of the theory may hold truth, Crawford suggests the reasons for conceptual metaphors may differ from Lakoff and Johnson's original ideas. For example, Crawford considers the idea that representing emotion in terms of physical domains has social advantages as it allows us to communicate emotion in objectively observable ways by using physical dimensions.

Murphy (1996) proposed an alternative way to think about metaphorical representation. Lakoff and Johnson's (1980) view - that thought about an 'abstract' concept such as emotion, must involve access to a more concrete concept such as vertical space – is described by Murphy as the 'strong' interpretation of metaphorical representation. The 'weak' interpretation is that the source domain (concrete concept) may influence the structure of the target domain (abstract concept) but the target domain still has its own separate representation. Murphy suggested a third, structural similarity view; that each concept is represented independently and that the links between them seen in language are due to the fact that the structure of these two domains is similar. For example, the reason why 'argument is war' is a commonly used metaphor in the English language is that our concept of argument and our concept of war share certain structural similarities. Without one structuring the other, the fact that both usually have two sides involved, with opposing views on a topic allows these concepts to be connected.

An alternative theory of emotion and cognition is Fredrickson’s (2001, 2004) broaden-and build theory of positive emotions. Fredrickson focuses on the valence (positive/negative) of emotions. Positive emotions are described as expanding an individual’s mindset, encouraging a divergent style of thinking and leading to the discovery of new ideas, solutions and actions, which can build that individual’s store of resources to cope with future tasks and challenges. In contrast, negative emotions have the opposite effect, narrowing cognition, and encouraging convergent, analytical and detail-oriented thinking. These effects also extend to selective attention, with positive emotion broadening its scope and negative emotion narrowing the focus of attention. Evidence to support these ideas comes from Fredrickson’s own research (e.g. Fredrickson & Branigan, 2005) which shows positive emotions broaden attention by encouraging a global bias on a global-local visual processing task (Kimchi & Palmer, 1982). Other studies using the Eriksen flanker task (Eriksen & Eriksen, 1974), a task in which narrowed attention is facilitative and broadened attention impairs performance (e.g. Melcher, Obst, Mann, Paulus & Gruber, 2012; Rowe et al., 2007). These studies have shown that negative emotion improves performance on the Eriksen flanker task (Melcher et al., 2012), while positive emotion impairs performance (Rowe et al., 2007). These and other studies which support Fredrickson’s theory are discussed further in a later section.

Clore and colleagues (Clore et al., 2001, as cited in Gasper & Clore, 2002) suggest that, in following from Schwarz and Clore’s (1983) affect-as-information model, emotion can inform the style of cognition we adopt. Clore et al.’s more recent version specifically mentions that negative emotion leads to a local cognitive style (e.g. ‘not seeing the forest for the trees’) while positive emotion encourages a more global style of cognition (e.g. focussing on the forest rather than the trees).

Common Methodologies in Emotion and Cognition Research

Three main approaches to studying the effect of emotion on cognitive processes such as attention emerge from the review of the literature. Some focus on inducing mood in participants or exploiting natural settings which induce emotion; others use clinical populations such as depressed or anxious subjects, and yet others study the impact of the evaluation of positive/negative stimuli (words or images) on subsequent cognitive tasks.

Emotions are often induced in research participants, which allows for a much more practical way of acquiring a sufficient sample size. Although one can use clinical populations (e.g. depression/anxiety disorders) (e.g. MacLeod, Mathews & Tata, 1986), it is more difficult to recruit such samples and there is a lack of opportunity to investigate positive emotion. Emotion can be successfully induced in normal participants, which also allows researchers to investigate how emotion functions in the general population. A myriad of emotion induction methods have been discovered, including: listening to music (e.g. Rowe et al., 2007), viewing positive/negative films (e.g. Oaksford, Morris, Grainger & Williams, 1996), hypnosis (e.g. Bower, Monteiro & Gilligan, 1978) and group singing (Wendrich, Brauchle & Staudinger, 2010). Naturally induced temporary emotional states are sometimes exploited by researchers (e.g. Wapner, Werner & Krus, 1957) as they ensure the genuineness of the emotion, although it is not always convenient to use this approach.

Many studies use a more subtle approach in studying the impact of emotion. Asking participants to evaluate positive and/or negative stimuli such as words (e.g. Eder & Rothermund, 2008) has also produced effects on attention. This approach is less time-costly than the emotion induction method and allows investigation of the extent to which emotion affects cognition, indicating that just thinking about whether a stimulus is positive or negative can be enough to impact performance on subsequent performance tasks.

Emotion and Cognition– Faciliatative, impairing or both?

As emotion is such an important part of our functioning, it should come as no surprise that mood can impact on our cognitive functioning. Anecdotal evidence can help to illustrate the plausibility of this. Think about a time when you were very happy. Or, think about a time when you were very angry, or very sad. In each of these situations, your focus probably changed according to your mood. For example, most would agree that when we are happy, everything seems to look different, the sunshine is brighter, the grass is greener, the bird are singing more beautifully. The same effect is implied in the expression 'seeing the world through rose-coloured glasses' which often describes the effect of being in love. On the other hand the opposite can be true when we experience sadness.

Importantly, empirical evidence has also supported the notion that emotion can impact on our thinking. Interestingly, it appears that emotion can equally facilitate as well as impair our cognition, depending on the emotion, and on the type of cognitive functioning, and in yet other situations it is unclear as to whether the effect is helpful or harmful. The various effects of emotion on our cognition are described below.

Emotion and Reasoning. In most studies in this area, there have been mixed findings regarding the impact emotion can have on reasoning and problem solving. The effect depends on the valence of the emotion, as well as the type of reasoning or problem solving required. Oaksford, Morris, Grainger and Williams (1996) investigated how induced mood affected deductive reasoning in three experiments. They used positive, negative and neutral films to induce corresponding moods, and investigated the effects of these induced moods on participants' subsequent performance on a deontic version of Wason's selection task (Wason, 1968), which is designed to assess convergent or deductive reasoning. This task usually presents participants with four two-sided cards displaying either a letter or number on each side. The cards are accompanied by a rule, for example that if a card displays a vowel on one side then it must have an even number on the other side. Participants can only see one side of each of the four cards, seeing for example a vowel on one card, a consonant on another, an even number on the third card and an odd number on the fourth. Participants are then asked which cards would need to be turned over in order to determine if the given rule holds true. Participants should attempt to falsify the rule by turning over the card displaying the vowel and the card displaying the odd number, however only around 4 per cent of participants make this response, the majority instead opting for a confirmatory strategy (Wason, 1968). Oaksford and colleagues used a deontic version of this task, in which participants are given a sense of having a duty or obligation to falsify the rule. This is often achieved by incorporating the task into a hypothetical situation in which participants are asked to imagine they are for example an immigration officer, and falsifying the rule is part of their job (e.g. ensuring people entering the country have the required vaccinations) (Oaksford et al., 1996).

Results from the first two experiments described in this study showed evidence of supressed performance on the deontic Wason selection task (Wason, 1968) for both positive and negative induced mood (Exp 1) and when concurrently performing a distractor task (without a previous mood induction) (Exp 2). This led the authors to suggest that induced mood states seem to impact reasoning in the same way as do tasks that deplete central executive capacity. Results from the third experiment showed that an induced positive mood (but not negative) suppressed performance on the Tower of London task (Shallice, 1982, as cited in Oaksford et al., 1996), a well-documented central executive employing task, again indicating that emotion (at least positive) seems to decrease central executive capacity, impairing performance on a task which utilises this.

Comparing these results with those of Isen, Daubman and Nowicki (1987) - who found that in a divergent, creative reasoning task such as Duncker’s candle problem (Dunker, 1945, as cited in Isen et al., 1987), positive induced mood (but not negative) improved performance - it seems that induced mood can either facilitate or impair reasoning, depending on the nature of the reasoning required. Positive mood improved performance on divergent reasoning tasks (Isen et al., 1987), while supressing performance on convergent or analytical reasoning (Oaksford et al., 1996). Oaksford and colleagues suggested this may be due to the fact that in creative tasks, positive mood may be of assistance as it may trigger more and more memories, encouraging divergent thinking. In contrast, in analytic tasks, divergent thinking is not helpful in solving the task, as particular steps need to be followed to solve analytic tasks.

These findings lend support to Fredrickson's (2004) Broaden-and-build theory that positive attention can aid in divergent, global thinking patterns, while negative emotion encourages a more convergent, detail-oriented and analytical style.

Emotion and Memory. Memory recall is another area in which emotion seems to play an important role. Studies using participants diagnosed with depression have consistently found these participants to show a bias towards mood congruent information in recall tasks. So a depressed mood is associated with increased recall of negative or unpleasant memories relative to positive memories (e.g. Bradley & Mathews, 1988; Clark & Teasdale, 1982; Mathews & Bradley, 1983). This effect has even been found in normal participants in whom a depressed mood has been induced (Teasdale & Fogarty, 1979; Teasdale, Taylor & Fogarty, 1980).

Emotion and Attention. The following studies reveal that both negative and positive emotional stimuli can capture our attention more effectively than neutral stimuli. For example, Anderson (2005) used an Attentional Blink (AB, see Raymond, Shapiro, & Arnell, 1992) paradigm to investigate the effects of emotion on the temporal nature of attention. The AB paradigm typically presents two targets (T1 and T2) within a stream of rapid serial presentation of distractor stimuli. After the first target (T1) is identified, the identification of the second target (T2) is impaired for up to 500ms. The smaller the interval between the two targets however, the less impairment is seen in identifying T2. This paradigm demonstrates the limited temporal capacity of the attentional system. Previous research had already indicated that the AB is decreased when T2 has an increased perceptual salience (Chun, 1997, as cited in Anderson, 2005).

Anderson mentioned that emotionally significant stimuli seem to be processed automatically (e.g. Neumann, 1984, as cited in Anderson), and that they would therefore compete more efficiently for attentional resources at a later stage of processing. It was hypothesised that if emotional stimuli require less cognitive resources to be captured in attention, an emotional T2 should decrease the AB while a neutral T2 should not. Anderson modified the AB paradigm to test this prediction, using words as targets and distractors, and manipulating the emotional valence of T2 words. Experiments 1 and 2 involved various comparisons of both positive/negative (with low/high arousal) emotional T2 words with neutral T2 words.

Across all these studies, AB was reduced when using emotional (positive and negative) versus neutral T2 words, though it was never completely eliminated. Increased awareness of T2 did not depend on paying more attention to emotional words, instead emotional words are less dependent on the limited capacity of encoding processes to reach awareness (Anderson, 2005). The decrease in AB for emotional T2 words was not related to factors such as word frequency, semantic cohesiveness, altered decision criteria, and various forms of distinctiveness.

In other words, compared to other stimulus characteristics, emotional valence can increase the processing speed for a stimulus. An interesting point to note was that a high arousal value T2 word lessened the AB even more than emotional valence, so highly arousing positive and negative T2 words had the lowest AB. This indicates that arousal, which is closely tied to emotion in many instances may play an important role in the attentional capture of emotional stimuli.

Biased attention to emotional stimuli can be emotion specific. In particular, anxiety has been found to bias auditory and visual attention to fear-related stimuli in a number of studies. Parkinson and Rachman (1981) for example, found mothers displaying anxiety due to their child being scheduled to undergo surgery recognised significantly more stress-related words (at a lower volume) than control subjects in an auditory recognition task, where a piece of music was played into both ears with stress-related and neutral words inserted. Burgess, Jones, Robertson, Radcliffe and Emerson (1981) found participants with clinical phobic anxiety detected more fear-relevant words presented to the unattended channel in a dichotic listening task than a control group. However, MacLeod, Mathews and Tata (1986) point out that the words used in this study were custom selected for each subject to match their specific phobia, which raises the possibility that the results found were due to familiarity. Mathews and MacLeod (1986) found that participants with generalised anxiety picked up threat related words in the unattended channel of a dichotic listening task. Although the subjects were not aware that these words had been presented (the volume was at a level at which detection is not conscious), the presentation of the words was correlated with impairment on a simple reaction-time task which was carried out in conjunction with the dichotic listening task (Mathews & MacLeod, 1986). The same effect was not found in control subjects.

An important study by MacLeod and colleagues (1986) investigated the effect of emotional disorders (anxiety and depression) on attention. The authors argued that the results of previous studies (e.g. Burgess et al., 1981; Parkinson & Rachman, 1981) of anxiety and attention may also be interpreted as being due to other reasons rather than an attentional bias. For the word detection tasks for example, they point out that the subjects may be extracting only partial information from the words and then guessing the words' identity. Subjects could favour guesses that are congruent with their current mood, causing the same effect that was seen, but clearly not due to attentional bias (MacLeod et al., 1986). Accordingly, MacLeod et al. designed their study to circumvent this methodological issue.

Participants diagnosed with generalised anxiety or depression, and controls were presented with two words on a screen simultaneously, one slightly above the centre, one slightly below followed by a dot which appeared in the same place as one of the words had been displayed before. Participants pressed a button as soon as they detected the dot. Reaction time to detect the dot would indicate the direction of the participant's attention. If detection was fast when the dot appeared in the same place as a previously displayed threat word, or slow when it appeared in the place of the other word, then this would indicate that the subject had an attentional bias towards the threat words.

Anxious participants were faster to identify the dot probe when it appeared in the same place as a preceding threat word, as opposed to a preceding neutral word, indicating that they were directing their attention more towards the threat words than the neutral words. Control subjects showed the opposite trend, seeming to avoid the threat words. Depressed participants showed no significant trend towards either word type. The results indicated that anxious participants show an attentional bias towards threat-related words, while depressed and control participants do not. So it seems that the specific nature of an emotional word determines whether attention will be biased toward it, when the emotion of a word is congruent with the mood state of the person, it should attract that person's attention.

Using a neutral response (button press) to a neutral stimulus (dot), this study eliminated the problem of a possible bias towards responding in mood congruent direction identified by the authors as a methodological issue in emotion and attention research. This principle has since been applied in many studies investigating the effect of emotion on our attention, some of which are described in the next section.

The preceding studies - along with those mentioned in the emotion and memory section earlier - indicate a general trend that in terms of negative emotion such as depression and anxiety, attention is biased towards mood-congruent stimuli and information. This can be seen as an impairment not necessarily in a cognitive functioning sense, but in the sense that this kind of attentional bias can only serve to maintain a negative mood. There is less evidence regarding a similar effect for positive emotion, though one such finding (Becker & Leinenger, 2011) is described below.

Emotion induction was found to affect the attentional filter of participants in a subsequent inattentional blindness task, in which they were required to track multiple objects while ignoring distractors (Becker & Leinenger, 2011). Participants were more likely to detect a distractor object when its features were arranged to show a schematic facial expression that matched the mood they had been induced into. For example, participants in the happy mood induction detected happy expression schematic face distractors better than any other expression (Becker & Leinenger, 2011).

As well as the attentional biases towards emotional stimuli described above, a number of studies using mood induction procedures have demonstrated a trend concerning the impact of emotion on the scope of attention. In accordance with Fredrickson’s (2004) broaden-and-build theory, positive emotion appears to broaden attention, while negative emotion narrows attentional focus. In one such study, Rowe and colleagues (2007) found that positive affect increases the breadth of attention in both the conceptual domain (semantic association task) and the visual attention domain (Eriksen flanker task, Eriksen & Eriksen, 1974). Positive induced mood was found to increase the number of semantic associates given by a participant to a probe word in a semantic association task, while simultaneously impairing visual selective attention to a central target letter by broadening visual attention to flanking distractor letters (Rowe et al., 2007).

Interestingly, Rowe et al.'s (2007) findings are complemented by a recent study undertaken by Melcher et al.(2012). Melcher and colleagues found that induced sadness using sad facial expressions as stimuli actually decreased reaction time on the Eriksen flanker task (Eriksen & Eriksen, 1974), the opposite effect from that found for positive mood in Rowe et al.'s study. This would indicate that negative affect in the form of sadness (the authors also investigated fear, but did not find the same effect) may decrease the breadth of attentional selection, facilitating performance on such tasks as the Eriksen flanker task.

In summary, the literature reviewed above indicates several general effects of emotion on our cognition. Firstly, emotional stimuli tend to catch our attention more effectively than neutral stimuli (Anderson, 2005), which can mean improved performance in tasks such as the Attentional Blink (AB) paradigm. When the presence of emotional stimuli is combined with the experience of emotion (by induction or due to mood disorders) the salience of the stimuli depends on its congruity with the emotion being experienced by the individual. Positive emotion biases attention to valence congruent emotional stimuli (Becker & Leinenger, 2011) while negative emotion biases recall of valence congruent memories and attention to valence congruent stimuli (e.g. Bradley & Mathews, 1988; Clark & Teasdale, 1982; Mathews & MacLeod, 1986). Finally, the valence of the emotion also appears to influence our scope of attention. Positive emotion broadens attention (e.g. Rowe et al., 2007; Poirel et al., 2012) while negative emotion narrows our focus (e.g. Melcher et al., 2012).

Emotion and Vertical Selective Attention. The research described in this section has formed the background and inspired the design for the current research. An early study focusing on the effects of emotion in this area was carried out by Wapner, Werner and Krus (1957). The researchers were interested in whether changes in the state (emotional) of a person can change their perception of a neutral stimulus. The participants (students) were only aware that they were taking part in a task which required them to bisect a square equally with a horizontal line; the emotional states were subtly induced between the two attempts at the task. A course instructor approached the participants and informed them of their grades on an actual examination they had completed before the study (not related to the study). The reasoning was that a high or low grade would induce either a feeling of success (positive emotion) or of failure (negative emotion), which the researchers hypothesised would impact on their perception and subsequently their performance on the second attempt at the bisection task. Results of their study supported this prediction; students who received a grade of A placed the horizontal line significantly higher on the re-test task than on the pre-test task, indicating their perception had changed with an induction of positive emotion shifting their attention upwards. In contrast, those who received a grade of F placed the line significantly lower on the retest compared to the pre-test, indicating that induction of negative emotion had changed their perception, shifting their attention downwards thereby skewing their perceived midpoint of the square.

As well as temporary emotional states such as in Wapner and colleagues' (1957) study, a more recent study has demonstrated that more stable dispositions also appear to impact vertical attention. Meier and Robinson (2006) investigated how dispositional negative affect as measured by Goldberg's (1999) neuroticism scale and the Beck Depression Inventory (BDI; Beck, Rush, Shaw & Emery, 1979, as cited in Meier & Robinson, 2006) affected vertical selective attention. Those who scored more highly on neuroticism and depressive symptoms were faster to identify a target letter ('p' or 'q') when it was presented at the bottom of the screen than at the top, compared to those who scored low on these negative mood dispositions (Meier & Robinson, 2006). So it appears that more stable emotional states also can shift attention vertically, at least in the case of negative emotion such as depression or anxiety.

Eder and Rothermund (2008) found similar effects of emotion on vertical selective attention, using a more subtle approach in regards to the emotional stimuli. They asked participants to evaluate positive and negative adjectives by using push/pull lever movements. In one study, half of the participants received instructions to move the lever ‘towards or away from themselves’ to classify a stimulus (adjective) as positive or negative respectively. The other half received instructions for the same movements described as moving the lever ‘up or down’ to classify an adjective as positive or negative respectively. Halfway through the trials, the instructions changed to reverse the movements which evaluated the stimuli. In other words, those who had previously moved the lever ‘towards themselves’ for a positive stimuli - and vice versa - were now asked to move the lever ‘away from themselves’ for a positive stimuli and ‘towards themselves for a positive stimuli’. The same reversal was implemented for the group whose instructions were to move the lever ‘up’ or ‘down’ to classify stimuli. Particularly important for the purposes of the current discussion, the results showed that in the ‘up/down’ group (as in the ‘towards/away’ group), reaction times to move the lever were much faster when the stimuli evaluation matched the lever movement than when these were mismatched. When the lever was to be moved upwards for a positive stimuli and downwards for a negative stimuli, reaction time was significantly faster than when the lever was to be moved upwards for a negative stimuli and vice versa. These results add further support to the idea that positive/negative emotion is linked to an up/down concept, and extended this connection to influence motor movements such as lever movement. By using evaluation of emotionally-valenced words, this study also indicated the connection between emotion and attention to be stronger than studies using emotion induction had indicated, such that even emotional evaluation of negative/positive words can activate the mechanisms controlling vertical movements.

Similar findings were reported by Brookshire, Ivry and Casasanto (2010) in a study using a speeded button press as a response to valenced words. Participants were not required to evaluate the valence or meaning of the words (Exp. 1) but to the colour of the words and were required to move their hand upwards or downwards to press a button which identified the colour of the words (e.g. press the top button if the word is in red, the bottom button if in blue). Brookshire et al. reported that reaction time was faster for congruent than incongruent valence-vertical movement trials. In other words, when the colour of a positive word required an upwards movement of the hand to press the button (e.g. when a positive word was displayed in red, requiring the top button to be pressed), or when the colour of a negative word required a downwards movement (e.g. negative word displayed in blue, so need to press bottom button), reaction time was faster than if a positive word required a downwards movement or a negative word required an upwards movement. This effect vanished when words were repeated however. A second experiment found the effect could be re-established by directing attention to the meaning of the word. These results led Brookshire et al. to suggest that although the effect of emotional stimuli on vertical motor movements may be automatic in certain circumstances, this can disappear with repetition of the stimuli (Exp 1), and that explicit attention to the emotional nature of the stimuli is required for continued activation of the emotion-motor movement effect (Exp 2).

Meier and Robinson (2004) supported Eder and Rothermund’s (2008) findings, again using evaluation of emotional words (positive and negative) versus neutral words. In their second study, Meier and Robinson placed participants in front of a computer and asked them to evaluate various words as ‘negative’ or ‘positive’ out loud, as they were individually presented in the centre of the computer screen. A target identification task followed each presentation of a word. A target letter (‘p’ or ‘q’) was presented either at the top or the bottom of the screen, and participants were required to identify the letter by pressing the corresponding key on the keyboard. Results showed that after evaluating a word as positive, participants were faster to identify the target word when it was presented at the top of the screen and slower if the target word was displayed at the bottom of the screen. The opposite effect was found after evaluating a negative word. These results indicate that visual attention shifted upwards as a result of evaluating a positive word, and downwards after evaluating a negative word. Once again, the positive-up, negative-down connection between emotion and vertical space was supported in this study.

In an unpublished study, Lovegrove (2009) used a similar version of Meier and Robinson's (2004) Study 2, replacing their positive/negative word stimuli with happy or sad schematic faces, to investigate whether the directional bias in attention due to emotion could also be found when using images in place of words. The prediction was that viewing a happy face would shift attention upwards, leading to faster identification of a letter target when this was presented in the upper half of the screen, while viewing a sad face would shift direction downwards, leading to faster identification of a target presented in the lower half of the screen.

Similar to Meier and Robinson's (2004) Study 2, participants in Lovegrove's (2009) study reacted faster to a target presented in the upper half than in the lower half of a screen after viewing a happy face (positive). Sad faces however, did not have an effect on vertical attention.

Present Study

While the Lovegrove (2009) study was important in providing support for one part of the theory that emotions affect our vertical selective attention (seeing a smiling face leads to positive emotion which creates an upwards bias in our attention), the lack of predicted results for negative emotion (sad face) are intriguing and prompt further investigation. The current investigation therefore aimed to extend this line of research, beginning with a modification of the Lovegrove study. The schematic faces used in Lovegrove's study had a few strands of hair on top of their heads. It is possible that this feature drew attention upwards, regardless of the emotion being depicted in the face itself, magnifying the upwards bias of the smiling faces and decreasing the possible downwards bias of the sad face, to the point where this became insignificant. The present research (Experiment 2) therefore removed this feature to ensure that emotion was the only factor drawing attention away from the centre of the face.

A possible confound was investigated in a further study, to ensure that the emotional aspect of the schematic facial stimuli was the driver of the attentional shift. As the 'mouth' shape constituted the only difference between the two schematic faces, this raised the prospect that these shapes only were behind the shift of attention rather than the emotional expression of the face. It was possible that the upwards pointing edges of the smiling schematic mouth and the downwards pointing edges of the sad schematic mouth were enough to direct attention upwards or downwards respectively. Experiment 3 serves to exclude this possibility. To remove any possible distraction from other facial features (e.g. eyes and facial border), Experiment 3 therefore used only the mouth shapes of the smiling and sad faces from Experiment 2.

Lovegrove (2009) also suggested that use of schematic sad faces may not have been successful in creating negative emotion in participants due to the lack of subtle details which humans usually subconsciously perceive when judging emotion in another person's face. For example, research has found that a set of subtle morphological features on a genuine smiling face, including raised cheeks and wrinkles around the eyes, named the Duchenne marker (Duchenne, 1862/1990, as cited in Soussignan, 2002) allow the distinction between this and a fake smile (Krumhuber, Manstead, Cosker, Marshall & Rosin, 2009; Soussignan, 2002). It is this suggestion which the current research seeks to investigate further, by using real human faces in Experiment 4. If it really is a lack of detail in the schematic faces that is causing the results seen in Lovegrove's study, then using real human faces should lead to the results originally predicted by Lovegrove.

Before all these experiments however, a preliminary study (Experiment 1) tested the design used with a known potent attention director, arrows. This was to allow confidence in the design of the experiments to enable shift of vertical attention. If the predicted attentional shifts were found using arrows, this indicates the design allows stimuli (such as arrows) to shift attention vertically.

Hypotheses

It is predicted for Experiment 1 that: (1) when participants see an upwards pointing arrow immediately preceding the target identification task, then target identification will be facilitated if the target appears in the top half of the screen ('up' position) compared to when that target appears in the bottom half of the screen ('down' position). Conversely, it is hypothesised that: (2) when a downwards pointing arrow precedes the target identification task, identification of the target will be faster (facilitated) if that target appears at the bottom of the screen ('down' position) than when that target is presented at the top of the screen ('up' position).

If predictions for Experiment 1 are supported, it is predicted for Experiment 2 that: (1) when participants see a smiling schematic face preceding the target identification task, target identification will be facilitated if the target appears in the top half of the screen ('up' position) compared to when that target appears in the bottom half of the screen ('down' position). (2) when a sad schematic face precedes the target identification task, identification of the target will be faster (facilitated) if that target appears at the bottom of the screen ('down' position) than when that target is presented at the top of the screen ('up' position).

For Experiment 3, if it is the emotional nature of the schematic faces which produces a shift in attention, rather than merely the exaggerated shape of the mouth, then we would predict no shift in vertical attention in response to the ‘mouth’ shapes. If it is the exaggerated mouth shape on the other hand, then seeing an upward pointing smiling schematic mouth would direct attention upwards (due to the upwards pointing corners of the mouth), leading to a faster reaction time to the target in the ‘up’ than the ‘down’ position, and seeing a downward pointing sad schematic mouth will direct attention downwards, resulting in a faster reaction time to identify the target in the ‘down’ than the ‘up’ position.

Experiment 4, using photographic images of real human faces should yield similar results; (1.) A smiling real human face should shift vertical attention upwards, resulting in faster identification of the subsequent target when it appears in the top as compared to the bottom of the screen. (2.) A sad real human face should shift vertical attention downwards, resulting in faster identification of the target when presented at the bottom of the screen, as compared to the top.

There are also alternative predictions for Experiments 2 and 4, concerning the Fredrickson’s (2004) Broaden-and-build theory. The design of these experiments also allows investigation of this theory as a side to our main investigation regarding the conceptual metaphor theory (Lakoff & Johnson, 1980). The Broaden-and-build theory and studies finding positive mood increased the breadth of visual attention (Rowe et al., 2007) while negative mood decreased its breadth (Melcher et al., 2012) - would suggest different results than those predicted above for Experiment 2 and 4. If Fredrickson’s theory holds true, results of these experiments should show that, if positive emotion broadens attention, then: (3) seeing a smiling face will reduce reaction time overall to target letters regardless of position, as compared to a neutral (Exp 4 only) or sad face. Conversely, if negative emotion narrows attention, then: (4) seeing a sad face will increase reaction time overall to targets regardless of position. There should be no effect of position on reaction times in this case.

Experiment 1 - Arrows

This experiment was carried out to first test the design of the experiments that were to follow with known potent attention directors; arrows (Green & Waldorff, 2012; Ristic & Kingstone, 2009), in place of the schematic/human faces used in subsequent experiments. Finding the predicted effects of attentional shift using these known attention directors would demonstrate the ability of the design to produce a shift in vertical attention. This would allow further experiments to test the attention shifting ability of emotional stimuli such as schematic/real faces using this design.

Method

Design

This study used a 2(Arrow direction: Up, Down) x 2(Target position: Up, Down) factor design with arrow direction and target position as the independent variables, and reaction time as the dependent variable.

Participants

Participants were twenty people recruited from the Victoria University campus and Wellington central city area (13 female, 7 male). No record was kept of age.

Materials/Procedure

Informed consent was given before beginning the experiment. The experiment was run in a quiet classroom at Victoria University of Wellington, with the students sitting at a 17-inch Dell computer monitor and keyboard, on which the arrows and target letters were presented. The experiment was run on the E-Prime program (v1.1) (Schneider, Eschman & Zuccolotto, 2002). Prime stimuli were upwards (↑) and downwards (↓) pointing arrows (208x208 pixels). Target letters were a ‘P’ or ‘Q’ (Point Size: 28, Font: Courier New, Bold). Before beginning the trials, each participant was placed at a separate computer, seated to ensure their eye level lined up with the centre of the computer screen. After a brief welcome message, they were presented with the following instructions:

"You will see a series of arrows in the middle of the screen. It is important that you pay attention to each arrow.

After each arrow, a 'P' or 'Q' will appear either at the top or bottom of the screen. If it is a Q, press the Q key on your keyboard with your left index finger. If it is a P, press the P key on your keyboard with your right index finger. Try to respond as quickly as you can.

Please press the <SPACE> bar when you are ready"

After reading the instructions, participants pressed the space bar to begin the trials. Each trial began with the display of a small cross (+) in the centre of the screen, to centre the participant's attention at the beginning of the trial. This appeared for 500ms, after which this was replaced with one of the arrows mentioned above. After 500ms, this disappeared. Next, a target letter ('P' or 'Q'), was displayed at either the top (460 pixel from bottom) or the bottom (20 pixel from bottom) of the screen, and the participant pressed the corresponding key on the keyboard to identify it. After the participant pressed one of the keys, a new trial began. There were 100 trials in total for each participant (50 of each arrow direction and 50 of each target position, and 25 of each arrow/target position combination) and trials were randomised for each participant. After completing the study, each participant was thanked for taking part and presented with a debriefing information sheet, to further explain the purpose of the study. Ethical approval was granted for this research by the Victoria University of Wellington School of Psychology Human Ethics Committee in 2012. Data were analysed using SPSS.

Results

Trials in which an error was made in identifying the target letter, and those in which reaction time was below 300 or above 1200 milliseconds were excluded from the analysis. Furthermore, mean reaction times for each arrow direction/Target position condition (Direction Up/Target Up, Direction Up/Target Down, Direction Down/Target Up, Direction Down/Target Down) were calculated for each participant. Overall mean reaction times were then calculated for each condition. A 2(Arrow Direction) x 2(Target Position) repeated measures ANOVA revealed no main effect of either arrow direction ($F<1$) or target position ($F<1$). There was a significant interaction between arrow direction and target position however ($F(1, 19) = 16.63$, $p = .001$), indicating arrow position and target position combined to influence reaction time.

As seen in Figure 1, mean reaction time in the DirectionUp/TargetUp condition (M= 561.44, SD= 160.42) was lower than in the DirectionUp/TargetDown condition (M= 631.75, SD= 154), indicating participants were faster to react to a target letter in the Up compared to the Down position after seeing an upwards pointing arrow. A paired samples t-test revealed the difference in mean reaction times between the DirectionUp/TargetUp and DirectionUp/TargetDown conditions was significant ($t(19)= 4.06$, $p < .001$). These results support the hypothesis that seeing an upwards pointing arrow would direct attention upwards and thereby reduce reaction time to a target letter at the top of the screen as compared to the bottom.

Mean reaction time in the DirectionDown/TargetUp condition (M= 622.63, SD= 214.73) was greater than in the DirectionDown/TargetDown condition (M= 572.95, SD= 136.73), indicating that participants were faster to identify a target letter in the Down compared to the Up position after seeing a downwards pointing arrow. A paired samples t-test revealed the difference in mean reaction times between the Down/Up and Down/Down conditions was significant ($t(19) = 2.12$, $p = .047$). This supports the hypothesis that seeing a downwards pointing arrow would direct attention downwards, thereby decreasing reaction time to identify a target letter at the bottom of the screen as compared to the top.

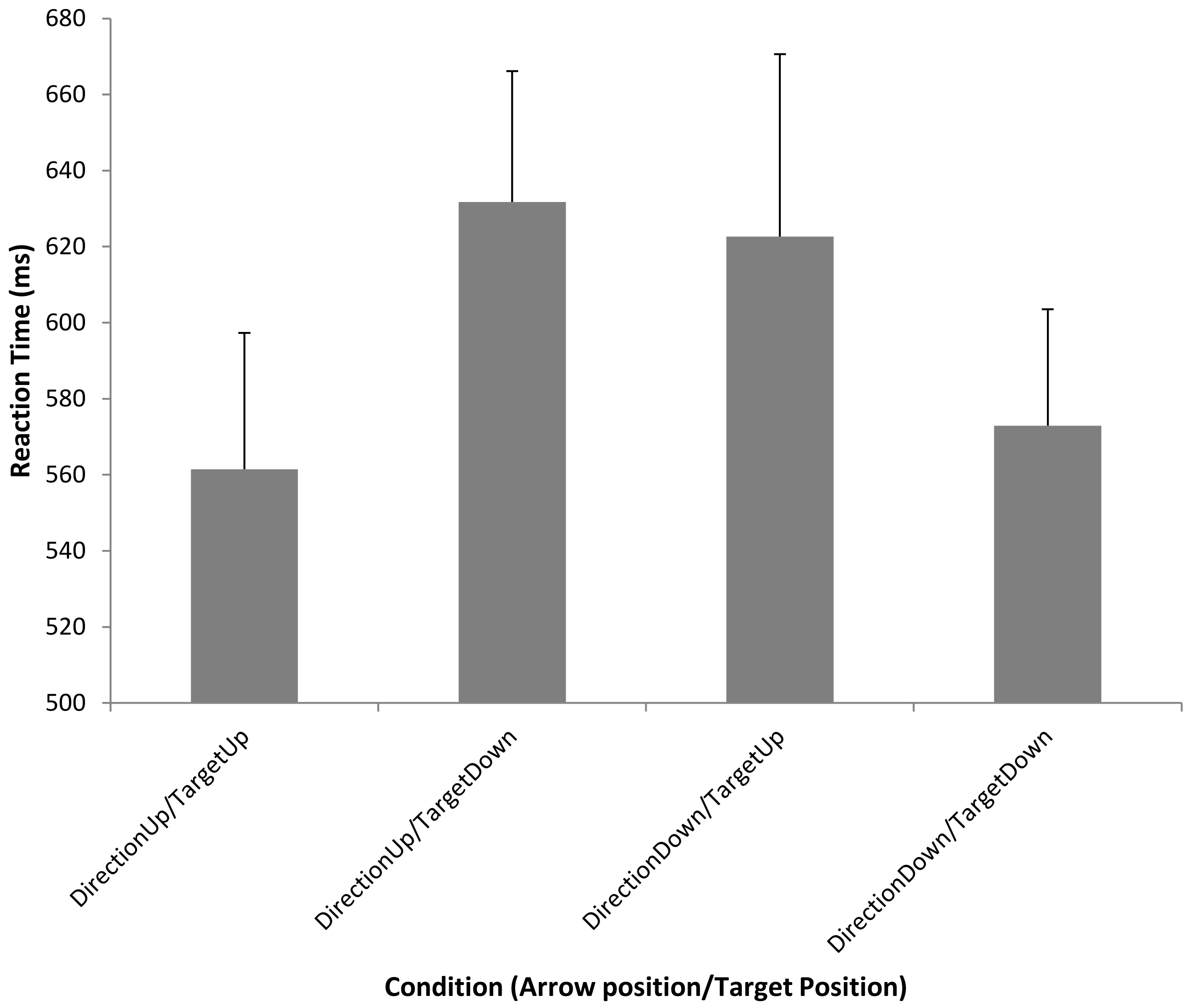

Figure 1. Mean reaction times (in milliseconds) by arrow direction and target position.

Discussion

The hypotheses for Experiment 1 were that, as arrows have been shown to be potent directors of attention (Green & Waldorff, 2012; Ristic & Kingstone, 2009), (1) seeing an upwards pointing arrow would direct attention upwards and thereby reduce reaction time to a target letter at the top of the screen as compared to the bottom and (2) seeing a downwards pointing arrow would direct attention downwards, thereby decreasing reaction time to identify a target letter at the bottom of the screen as compared to the top. Results supported the hypotheses. These findings confirmed that the design of the experiments in this thesis allows for attention to be directed vertically by stimuli known to be potent directors of attention.

Experiment 2 – Schematic Faces

Having established that the design of the experiments allows a test of whether stimuli direct attention vertically in the preliminary experiment, further investigation of facial stimuli was now possible. Experiment 2 aimed to test whether the removal of the hair on the top of the head from the schematic faces used in Lovegrove's (2009) study would find the predicted results of happy and sad schematic faces directing attention both upwards, and downwards, respectively. As well as investigating the idea of conceptual metaphor/association between emotion and attention, this study also allowed possible insight into Fredrickson's (2004) broaden-and-build theory of positive emotions. In accordance with Fredrickson's theory, a happy face would result in broadened attention and decrease reaction time for both target positions, while a sad face would lead to narrowed attention, increasing reaction time for both target positions.

Method

Design

The experiment used a within subjects 2 (Valence: happy, sad) x 2(Target Position: up, down) design, with valence and target position as independent variables and reaction time as the dependent variable.

Participants

Participants were forty-four first year psychology students (31 females and 13 males) at Victoria University of Wellington (VUW), recruited through the university's Introduction to Psychology Research Programme (IPRP) which allows students to gain part of their course credit by participating in current studies being undertaken at the university. They received .5 of a course credit in return for their participation. Students ranged in age from 18 to 45 (M = 19.48, SD= 4.31). Participants had normal to corrected vision.

Materials/Procedure

The experiment was run in a quiet classroom at Victoria University of Wellington, with the students sitting at a 17-inch Dell computer monitor, on which the faces and target letters were presented. The experiment was run on the E-Prime program (v1.1) (Schneider, Eschman & Zuccolotto, 2002). This experiment used schematic faces. The faces used varied according to valence, either smiling (positive) or frowning (negative) and were presented in grayscale (169x208 pixels) (See Appendix A). Target letters were a ‘P’ or ‘Q’ (Point Size: 28, Font: Courier New, Bold). Before beginning the trials, informed consent was obtained and each participant was placed at a separate computer, seated to ensure their eye level lined up with the centre of the computer screen. After a brief welcome message, they were presented with the following instructions:

“You will see a series of pictures of faces in the middle of the screen. It is important that you pay attention to each face.

After each face, a ‘P’ or ‘Q’ will appear either at the top or bottom of the screen. If it is a Q, press the Q key on your keyboard with your left index finger. If it is a P, press the P key on your keyboard with your right index finger. Try to respond as quickly as you can.

Please press the <SPACE> bar when you are ready”

After reading the instructions, participants pressed the space bar to begin the trials. Each trial began with a fixation cross (+) in the centre of the screen, to centre the participant’s attention. This appeared for 500ms, after which it was replaced with one of the two faces mentioned above. This face was also displayed in the centre of the screen. After 500ms, the face was replaced by a target letter (‘P’ or ‘Q’), displayed either at the top (460 pixels from bottom) or the bottom (20 pixels from bottom) of the screen, and the participant pressed the corresponding key on the keyboard to identify whether it. After the participant pressed one of the keys, a new trial began. There were 100 trials in total for each participant (50 of each face valence and target position, 25 of each valence-target position combination) and trials were randomised for each participant. After completing the study, each participant was thanked for taking part and presented with a debriefing information sheet, to further explain the purpose of the study. Ethical approval was granted for this research by the Victoria University of Wellington School of Psychology Human Ethics Committee in 2012. Data were analysed using SPSS.

Results

Trials in which an error was made in identifying the target letter, and those in which reaction time was below 300 or above 1200 milliseconds were excluded from the analysis. A 2(Valence) x 2(Target position) repeated measures ANOVA revealed no main effects or interactions. Mean reaction times for each valence/target position condition (Happy/Up, Happy/Down, Sad/Up, Sad/Down) were calculated for each participant. Overall mean reaction times were then calculated for each condition. These are shown in Table 1 below, along with the standard deviation (SD) scores for each condition.

Table 1.

Means and Standard Deviations of Reaction Times (in milliseconds) by Valence and Target Position.

Condition	Mean Reaction Time (ms)	Standard Deviation (ms)
Happy/Up	507.38	73.06
Happy/Down	537.92	68.66
Sad/Up	521.30	95.44
Sad/Down	531.58	69.45

As seen in Table 1. above, mean reaction time in the Happy/Up condition is lower than in the Happy/Down condition, indicating participants were faster to react to a target letter in the Up compared to the Down position after seeing a Happy face. A paired samples t-test revealed the difference in mean reaction times between the Happy/Up and Happy/Down conditions was significant ($t(43) = 4.04$, $p < .001$).

Mean reaction time in the Sad/Up condition is lower than in the Sad/Down condition, indicating that participants were faster to identify a target letter in the Up compared to the Down position after seeing a Sad face, but this difference was not significant ($t(43) = 0.82$, $p = .417$).

Figure 2. shows the mean reaction times and standard error for each condition.

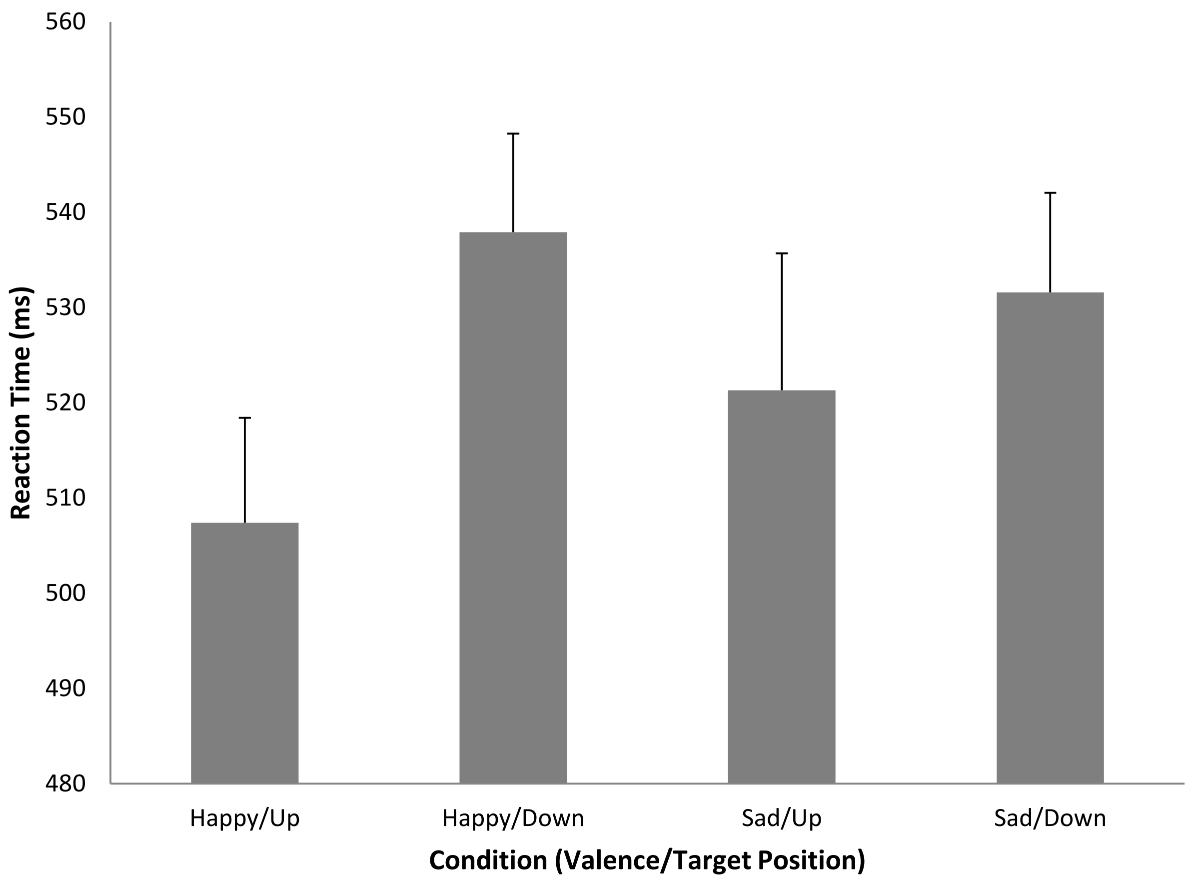

Figure 2. Mean reaction times (in milliseconds) by Valence and Target Position.

Discussion

The hypotheses for this study were that (1) seeing a happy face would direct attention upwards and thereby reduce reaction time to a target letter at the top of the screen as compared to the bottom, and (2) seeing a sad face would direct attention downwards, thereby decreasing reaction time to identify a target letter at the bottom of the screen as compared to the top. These predictions were only partially supported by the results. Though a significant effect of seeing a happy schematic face was found in the predicted direction, decreasing reaction time to identify a target at the top of the screen versus the bottom, the predicted effect of seeing a sad schematic face was not found. That is, there was no significant difference between reaction time to identify the target between the top and bottom of the screen after seeing a sad face.

The design of this study also allowed for insight into another theory surrounding emotion and cognition; Frederickson's (2004) broaden-and-build theory of positive emotions. In accordance with this theory, an alternate prediction was made for this study. It was predicted that seeing a happy face would broaden attention, decreasing reaction time to the target in either location (Up or Down), as compared to seeing a sad face. Also, seeing a sad face would narrow attention, increasing reaction time to the target in either location compared to seeing a neutral or happy face. The results of this study did not support these hypotheses, with no main effect of valence found. No significant differences in reaction times to either target position were found between positive and negative valenced facial expressions.

At this point a possible confound was noted with regards to the 'mouth' shape of the schematic faces. The only feature of the faces that was manipulated to change the expression was the 'mouth' shape. Experiment 3 was conducted to eliminate the possibility that, rather than the emotional expression of the face, the exaggerated shape of the schematic mouth was acting as an attention director. The upwards pointing corners of the mouth for the smiling face and the downwards pointing corners of the mouth for the sad face may have directed attention upwards or downwards respectively, in a similar fashion as the arrows in Experiment 1. To ensure it is the emotional nature of the whole expression itself rather than the ‘mouth’ shape which is directing attention, Experiment 3 removed all other features from the schematic faces and used only the ‘mouth’ shapes.

Experiment 3 – 'Mouth' Shapes

Method

Design

The experiment used a within subjects 2 (Mouth shape: Smiling, Frowning) x 2(Target Position: Up, Down) design, with mouth shape and target position as independent variables and reaction time as the dependent variable.

Participants

Participants were thirty students at Victoria University of Wellington (22 female, 8 male). Participants were recruited through the university's Introduction to Psychology Research Programme (IPRP). They received .5 of a course credit in return for their participation.

Materials/Procedure

Informed consent was obtained for each participant before beginning the experiment. Procedure and materials were identical to those used in Experiment 2, however the schematic faces used were modified. All other features of each face were removed, leaving only the 'mouth' shape in each case. This shape (upwards (smiling) or downwards (frowning) curved line) was presented in the same place on the screen as it had been as part of the face. Target letters were a 'P' or 'Q' (Point Size: 28, Font: Courier New, Bold). Before beginning the trials, each participant was placed at a separate computer, seated to ensure their eye level lined up with the centre of the computer screen. After a brief welcome message, they were presented with the following instructions:

"You will see a series of pictures of shapes in the middle of the screen. It is important that you pay attention to each shape.

After each shape, a 'P' or 'Q' will appear either at the top or bottom of the screen. If it is a Q, press the Q key on your keyboard with your left index finger. If it is a P, press the P key on your keyboard with your right index finger. Try to respond as quickly as you can.

Please press the <SPACE> bar when you are ready"

After reading the instructions, participants pressed the space bar to begin the trials. Each trial began with a fixation cross (+) in the centre of the screen, to centre the participant's attention. This appeared for 500ms, after which this was replaced with one of the mouth shapes (curved line) mentioned above. This mouth shape was displayed as if part of a centred schematic face, but with all other features removed. After 500ms, the mouth shape was replaced by a target letter ('P' or 'Q'), displayed either at the top (460 pixel from bottom) or the bottom (20 pixel from bottom) of the screen, and the participant pressed the corresponding key on the keyboard to identify it. After a key was pressed, a new trial began. There were 100 trials in total for each participant (50 for each mouth shape and target position, 25 for each 'mouth' shape/target position combination) and trials were randomised for each participant. After completing the study, each participant was thanked for taking part and presented with a debriefing information sheet, to further explain the purpose of the study. Ethical approval was granted for this research by the Victoria University of Wellington School of Psychology Human Ethics Committee in 2012. Data were analysed using SPSS.

Results

Trials in which an error was made in identifying the target letter, and those in which reaction time was below 300 or above 1200 milliseconds were excluded from the analysis. Mean reaction times for each valence/target position condition (Happy/Up, Happy/Down, Sad/Up, Sad/Down) were calculated for each participant. Overall mean reaction times were then calculated for each condition. A 2 (Shape) x 2 (Target Position) repeated measures ANOVA found no main effect of valence (F<1), but a significant main effect for Position

($F(1,25) = 12.40$, $p<.01$), reflected in a faster overall reaction time to stimuli in the upper field. Importantly, there was no significant Shape x Target Position interaction ($F<1$) supporting the hypothesis that the results obtained in Experiment 1 were being driven by the emotional nature of the face and not simply the ‘mouth’ shapes.

Discussion

The hypotheses for Experiment 3 were that if it is the emotional nature of the schematic faces which shifts attention, there should be no difference in reaction times in response to either shape. If however, it is the shape of the schematic mouth rather than the emotional expression of the whole face which can direct attention, vertically, then seeing a smiling schematic mouth should direct attention upwards (due to the upwards pointing corners of the mouth), leading to a faster reaction time to the target in the ‘up’ than the ‘down’ position, and seeing a sad schematic mouth will direct attention downwards, resulting in a faster reaction time to identify the target in the ‘down’ than the ‘up’ position. The results supported the first hypothesis. There was no effect of mouth shape on vertical attention, with no significant interaction between valence (smiling/frowning mouth shape) and target position. This finding - in conjunction with the findings of Lovegrove (2009) and Experiment 2 above -indicates that there is some element of the complete facial expression that is creating the effect on vertical attention, at least for the happy face.

The possibility that the schematic faces are too simplistic to create a salient activation of emotion still exists however and it may be that the lack of subtle details provided by a schematic face may have caused the lack of predicted results. For this reason, Experiment 4 used real human faces.

Experiment 4 – Real Faces

The use of real faces in Experiment 4 aimed to investigate whether a more detailed expression may produce a shift of vertical spatial attention. This experiment used real faces, including both genders and three expressions (Happy, Sad and Neutral). As well as investigating the idea of conceptual metaphor/association between emotion and attention, this study also allowed possible insight into Fredrickson's (2004) broaden-and-build theory of positive emotions. In accordance with Fredrickson's theory, a happy face would result in broadened attention and decrease reaction time for both target positions, while a sad face would lead to narrowed attention, increasing reaction time for both target positions.

Method

Design

Experiment 4 used a within subjects 3(Valence: Happy (positive), Sad (negative), Neutral) x 2(Gender: Male, Female) x 2(Target position: Up, Down) design, with valence, gender and target position as the independent variables, and reaction time as the dependent variable.

Particpants

Participants were forty-five first year psychology students (28 females, 17 males) at Victoria University of Wellington (VUW), recruited through the university's Introduction to Psychology Research Programme (IPRP). They received .5 of a course credit in return for their participation. Participants ranged in age from 18 to 63 (M = 20.93, SD =7.05) and had normal to corrected vision. The data for three participants were removed as their error rates exceeded twenty per cent. This left a total of forty-two participants for Experiment 2.

Materials/Procedure

The procedure in Experiment 4 was identical to that in Experiment 2, however the schematic faces were replaced with real human faces. Participants were seated at a 17-inch

Dell computer monitor and keyboard. The experiment was run on the E-Prime program (v1.1) (Schneider, Eschman & Zuccolotto, 2002). Informed consent was obtained before beginning trials and each participant was placed at a separate computer, seated to ensure their eye level lined up with the centre of the computer screen. After a brief welcome message they were presented with the following instructions:

"You will see a series of pictures of faces in the middle of the screen. It is important that you pay attention to each face.

After each face, a 'P' or 'Q' will appear either at the top or bottom of the screen. If it is a Q, press the Q key on your keyboard with your left index finger. If it is a P, press the P key on your keyboard with your right index finger. Try to respond as quickly as you can.

Please press the <SPACE> bar when you are ready"

After reading the instructions, participants pressed the space bar to begin the trials. In each trial, a fixation cross (+) was first presented in the centre of the screen for 500ms, to centre attention. This was followed by display of a real human smiling, frowning or neutral face (see Appendix B), which also appeared for 500ms. Faces of both male and female gender were used. Faces used in this experiment were selected from the Averaged Karolinska Directed Emotional Faces set (AKDEF, Lundqvist & Litton, 1998) and were presented in grayscale (230x230 pixels). The face then disappeared, followed by a target letter ('P' or 'Q') (Point Size: 28, Font: Courier New, Bold) which appeared at either the top (460 pixel from bottom) or the bottom (20 pixel from bottom) of the screen. The participant was required to identify which letter was displayed by pressing the corresponding key on the keyboard with their right or left index finger. Reaction time to identify the letter was measured from the time the target letter appeared on the screen to the time the participant pressed one of these keys.

The target letter then disappeared and a new trial began. There were 120 trials in total (60 for each gender and target position, 40 for each expression and 10 of each gender/target position/expression combination) and trials were randomised for each participant. After completing the trials, participants were thanked for taking part and presented with a debriefing information sheet providing further detail on the purpose of the study. Ethical approval was granted for this research by the Victoria University of Wellington School of Psychology Human Ethics Committee in 2012. Data were analysed using SPSS.

Results

Trials in which an error was made in identifying the target letter, and those in which reaction time was below 300 or above 1200 milliseconds were excluded from the analysis. A 3(Valence) x 2(Gender) x 2 (Target Position) repeated measures ANOVA revealed no main effects or interactions. As no main effect of gender was found, this was collapsed for all further analysis. Mean reaction times for each condition (Happy/Up, Happy/Down, Neutral/Up, Neutral/Down, Sad/Up, Sad/Down) were calculated for each participant. Overall mean reaction times were then calculated for each condition. These are shown in Table 2. below, along with the standard deviation (SD) scores for each condition.

Table 2.

Means and Standard Deviations of Reaction Times (in milliseconds) by Valence and Target Position.

Condition	Mean Reaction Time (ms)	Standard Deviation (ms)
Happy/Up	519.69	62.54
Happy/Down	535.80	70
Neutral/Up	531.06	57.43
Neutral/Down	545.66	72.81
Sad/Up	543.22	64.56
Sad/Down	549.68	79.56

As seen in Table 2. above, mean reaction time in the Happy/Up condition is lower than in the Happy/Down condition, indicating participants were faster to react to a target letter in the Up compared to the Down position after seeing a Happy face. A paired samples t-test revealed the difference in mean reaction times between the Happy/Up and Happy/Down conditions was significant ($t(41)= 2.39$, $p = .022$).

Mean reaction time in the Neutral/Up condition is lower than in the Neutral/Down condition, indicating that participants were faster to identify a target letter in the Up compared to the Down position after seeing a Neutral face. This difference however, was not significant ($t(41) = 1.57$, $p = .125$).

Mean reaction time in the Sad/Up condition is lower than in the Sad/Down condition, indicating that participants were faster to identify a target letter in the Up compared to the Down position after seeing a Sad face, but this difference was not significant ($t(41) = 0.68$, $p = .5$).

Figure 3. shows the mean reaction time and standard error for each condition.

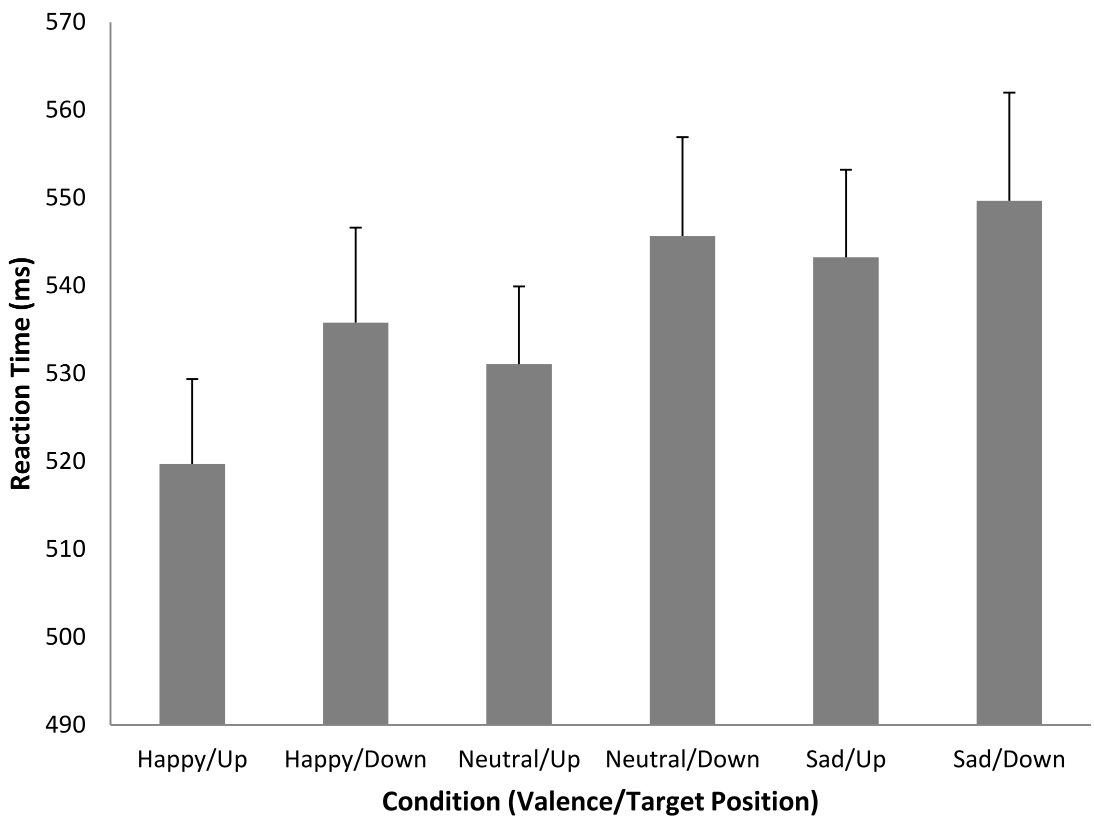

Figure 3. Mean reaction times (in milliseconds) by Valence and Target Position.

The above results support the hypothesis that seeing a happy face would direct attention upwards and thereby reduce reaction time to a target letter at the top of the screen as compared to the bottom. They do not support the hypothesis that seeing a sad face would direct attention downwards, decreasing reaction time to identify a target letter at the bottom of the screen as compared to the top.

Discussion

The hypotheses for this study were that (1) seeing a happy face would direct attention upwards and thereby reduce reaction time to a target letter at the top of the screen as compared to the bottom, and (2) seeing a sad face would direct attention downwards, thereby decreasing reaction time to identify a target letter at the bottom of the screen as compared to the top. These predictions were only partly supported by the results. Though a significant effect of seeing a happy schematic face was found in the predicted direction, decreasing reaction time to identify a target at the top of the screen versus the bottom, the predicted effect of seeing a sad schematic face was not found. There was no significant difference between reaction time to identify the target between the top and bottom of the screen after seeing a sad face or a neutral face.

The design of this study also allowed for insight into another theory surrounding emotion and cognition; The results of this study did not find support for Frederickson's (2004) broaden-and-build theory of positive emotions, with no main effect of valence. No significant differences in reaction times to either target position were found between positive, neutral and negative valenced facial expressions. This experiment therefore cannot provide evidence in support of Fredrickson's theory.

General Discussion

The aim of this thesis was to advance current knowledge regarding the effect of affective stimuli on vertical attention. Various effects of emotion on attention and other cognitive processes have been documented in the literature on this area of research (e.g. Anderson, 2005; MacLeod et al., 1986; Meier & Robinson, 2004; Oaksford et al., 1996; Wapner et al., 1957). The primary question asked by the current research concerned the impact of briefly presented valenced faces on vertical selective attention. Emotion induction, as well as affective stimuli in the form of valenced words have been shown to shift attention vertically. Specifically, positive emotion (and the evaluation of positive words) shifts attention upwards in space, while negative emotion (and the evaluation of negative words) cues attention downwards (e.g. Eder & Rothermund, 2008; Meier & Robinson, 2004; Meier & Robinson, 2006; Wapner et al., 1957). No research concerning the possible extension of this effect to other visual affective stimuli such as pictures were found in a review of the literature. In one unpublished study, Lovegrove (2009) investigated whether viewing happy (positive) and sad (negative) schematic faces would produce the same effects on vertical attention as valenced linguistic stimuli (positive/negative words) had shown in previous studies (e.g. Meier & Robinson, 2004). Lovegrove found that happy faces shifted attention upwards, but no significant effect was found for sad faces. The experiments conducted in this thesis therefore aimed to determine whether emotionally valenced stimuli in the form of facial expressions would have the same effect on vertical attention as previously found for linguistic stimuli, and under which specific conditions this effect may occur.

Experiment 1 using arrows, which are known to be potent directors of spatial attention (Green & Waldorff, 2012; Ristic & Kingstone, 2009), showed as predicted, that seeing an upwards pointing arrow shifted attention to the top of the screen, leading to a faster reaction time when the subsequent target letter was presented at the top of the screen as opposed to the bottom of the screen. The same direction-congruent effect was found for a downwards pointing arrow. These results were important in validating the design of the experiments used in the current research as they showed this design allows the shift of vertical attention with a known attention director. The subsequent studies then used modifications of that same design, only replacing the arrows first with happy/sad schematic (Experiment 2), ‘mouth’ shapes (Experiment 3) and then with real human faces (Experiment 4).

Experiment 2 was a modification of Meier and Robinson’s (2004) Study 2, replacing valenced words with schematic faces. Similar schematic faces as those used by Lovegrove were employed, however using more simplistic features, and presenting these in grayscale. The hair which was originally used on Lovegrove’s schematic faces was also removed as it was thought that this detail may have drawn attention upwards, over and above any effect the valence of the expression may have had. It was predicted for this study that (1) seeing a happy face before the target identification task would shift attention upwards, producing a faster reaction time to identify a target letter (‘P’ or ‘Q’) on trials in which that letter was presented at the top of the screen than trials in which the letter was presented at the bottom of the screen, and (2) seeing a frowning face would shift attention downwards, decreasing reaction time for targets in the ‘Down’ versus the ‘Up’ position. The results of Experiment 2 supported only the first hypothesis. Reaction time was significantly faster for targets in the ‘Up’ than the ‘Down’ position after viewing a happy face, indicating that attention had been shifted upwards after seeing the happy face. No significant differences were found between reaction times to targets in either position after seeing a frowning face however. As mentioned above, similar results were obtained by Lovegrove also using schematic faces. In lieu of the current results, it does not appear that the strands of hair on Lovegrove’s schematic faces’ heads were responsible for an upwards shift of attention in excess of any shift caused by the expression itself.

Experiment 3 was conducted to exclude the possibility that rather than the emotional expression of the face, the exaggerated shape of the schematic mouth was acting as an attention director. Results showed no interaction between mouth shape and target position in reaction times, supporting the hypothesis that the results obtained in Experiment 2 were being driven by the emotional nature of the face and not simply the mouth shape.

A possible reason for the lack of significant findings for the sad face in Experiment 2 was thought to be the simplicity of the schematic faces. Humans are adept in the task of facial expression recognition (Singh & Ellis, 1998) and we pick up on subtle details in human faces when reading expressions, as is the case for instance with the Duchenne smile markers (Duchenne, 1862/1990, as cited in Soussignan, 2002; Krumhuber et al., 2009). Experiment 4 therefore used real human faces in order to investigate whether these would show an effect in directing vertical attention. Again, it was predicted that seeing a happy face would shift attention upwards in space, leading to a faster reaction time in the target identification task on trials where the target letter appeared at the top of the screen as opposed to the bottom. It was also predicted that the opposite effect would be seen for a frowning face; a downwards shift in vertical attention and subsequently a faster reaction time for target letters appearing at the bottom of the screen as opposed to the top. The results for Experiment 4 showed support for the first hypothesis, with happy faces producing a faster reaction time to identify the target letter in the ‘Up’ than the ‘Down’ position. Results did not however support the second hypothesis for Experiment 4, with no significant effect on reaction time for target letters in either position for frowning faces.

Results of Experiments 2 and 4 offer partial support for Lakoff and Johnson’s (1980) conceptual metaphor theory. The ‘good is up’ part of the spatial-emotion conceptual metaphor was supported, with the reaction time to the ‘up’ target significantly faster than to the ‘down’ target, after viewing a happy schematic or human face. The ‘bad is down’ part of this same metaphor however was not supported in either Experiment 1 or 2, with frowning schematic and human faces not resulting in a significantly decreased reaction time for targets in the ‘down’ versus the ‘up’ position.

The design of Experiment 4 also had the potential to provide further knowledge regarding Fredrickson’s broaden-and-build theory (Fredrickson, 2001, 2004). According to this theory it was predicted that seeing the happy face would broaden attention, decreasing reaction time to both ‘Up’ and ‘Down’ targets, compared to viewing a neutral face or sad face, while Experiment 4 found only a decrease in reaction time for ‘up’ targets in this condition. Secondly, this theory would predict that seeing a sad face would increase reaction time to both ‘Up’ and ‘Down’ targets by narrowing the focus of attention, compared to seeing a neutral or happy face. No significant differences in reaction times of happy, neutral and sad faces for either target position were found in Experiment 4. Thus no support was found for these hypotheses or for Fredrickson’s theory.

As the results of Experiment 1 using arrows found the predicted results, and previous research using a similar paradigm (e.g. Meier & Robinson, 2004) also found results in line with predictions, it is possible that some element/s of the facial stimuli used in the current research account for the lack of predicted results in the main experiments. Several possibilities are considered below.

Arousal vs. valence?

Emotion and cognition research, while focussing predominantly on the valence of emotion and emotional stimuli, has also produced interesting findings regarding the arousal level of emotions, in other words, the extent to which they produce physiological reactions such as increased heart rate or perspiration. The most robust findings in this area concern how the arousal level of emotional stimuli impacts on their ability to capture attention. For example, Lang, Greenwald, Bradley and Hamm (1993, as cited in Fernandes, Koji, Dixon & Aquino, 2011) found longer viewing times for highly arousing positive (erotic) and negative (mutilated bodies) images as compared to low arousal images. Studies using the attentional blink (AB) paradigm, such as Anderson's (2005) study described earlier have also found when the second target was emotional and highly arousing, this reduced the AB to a greater extent than when the second target was low in arousal. A similar study by Keil and Ihssen (2004) also found that arousing verbs reduced the AB, while non-arousing verbs did not. The attentional capture of high arousal was further supported by Schimmack and Derryberry (2005), who that found high-arousal distractor images (negative and positive) caused greater interference in a primary mathematical problem solving task than did low-arousal negative images.

More recent studies have begun to compare the effects of both valence and arousal on attention, and an emerging hypothesis is that these two factors, though independent, may interact to influence attention (e.g. Fernandes et al., 2011). Robinson, Storbeck, Meier & Kirkeby (2004) found that both for emotional pictures and words, arousal interacted with valence to impact evaluative reaction times. Participants were faster to identify a high arousal-negative valence stimulus or low arousal-positive stimulus than they were to identify a low-arousal-negative or high-arousal positive stimulus. The authors propose these results may be due to an initial evaluation of any highly arousing stimulus as threatening, and that when that stimulus is also negative, this is congruent with the initial evaluation, allowing a faster response than if a highly arousing stimulus is positive. In contrast, when stimuli are low in arousal, a positive valence would be congruent with an evaluation based on arousal as ‘non-threatening’ or low- arousal. Fernandes et al. (2011) also found a similar interaction between valence and arousal, with high-arousal negative and low-arousal positive images captured attention more effectively - thereby creating increased interference in a primary number matching task - than did low-arousal negative or high-arousal positive images. These studies suggest that while independent, valence and arousal may interact to influence attention.

In contrast however, in a recent unpublished study using word stimuli, Schaverien (2012) found no interaction between valence and arousal for reaction time to evaluate valenced words presented in their congruent (Positive-Up, Negative-Down) versus incongruent (Positive-Down, Negative-Up) positions on the screen. These results would indicate that arousal does not interact with valence to activate the connection between emotion and vertical space, at least in regards to linguistic stimuli. It is clear that further research remains to be conducted to determine the exact nature of the possible interaction between valence and arousal, however, it is something that should be considered in relation to the current results.

The same relationship between valence and arousal remains to be investigated in relation to facial expressions as stimuli. Arousal was not controlled for in the current study so it is possible this may have confounded results. The finding in Experiment 4 that real happy faces produced the expected effect, while real sad faces did not, could be explained by this idea of arousal. A happy face would be classed as having a high arousal along with the positive valence, while a sad face has low arousal and low valence. Perhaps it is not just valence which activates the association between emotion and vertical space, but also the arousal level of the stimulus. The high-arousal of the happy face may be what produced the significant effect, while the low-arousal of the sad face was not sufficiently arousing to produce the predicted effect.

In future, a modification of the current experiments could manipulate arousal in combination with valence with additional expressions. The current study used High (positive) valence – High arousal (HV-HA, happy face) and Low (negative) valence – Low arousal (LV-LA, sad face) combinations only. A more conclusive test of the possible interaction of arousal and valence would add a LV-HA (e.g. fear/anger) combination.

Conceptual Metaphor Activation – Automatic?

Considering the above, a further possibility for the lack of predicted effect for sad faces in the current study arises, in regards to the instructions given to participants. The issue of automatic and obligatory activation of conceptual metaphors has previously been debated by critics of Lakoff and Johnson's (1980) theory, such as Brookshire et al.(2010), who argued that the activation of the emotion-verticality metaphor is not necessarily as automatic as Lakoff and Johnson suggested, but depends on the situation. In two experiments, Brookshire et al. found the 'Good is Up/Bad is Down' association between vertical motor movements in response to emotional words was automatic – in other words, it occurred even when the task required no attention to the meaning of the word - only on the first presentation of each word. After this explicit attention to word meaning was required for the effect to return.

The instructions given to participants in the current experiments did not explicitly ask them to evaluate the valence of each face, rather they were only asked to pay careful attention to each face. Lovegrove's study which also did not explicitly ask participants to evaluate the valence of the affective stimuli found a similar lack of effect for the negative stimuli. Thinking about this in combination with the possible confound of arousal discussed above, one could speculate that in the absence of a high level of arousal, the emotional faces may not be salient enough to activate the emotion-vertical space association automatically. However, as happy faces would be considered high in arousal (J. McDowall, personal communication, 17^{th} January), perhaps the happy faces were salient enough to activate this association without explicit instructions to evaluate the faces, while the low-arousal sad faces were not.

On the other hand, Niedenthal (2007) discusses recent theories of embodied cognition, which suggest that emotion can be ‘reexperienced’ when thinking about an emotional event, or when seeing emotion in others. In support of this theory, neuroimaging studies, such as that of Wicker et al. (2003), show that recognising an emotional expression in someone else activates regions of the brain which overlap strongly with those activated when experiencing the same emotion yourself. This kind of evidence would suggest one would not need explicit instructions of evaluation when using facial expressions as stimuli, but that facial stimuli may even act as a mild form of mood induction tools.

It remains unclear in the scope of the current research as to how automaticity may play a role in the results found. This may prove to be a key factor to be considered in future research, which may investigate this by comparing explicit instructions to evaluate facial expressions with more implicit cues for evaluation, and instructions which do not require any evaluation.

Other issues

Participants’ distance from the computer screen should also be controlled for in future studies. In the current research this was not controlled for, and so there is a possibility that some participants were further away and were therefore able to see the letter at the edge of their vision and identify it without needing to focus their attention on it. Again, there is no indication in the results that this factor confounded findings, however one should consider this in future.

A future version of the current experiments could also vary length of presentation of faces as the length of presentation used in the current research (500ms) may have allowed any initial shift of attention in response to the emotional nature of the face to go unrecorded, as further presentation time allowed attention to centre back to the face itself before it disappeared. Once again, there was an upwards attentional shift found in response to positive facial expression so it is unclear as to whether presentation time was a factor in the current results. Varying presentation time in future studies could determine the optimal presentation time for this paradigm.

Implications

The findings of the current research have implications for the wider field of emotion and attention research. They offer partial support of Lakoff and Johnson's (1980) conceptual metaphor theory, and show that both schematic and real facial expressions can impact vertical attention. This thesis however also highlights the apparent existence of complexities for research in this area. It appears from the current results as well as those from similar previous research (Lovegrove, 2009), that there may be specific conditions in which affective pictures such as facial expressions impact on our vertical selective attention. While positively valenced expressions repeatedly were found to shift attention upwards in the current experiments, negatively valenced expressions have not produced the predicted effect of shifting attention downwards. This indicates there may be certain characteristics of the negative expressions used in these studies, which cause their impact on vertical attention to be less robust than that of positive expressions. One important possibility is the arousal versus valence issue discussed above. Future research varying both valence and arousal of expressions may shed more light on this.

Fredrickson's (2004) broaden-and-build theory of positive emotions was not supported by the results of the current research (Experiment 2). Some other studies have found support for this theory in terms of lateral attention in the Eriksen flanker task (Eriksen & Eriksen, 1974) (e.g. Melcher, Obst, Mann, Paulus & Gruber, 2012; Rowe et al., 2007). It is possible that the broadening effect of positive emotion on attention may not extend to vertical attention, or that the stimuli used in the current research were not salient enough to produce the effects predicted by this theory. A further study using mood induction or explicit evaluation of affective stimuli to measure the effect of on the breadth of vertical attention would offer further insight into this theory.

Summary and Conclusions

This thesis investigated the effect of affective facial stimuli on vertical selective attention, to advance knowledge in the field of emotion and attention research. Positively (happy) and negatively (frowning) schematic (Experiment 2) and real (Experiment 4) faces were assessed for their ability to activate the association between emotion and vertical space proposed by Lakoff and Johnson's (1980) conceptual metaphor theory.

Both Experiment 2 (schematic faces) and Experiment 4 (real faces) found that a happy face resulted in faster identification of targets in the valence-congruent 'up' than the valence-incongruent 'down' position, partially supporting the idea of an emotion-vertical space conceptual metaphor, but only the 'good is up' part of this metaphor. A predicted faster reaction time to targets in the 'down' position following presentation of a sad face was not found,

Results of Experiments 2 and 4 failed to find support for Fredrickson's (2004) broaden-and-build theory of positive emotion, which was investigated as an aside to the conceptual metaphor theory in this experiment. No significant decrease in reaction times overall (to both target positions) following presentation of a happy face as would be predicted by Fredrickson's theory was found. Likewise, there was no significant increase in reaction time overall in response to a sad face.

The results also support the 'weak' over the 'strong' interpretation of the conceptual metaphor theory (Murphy, 1996). The current findings that positively - but not negatively - valenced facial stimuli shift attention vertically add support to Murphy's 'weak' interpretation that while it may be useful to think about vertical space when thinking about emotion (in the case of the positive faces), it is not necessary (negative faces).

This research demonstrates the complexities that arise for pictorial affective stimuli such as facial expressions in emotion-attention research. The results, along with others from similar studies (e.g. Lovegrove, 2009) indicate that activation of the 'good is up' half of the 'good is up/bad is down' conceptual metaphor is more robust than the 'bad is down' half when using facial expressions as stimuli. The reasons for this cannot be revealed in the scope of the present experiments and it is clear that further research is required to tease out the conditions which may activate this other half. In time this line of research is hoped to aid in informing therapy approaches for the treatment of mood disorders. A number of future research opportunities exist in pursuit of this goal, specifically in regards to using facial stimuli in emotion-attention research. Particularly the further investigation of the possible interaction of valence and arousal and the degree of automaticity of activation are thought to be interesting avenues to advance knowledge in this area further.

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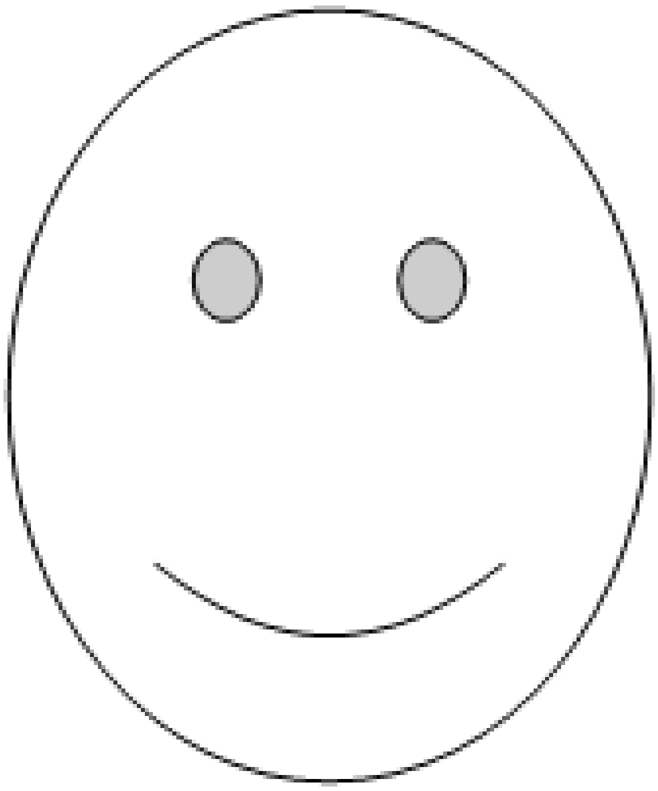
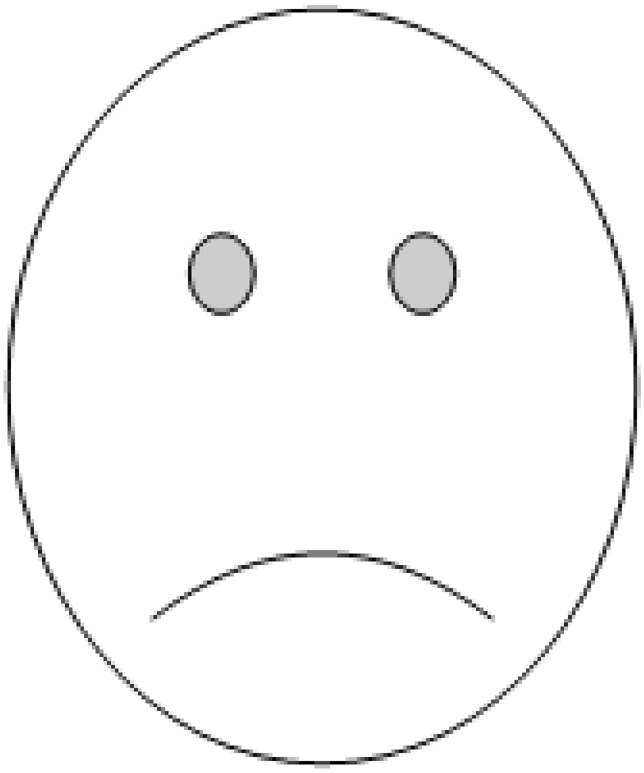
Appendix A – Schematic Faces



Happy face



Sad face

Appendix B – Real faces

(from The Averaged Karolinska Directed Emotional Faces, AKDEF, Lundqvist & Litton, 1998)

Female - Happy

Female - Neutral

Female –Sad

Male - Happy

Male - Neutral

Male - Sad