Attention: Here, There and Everywhere

The Relationship between Emotional Images and Attention Distribution

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Abstract

Within the field of cognitive psychology there are two opposing theoretical frameworks, the conceptual metaphor theory and the broaden-and-build theory, which attempt to explain the influence of emotionally valenced stimuli on attention distribution. The conceptual metaphor theory (Lakoff & Johnson, 1999) asserts that concrete concepts (e.g. vertical distance or brightness) are used as metaphors to scaffold mental representations of abstract concepts (e.g. love and power). These metaphors rely on sensorimotor information in order to be understood, and therefore are said to be embodied. The focus of this thesis is the *"Good is Up, Bad is Down"* conceptual metaphor. A central prediction of this theory is that emotionally valenced stimuli should activate the *"Good is Up, Bad is Down"* metaphor, and automatically shift vertical attention congruently. In contrast, the broaden-and-build theory (Fredrickson, 2004) is based on evolutionary principles (Frijda, 1986), with negative emotions associated with specific-action tendencies and positive emotions associated with diffuse-action tendencies. The main prediction derived from this theory is that when individuals are induced into positive emotions their attention is broadened, whereas when induced into negative emotions their attention is narrowed. The central aim of this thesis was to gather experimental data in support for either the conceptual metaphor theory or the broaden-and-build theory when using emotionally laden images to induce affect, compared to prior research, which has utilised valenced words.

This thesis also aimed to examine the influence, if any, of both valence and arousal of the emotional images. The literature provides conflicting views on whether these constructs are orthogonal or interconnected, and as such what effect they have on evaluative processing. To date, research examining the conceptual metaphor theory or the broaden-and-build theory has not controlled for both valence and arousal in their experimental design.

Two experiments were designed to assess both aims. In Experiment 1, emotionally valenced images were presented in either the upper or lower visual field, and participants were asked to categorise the image as "positive" or "negative" by pressing a designated key on a keyboard. In Experiment 2, the emotional images were displayed in the centre of the visual field for a fixed period of time, followed by the presentation of a target letter in either the upper or lower visual field. Participants responded by pressing the corresponding key to the target letter on a keyboard. Across both experiments no shifts in attention were congruent with the *"Good is Up, Bad is Down"* conceptual metaphor theory, indicating that the conceptual metaphor theory is not supported when utilising images. In contrast, Experiment 2 provided experimental data in support of the broaden-and-build theory, with participants responding faster to all target letters following high valenced images regardless of their position. Finally, this thesis provides support to the notion that valence and arousal are orthogonal constructs, independently influencing higher order cognitive processes such as attention.

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"How do people think?" is a question that has intrigued cognitive psychologists for decades, and has consequently led to a vast and in-depth corpus of research. Currently, there are two prominent theoretical viewpoints in this research domain, the "traditional view" and "the grounded cognition view". Traditional theories of cognition assume that knowledge is held in semantic memory systems, which are isolated from the brains alternate modal systems; such as perception, action and introspection (Barsalou & Hale, 1993; Rumelhart, 1988; Smith, 1981). Conversely, the theory of grounded cognition takes an amodal systems approach, concluding that the brains evolutionary systems collaborate to produce cognition (Barsalou, 2008; Gibbs, 2006; Lakoff & Johnson, 1999; Solomon & Barsalou, 2004; Wilson, 2002). Grounded cognition theorists commonly refer to the idea that cognition relies on the activation of the sensorimotor system, hence concurring that cognition is embodied (Pecher, Boot, & Van Dantzig, 2011). The cognitive viewpoint relevant to this thesis is that of grounded cognition.

Grounded Cognition

The defining characteristic of grounded cognition is its core focus on mental simulation in the production of cognition (Decety & Grezes, 2006). Simulation is the "re-enactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind" (Barsalou, 2008, p. 618). For example, when an individual thinks about an object, neurally stored patterns that have been encoded upon real experiences with the object are reactivated. Barsalou (1999) comments that this can include visual, auditory, tactile, olfactory and gustatory information, allowing the individual to feel as if they are actually perceiving the object upon re-activation.

Barsalou's (1999) Perceptual Symbol Systems (PSS) theory is widely acknowledged as advancing the understanding of how grounded cognition works, and subsequently how mental simulation is utilised (Pezzulo & Calvi, 2011). According to the PSS theory, the brain

records sensorimotor information from a perceptual experience as a perceptual symbol, which is a schematic representation of selectively chosen features. As stated earlier, these features can include the five sensory modalities, and also proprioception and introspection (Barsalou, Solomon & Wu, 1999). The brain then stores these symbols in a perceptual simulator, which is a set of perceptual symbols that represent one particular concept. Therefore a simulator is not a re-enactment of a specific experience, but rather a network of information subsets that have been captured during discrete experiences. As perceptual symbols can be dynamically combined to create a simulation, concepts are considered to be specific instances of a category. For instance, an individual may represent a car by simulating seeing a car, driving a car or being a passenger in a car. This dynamic ability to combine components from different perceptual symbols, and thus create unique concepts, consequently means these mental simulations are equivalent to actual perception and action (Pecher et al., 2011). Furthermore, Barsalou (1999) highlights that mental symbols and simulations form a fully functional conceptual system, which is interlinked with higher cognitive processes. This connection enables simulation activation to influence processes such as attention, memory and language processing. This thesis will focus on the effect that an individual's PSS, and more broadly grounded cognition, has on attention.

Evidence for the Grounded cognition view: Concrete concepts and vertical attention

The PSS theory explicitly noted that words could also produce mental simulators, which can in turn become entwined with the object simulator for which the word denotes. Barsalou (1999) noted that when an individual sights a word, activation of a word simulation has the ability to activate and control the correlated object's simulations. In light of this connection, researchers have developed tasks to investigate the influence of grounded cognition on vertical attention, by exploring the relationship between concrete-word meanings and spatial location.

Steic and Dojiman's (2007) investigated this relationship by presenting undergraduate psychology students with words denoting flying and non-flying animals, which were presented in either the upper or lower portion of a computer screen. The flying animal words (e.g. stork and honeybee) were pre assessed by a separate group of undergraduate students as being spatially 'upwards' oriented, and the non-flying animal words (e.g. rabbit and mole) as spatially 'downwards' oriented. Participants were required to indicate on a keyboard whether the exhibited word represented a flying or non-flying animal. Results showed that participants judged words denoting flying animals faster when they were displayed in the upper section of the screen and non-flying animal words when they were presented at the bottom of the screen.

Similarly, Zwaan and Yaxley (2003) validated this significant interaction by presenting undergraduate students with semantically linked words pairs, which had a vertical canonical spatial relationship (e.g. attic and basement). The word pairs were presented on a computer screen in either their canonical (attic presented above basement) or non-canonical (basement presented above attic) order. Filler pairs that were semantically but not canonically linked (e.g. apple and pear) and unrelated pairs (e.g. car and tree) were also presented. Participants were asked to assess whether the words were related or unrelated, and reaction times for the experimental pairs were analysed. The results found that when word pairs were presented in canonical order the participant's semantic-relatedness judgments were significantly faster than when the word pairs were not in canonical order.

If the PSS theory is applied to Steic and Dojiman's (2007) study, the presentation of an object word (e.g. honeybee), activated the appropriate perceptual simulation of that object. This simulation would have included spatial location information, such as honeybees being found up in the sky, subsequently causing a shift in the participant's attention upwards (due to the connections between higher cognitive functions). If the word honeybee was presented at the top of the screen, the registered word's position is congruent with the learned behavioural position of

the honeybee, thus allowing for a faster categorisation judgment. Correspondingly, the words presented in Zwann and Yaxley's (2003) experiment would have both activated their appropriate perceptual simulations, therefore highlighting learnt spatial location information. Hence, when the registered words were canonically congruent with their neurally stored information on spatial location, categorisation judgments could be processed faster. Both of these studies therefore highlight the significant relationship between grounded cognition and spatial attention for concrete concepts.

Grounded cognition and abstract concepts: The conceptual metaphor theory

Whilst grounded cognition appears to eloquently explain how concrete concepts are represented in the brain, it is harder to imagine how this embodied grounded cognition works for abstract concepts, such as power and love, which have no tangible sensorimotor properties. A conglomerate of theories have proposed how grounded cognition represents abstract concepts, including utilizing situational information (Barsalou & Weimer-Hastings, 2005), internal affect (Andrews, Vigliocco, & Vinson, 2009) and linguistic information (Kousta, Vigliocco, Vinson, Andrews, & Del Campo, 2011). An alternate view, the conceptual metaphor theory, suggests that abstract concepts are grounded in the sensorimotor system via the use of lexical metaphors, which is otherwise known as metaphorical mapping (Quadflieg et al., 2011).

The Conceptual Metaphor Theory (CMT) was developed by Lakoff and Johnson (1980, 1999) and is said to be strongly based on the scientific principles of philosophy and linguistics (Meier & Robinson, 2005). As noted above, the fundamental principle of the CMT is metaphorical mapping, or that concrete concepts (source domains/ 'vehicles') are used as metaphors to represent abstract concepts (target domains/ 'the topic'). In other words, Lakoff and Johnson (1980, 1999) state that a concrete vehicle is needed to scaffold a mental representation of an abstract topic, and that the mental representation of the vehicle is needed in order for an individual to fully understand the topic. The source domain is a sensorimotor experience, such as

distance, vertical position, temperature or brightness. The target domain is an abstract concept, such as intimacy, power, health or affect. As these metaphors rely on sensorimotor information and its relation to the physical world in order to be understood, they are thus said to be embodied (Crawford, 2009).

A myriad of conceptual metaphors appear to be used in everyday language, across many spoken languages, to discuss the concept of affect (Gibbs, 2006). For example, *"affection is warmth", "intimacy is closeness"* and *"good is up and bad is down".* If analysed from a developmental viewpoint, these conceptual metaphors appear logical. Children learn that 'affection is warmth' from the heat received during intimate hugs with parents, that 'intimacy is closeness' from the distal proximity perceived between the child and parent, and that 'good is up' from the attention, love and nutrients they receive from parents that appears above them (Crawford, 2009). As these connections between source and target domains develop early during childhood, cognitive theorists propose that these neural links are consistently strengthened, and lead to the unconscious use of conceptual metaphors (Godfrey & Grimshaw, 2012; Lakoff & Johnson, 1999)

Evidence for the Conceptual Metaphor Theory: Good is up/Bad is down

Meier and Robinson (2005) proposed a set of hypotheses which they believed, if proven, would determine whether conceptual metaphors are used to underlie representations of abstract concepts. Whilst these hypotheses have been tested on conceptual metaphors regarding power (Schubert, 2005) and religion (Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007), this thesis will focus on metaphors associated with emotion-linked concepts. More specifically, whilst research has been conducted on emotionally-linked metaphors associated with brightness (Meier, Robinson, Crawford, & Ahlvers, 2007), distance (Neumann & Strack, 2000) and dominance (Robinson, Zabelina, Ode, & Moeller, 2008), this thesis will focus on experiments that have directly tests the *"Good is Up, Bad is Down"* metaphor.

Meier and Robinson's (2005) first hypothesis examined the underlying assumption of CMT, that the concept of emotion is scaffolded upon metaphors, such as *"Good is Up"*. The authors state that if this assumption is correct, the way in which individuals encode and represent information about emotionally driven stimuli should be influenced by the "metaphor-consistent physical aspects of the stimuli" (Meier & Robinson, 2005, p. 241). Hence, individuals should process positive stimuli faster if they are presented at the top rather than the bottom of the visual field. Meier and Robinson (2004) conducted a study where they presented undergraduate students with 100 positive and negative words (e.g. kiss, pretty, obnoxious and poison). The vertical position of the word was manipulated, such that the word was displayed either at the top or the bottom of the computer screen. Participants were asked to decide whether the word was positive or negative by pressing a designated key on a keyboard. The results showed that participants' were faster to categorise positive words when they were displayed at the top of the screen, and negative words when they were displayed at the bottom of the screen. The results from this study support Meier and Robinson's (2005) first hypothesis of consistency, that stimuli will have a processing advantage if they are presented congruently with the physical properties of the conceptual metaphor.

The second hypothesis proposed that if emotion-linked concepts are represented by conceptual metaphors, then activation of the target domain should influence the activation of the source domain (sensorimotor information) congruently. For example, the evaluation of negative stimuli should activate stored "downwards" sensorimotor information, which should in turn shift attention downwards. Meier and Robinson's (2004) second experiment used the same positive and negative words, but displayed the words centrally as opposed to shifting their displayed position up or down. Participants were asked to assess the word's valence vocally, and once doing so a target letter (a *p* or a *q*) appeared at the top or bottom of the screen. Participants were then asked to respond to the target by pressing the corresponding key on the keyboard. Results

showed that target letter judgments occurred faster when presented at the top of the screen if the word had been judged positive, rather than negative. Conversely, target letter discrimination when presented at the bottom of the screen occurred faster when the previous word had been judged negative rather than positive. This experiment supported the second hypothesis that making a valence evaluation shifts spatial attention in a metaphor-consistent way.

Meier and Robinson's (2005) third and final hypothesis questioned the automaticity of metaphoric mapping. The authors postulated that if conceptual metaphors were required for understanding abstract concepts, then congruent conceptual metaphor source-target domain mappings should occur automatically. In other words, if an individual views a positive word, their attention should automatically (after a very short delay) be shifted upwards, regardless of whether they have consciously judged the word's valence. This hypothesis had not been investigated in relation to the "*Good is Up, Bad is Down"* metaphor, yet it has been supported in regards to the metaphors *"Bright is Up, Dark is Down"* (Meier et al., 2007) and *"Powerful is Up, Powerless is Down"* (Zanolie et al., 2012).

Meier et al., (2007) tested the automaticity of the relevant metaphoric mapping by placing positive and negative words in the centre of a computer screen, followed by a categorization task. This task involved the presentation of a light or dark box, in which participants had to categorise the box in relation to its brightness. Unlike Meier and Robinson's (2004) study, participants were not asked to assess the words valence prior to the appearance of the shaded box, and participants were only given 400ms to respond. Results demonstrated that participants responded significantly faster (in less than 400 ms) to the light square, regardless of its position, if the preceding word had been positive (vs. negative), therefore supporting the hypothesis that metaphoric mapping is automatic.

Correspondingly, Zanolie et al., (2012) made apparent the automatic nature of metaphoric mapping by measuring event-related potentials (ERPs) as participants made

power related judgements. An ERP can be defined as a temporal signature of macroscopic brain electrical activity related to a sensory, motor, or cognitive event, which are recorded by electro-encephalography (EEG) and are used to explore brain activity (Rivet & Souloumiac, 2013). As seen in Meier et al., (2004) second experiment, words were centrally displayed on a computer screen, followed by the presentation of a target letter in either the top or bottom portion of the screen. The words were linked to people's professions or social classes (e.g. prisoner, baby, and slave), and participants' had to make a power related judgement before the target letter was displayed. Whilst this occurred, ERPs were measured from the N1 and P1 components of the brain, which are said to be responsible for discriminating attention at target locations. As hypothesised, participants made faster judgements when the word's spatial location was congruent with the perceived word's power as well as the ERPs showing higher N1 amplitude for congruent spatial positions. The authors concluded that the presentation of power words caused the automatic activation and shift of conceptual-metaphor congruent spatial attention.

The collaborative evidence from these studies strongly indicate that when individuals are exposed to either concrete or abstract positive stimuli, their attention is directed upwards in space. Conversely, when individuals are exposed to concrete or abstract negative stimuli, their attention is directed downwards in space. Furthermore, whilst these studies have shown support for the metaphoric mapping of the abstract concepts affect in relation to brightness and warmth, no study has yet investigated the automaticity of the metaphoric mapping for the conceptual metaphor *"Good is Up, Bad is Down"*. Nor has a study explored whether conceptual metaphors activate underlying abstract concepts if the displayed stimuli is an image rather than a word.

A Contrasting Viewpoint: The Broaden-and-Build Theory

Whilst the conceptual metaphor theory provides one theoretical framework for how abstract, emotionally valanced stimuli can automatically shift the distribution of attention; the broaden-and-build theory (Fredrickson, 2001) offers an alternate explanation. In brief, the broaden-and-build model suggests that when individuals are experiencing positive emotions their attention is broadened, whereas when experiencing negative emotions their attention is narrowed. In light of this preliminary explanation, this thesis must provide a detailed explanation of emotion before a thorough understanding of the broaden-and-build model can be gained.

Emotion

Emotion is a concept that regularly appears in everyday language, with children as young as two being able to articulate common feelings such as happiness, sadness and anger (Andrews, Viglicco & Vinson, 2009). However, whilst individuals are able to fluently use emotion labels in daily discussion, this is different from fundamentally understanding the concept of 'emotion'. The literature does not offer one succinct definition of emotion, as this concept has attracted researchers from a wide range of disciplines. This includes, but is not limited to, philosophy (Solomon, 2010), evolutionary psychology (Tooby & Cosmides, 2008), cognitive psychology (Niedenthal, Krauth-Gruber, & Ric, 2006), social sciences, biology and neuroscience (Sotgiu, 2007). For the purpose of this thesis, emotion will be addressed from a cognitive psychology viewpoint.

Cognitive psychologists, Fredrickson and Branigan (2005), describe emotions to be momentary, complex experiences that create shifts in people's cognitions, behaviours and physiological responses. These chain reactions to cognitive and physiological systems are said to have been shaped over time by natural selection, allowing individuals to appropriately respond to a wide range of ancestrally recurrent situations (e.g. approach a kind person or

avoid a threat). A breadth of research indicates that these chain responses are able to influence higher cognitive processes, specifically the distribution of attention (Anderson, 2005; Gray, 2004; Oaksford, Morris, Grainger, & Williams, 1996; Rowe, Hirsh, & Anderson, 2007). Attention is considered a higher-order cognitive process that allows individuals to select a subset of information in their surrounding environment, and to grant that information priority for processing (Phelps, Ling, & Carrasco, 2006). The distribution of attention therefore refers to the allocation of attentional recourses to a certain spatial location where such information is gathered (McLaughlin, Borrie, & Murtha, 2010) It is this interaction between emotional states and attention distribution that is the focus of this thesis.

The interaction of emotional states and attention distribution: A focus on the negative

The effect of negative emotional states on individuals' attention processes has notably gathered greater scientific attention than that of positive emotional states. As a result of this unilateral focus, there is a substantial pool of empirical evidence suggesting that negative emotional states cause a narrowing of attention (Schmitz, De Rosa, & Anderson, 2009). Hence, when an individual is experiencing a negative emotional state, a restricted subset of information is prioritised for processing, with extra environmental information being overlooked. Proverbially, this can be commonly referred to as "not seeing the wood from the trees" or "tunnel vision".

Cognitive psychologists propose that this bias towards studying negative emotional states, and their consequential attention narrowing, has occurred for two reasons. Firstly, Fredrickson (2004) asserts that this is due to the association between negative emotional states and psychological dysfunction, and therefore people's safety and well being. For example, sustained and extreme negative emotional states have been linked to a varying array of psychological disorders, such as depression, eating disorders and anxiety. In contrast, whilst intense positive emotions have been connected to psychological disorders such as

mania and addictions, these are considered "less problematic" (Seligman & Csikszentmihalyi, 2000).

Secondly, Fredrickson (2004) emphasizes that negative emotional states have been the focus of empirical research as they are thought to be inherently linked with specific-action tendencies (Frijda, 1986). Emotion-induced specific-action tendencies are a fusion of mind and body; causing individuals to behaviourally react in an evolutionary adaptive manner (e.g. flee when feeling fear and attack when angry). These physiological reactions, induced by the experience of negative emotional states and narrowed attention, can be linked to the actions employed by our ancestors to increase the rate of survival in life-and-death situations (Garland et al., 2010; Tooby & Cosmides, 2008). In other words, Fredrickson (2004) asserts that the actual interconnection between negative emotional states, narrowing attention, and evolutionary survival mechanisms has not only drawn researcher's attention, but has further provided an opportunity to gather information on how humans react in life threatening situations.

The Broaden-and-Build Theory: A focus on the positive

Nonetheless, whilst the majority of research in this area has overlooked the effects of positive emotional states, Fredrickson's (2004) broaden-and-build model has been instrumental in examining their influence on attention distribution. The broaden-and-build theory asserts that positive emotional states, such as happiness, excitement, joy and love, provisionally expand an individual's cognition and attention (Wadlinger & Isaacowitz, 2006). Specifically, they are said to broaden a person's thought-action repertoire[1], providing the opportunity to explore a wider range of thoughts and actions. Accordingly, this can result in

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[1] A "thought-action repertoire" is a term coined by Fredrickson (1998), which is used to capture the range of cognitive and physiological changes that occur as a result of experiencing an emotion. When an individual experiences a negative emotional state, they narrow their thought action repertoire, drawing on specific-action tendencies. When an individual is in a positive emotional state, they broaden their thought-action repertoires, allowing them to broaden their interest and attention in their surroundings.

flexible and creative thinking, an increase in one's attention to their surroundings, and motivation to be playful and explorative (Fredrickson & Branigan, 2005).

Additionally, this theory ascertains that broadened thought-action repertoires have long-term adaptive advantages, allowing people to create durable personal resources. These resources can include physical resources (e.g. good health), social resources (e.g. making friends and belonging to social networks), intellectual resources (e.g. executive functioning, linear thinking and theory of mind) and psychological resources (e.g. optimism and resilience). Fredrickson & Branigan (2005) state that these resources improve an individual's coping skills and ability to survive in future situations where they may face unpleasant circumstances and/or negative emotional states. Thus, the authors therefore suggest that positive emotional states are also evolutionary adaptations that enabled our ancestors to survive.

Evidence supporting the broaden-and-build theory

Over the past fifteen years, evidence supporting the broaden-and-build has been generated from a wide theoretical base. This has included the demonstration that positive emotions expand people's repertoires of sought-after actions (fredrickson & Branigan, 2005), creativity and flexibility (Ashby, Isen, & Turken, 1999; Bolte, Goschke, & Kuhl, 2003; Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985), openness to new situations (Kahn & Isen, 1993) and resilient personal resources (Diener, Lucas, & Scollon, 2006). In relation to this thesis however, research has also shown how the induction of positive emotional states increases the breadth of attention (Fredrickson & Branigan, 2005). Individuals are therefore able to flag and process a wide range of information, resulting in the person grasping a better global understanding of their environment. This finding has been supported from a variety of research paradigms, including behavioural experiments (Fredrickson & Branigan, 2005; Rowe et al., 2007), eye-tracking (Wadlinger & Isaacowitz,

2006) and brain imaging techniques (Schmitz et al., 2009; Soto et al., 2009).

Fredrickson and Branigan (2005) investigated the effect of emotional states on attention by asking university students to complete a global-local visual processing task. Initially, participants were induced into one of five emotional states by watching a short video. The films either elicited amusement, contentment, neutrality, anger or anxiety. The authors assessed that these emotional states were accurately induced by asking participants to rate how much they felt of each of the following nine emotions: amusement, anger, anxiety, contentment, disgust, fear, happiness, sadness and serenity. Participants then completed a behavioural task, which was labelled a "Similarity Judgement Task" (Fredrickson & Branigan, 2005, pp. 320).

1a. Global-Local Item #13

1b. Global-Local Item #9

1c. Global-Local Item #4

1d. Global-Local Item #1
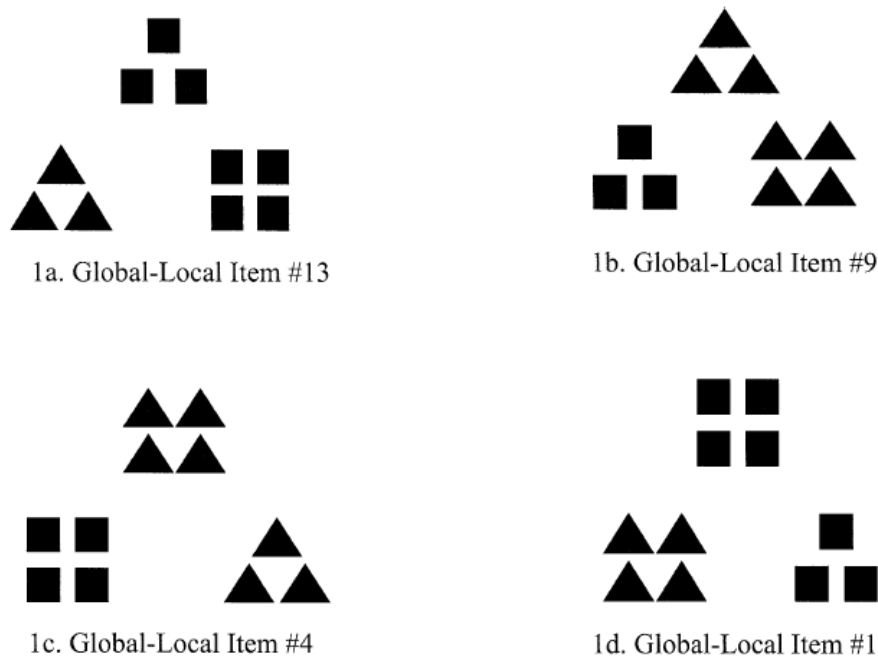
Figure 1. Example of global-local items used in Fredrickson and Branigan (2005).

Participants were asked to look at two comparison figures, and judge which figure was more similar to a standard figure (see Figure 1; the standard figure is presented on top of the two comparison figures). The independent variable was based on the participants' selection; whether they selected the comparison figure based on global or local characteristics. The global figure represented the overall shape of the object, whereas the

local figure represented the individual smaller shapes within the global figure. For example, if presented with Figure 1a, participants that chose a global comparison figure would have selected the left hand side figure. This figure's global representation is that of a triangle, as seen in the standard figure presented above. It does not matter that the individual shapes in the standard figure were squares, whereas in the comparison figure they were triangles. If a participant had chosen a comparison figure based on those individual shapes that comprise the global figure, they would have made a local comparison figure selection. As hypothesised, participants who were manipulated into a positive emotional state displayed a broader attentional scope than those in a neutral or negative emotional state, choosing global rather than local comparison figures.

Similarly, Rowe, Hirsch and Anderson (2006) used a behavioural experiment to show support for the broaden-and-build theory. This study utilised a flanker task, which required participants to selectively attend and identify a central target whilst ignoring extraneous flanking distractors. The flankers were either compatible or incompatible with the central target. Participants were induced into either positive or negative emotional states by listening to valenced pieces of music. The researchers hypothesised that induction of a positive emotional state would broaden the participant's attention, diminishing their ability to selectively attend simply to the central target because they are distracted by the flankers. The results confirmed this hypothesis, with participants induced into a positive emotional state taking significantly longer than those in a negative emotional state to respond to a central target when incompatible flanking distractors were displayed. Thus, this study supports the notion that positive emotional states broaden people's attentional scope, allowing for greater peripheral information to be flagged and processed.

Walldinger and Isaacowitz (2006) provided evidence in support of the broaden-and-build theory using eye-tracking technology. Half of the participants, university students, were

induced into a positive emotional state by receiving a small bag of chocolates, which research has proven to be an effective way of producing positive affect(Carnevale & Isen, 1986; Estrada, Isen, & Young, 1997; Isen et al., 1987). Asking participants' to rate their mood on a likert scale before testing began assessed the validity of the mood induction. Participants then watched a slide show, with each slide containing three correspondingly valenced images, displayed in varying screen positions. Attentional breadth was measured by determining the participant's percentage of viewing time to peripheral images in addition to the number of visual saccades made per slide. As hypothesised, participants induced into a positive mood spent a higher percentage of their time viewing peripherally located images and made more visual saccades than those in a neutral or negative emotional state. This is consistent with broaden-and-build notion that positive emotional states broaden individuals' selective attention comparative to negative

With advancements in technological research in the cognitive psychology domain, functional magnetic resonance imaging (fMRI) has also been used to investigate Fredrickson's (2004) broaden and build theory. Schmitz et al., (2009) used fMRI to determine the level of activation in the parahippocampal place area (PPA), which is an area of the brain that processes visual place information (Bear, Connor & Paradiso, 2007). The participants were induced into multiple emotional states by viewing valenced images in a slide show (positive, negative and neutral). Interwoven between the images was a visuospatial task, which involved the participant selectively focussing their attention on a neutral face that was presented in the foveal centre, whilst ignoring a photo of a house that was presented in the peripheral surround. By focussing on the PPA, the fMRI could then measure the level of peripheral information processed when the participant performed this task. As hypothesised, the data confirmed that inducing emotional states can affect attention and therefore visual processing and cortical responses. Participants induced into a positive

emotional state processed a higher percentage of peripheral information than those in a negative emotional state, indicating that positive emotional states increase and negative states decrease attention distribution.

Soto et al., (2009) also investigated the role of emotional states on attention distribution and visual encoding by using fMRI to analyse medical patients with visual neglect. The participants were induced into an emotional state by listening to either preferred or disliked music, and then performed a visual task in this condition. The participants in the neutral condition performed the task in silence. Results showed that the patients who were induced into a positive emotional state showed enhanced visual awareness in their neglected field of view than those in a negative emotional state. The researchers concluded that positive emotional states increase visual processing by broadening the individuals attentional scope, also supporting Fredrickson's (2004) broaden-and-build theory.

This array of research, utilising both cognitive and neuropsychological techniques, highlights that individuals' attention can be broadened and narrowed when induced into positive and negative mood states respectively. Whilst these studies have utilised music, short films and candy to induce emotional states, no study has yet investigated whether the presentation of valenced images can also manipulate emotional states, and consequently shift the distribution of attention. This thesis will aim to design experiments that can tease out whether the conceptual metaphor theory or the broaden-and-build theory better explains the connection between emotional states and sub sequential attention distribution.

Valence and Arousal

As seen in prior research, this thesis will employ the use of evaluative appraisals to assess the relationship between emotional stimuli and attention distribution. However, before the methodology for this study can be designed, the relationship between valence and arousal must be explored. Valence and arousal have been categorised as the two predominant

dimensions underlying emotion (Russell, 2003; Stanger, Kavussanu, Willoughby, & Ring, 2012), and are regularly used in the evaluative appraisal of emotional stimuli (Cunningham & Zelazo, 2007). Valence refers to how pleasant a stimulus is, and ranges from positive to negative (Ford, Addis, & Giovanello, 2012). For example, a smiling face is generally associated with a positive valence (pleasant) whereas a frowning face is associated with a negative valence (unpleasant). Arousal refers to how intense the stimulus is, and ranges from calm to exciting (Eder & Rothermund, 2010). For example, an exploding bomb would generally be associated with high arousal (intense) and a waterfall would be associated with low arousal (calm).

Certain investigations in this domain, as highlighted earlier, have evaluated emotional stimuli on the dimension of valence, whilst overlooking the contribution of arousal. This approach is consistent with theories that specified valence and arousal as orthogonal constructs, processed in parallel and independently influencing higher-order cognitive processes such as attention (Robinson, 1998; Russell & Barrett, 1999). These early studies proclaimed that threatening (negative) stimuli attract and maintain attention longer than positive stimuli; (Fox, Griggs, & Mouchlianitis, 2007; Lang, Davis, & Ohman, 2000) that emotionally relevant stimuli are processed with greater efficiency than neutral stimuli (Shapiro, Caldwell, & Sorensen, 1997) and that negative words cause greater interference in Stroop tasks than positive and neutral words (McGlynn, Wheeler, Wilamowska, & Katz, 2008). In contrast, separate research declared that it is the intensity of stimuli that determines the urgency of attention allocation, with highly arousing stimuli 'grabbing' attention faster than less arousing stimuli (Schimmack, 2005). Öhamn (2007, pp. 167) supports this theory by stating that "abrupt, high intensity stimulation has been associated with danger throughout evolution, and therefore the sensory systems have tuned immediately and automatically to respond to such stimulus". Further studies stressed the automaticity of this process via the use

of skin-conductance measurements (Gronau, Cohen, & Ben-Shakhar, 2003) and attentional blink responses (Anderson, 2005).

However, closer examination of the methodologies utilised in these experiments suggests that valence and arousal might have been confounded, thus putting the validity of these studies into question. For example, emotional stimuli often coupled negative valence and high arousal (e.g. image of snakes) and positive valence and low arousal (e.g. image of kittens). Therefore, whilst these initial theories recognised the significance of both valence and arousal underlying emotional information, there is little coherence regarding the contribution of both dimensions in the detection and appraisal of emotional stimuli.

Valence and Arousal: An Interaction

Currently, there is an increasing pool of empirical evidence which suggests that valence and arousal are related, producing a combined effect on higher order processes such as the distribution of attention and evaluative processing (Watson, Wiese, Vaidya, & Tellegen, 1999). Theory suggests that the integration of these dimensions is connected to an innate orienting response that is associated with the human fear system (Robinson, Storbeck, Meier, & Kirkeby, 2004) with individuals approaching familiar stimuli and more avoidant of threatening stimuli. In accordance with this view, Neumann, Forster and Strack (2003) and Zajonc (2001) argue that both negative and intense/novel stimuli (low valence/high arousal) induce an avoidance response, whereas positive and mild/familiar stimuli (high valence/low arousal) trigger an approach response.

Distinct combinations of these two dimensions have varying influences on the orienting response and the automaticity of conscious evaluative appraisals (Eder & Rothermund, 2010). Congruent stimuli (negative/high arousal and positive /low arousal) both trigger the equivalent orienting response, and therefore should be evaluated quickly at a conscious level. For example, individuals appear to be able to quickly determine that an

intruder (negative and highly arousing) is a potential threat and should be avoided, whereas a plate of cookies (positive with a low arousal level) brings pleasure and should be approached. On the other hand, stimuli that contain a combination of valence and arousal levels may result in the confliction of avoidance and approach responses, thus leading to delayed evaluative appraisals. For example, for some an image of naked man may be both highly arousing and positive, which may cause an individual to take time to evaluate whether the stimuli should be approached or avoided. Contextual information may therefore need to be considered before an evaluative appraisal is made (Robinson et al., 2004).

The hypothesis that evaluative appraisals are fastest when an emotional stimulus is congruent in valence and arousal (high arousal/negative and low arousal/positive), and slower when incongruent (high arousal/positive and low arousal/negative) has been tested across multiple research paradigms. Purkis, Lipp, Edwards, and Barnes (2009) directly tested this interaction by asking participants to make valence and arousal evaluative appraisals for a series of images and words. The stimuli were categorically separated into four clusters; high arousal/high valence (e.g. Fireworks), high arousal/low valence (e.g. Assault), low arousal/high valence (e.g. Angel) and low arousal/low valence (e.g. Gloom). Participants were instructed to make evaluative appraisals of the stimulus' 'pleasantness' as accurately and quickly as possible by pressing one of two designated keys on a keyboard. As expected, valence judgements occurred significantly faster and more accurately for high arousal/low valence images and low arousal/high valence images. This effect was significantly stronger when the stimuli were images rather than words.

In contrast, Eder and Rothermund (2010) and Robinson et al. (2004) investigated the interaction of valence and arousal studies using indirect measures. In other words, participants completed a primary task whilst valence and arousal measurements were collected without the participants' knowledge. Eder and Rothermond (2010) asked

participants to complete an evaluation task interwoven with an affective Simon task that discursively examined affective evaluations. As seen in previous research (Purkis et al., 2009), this study presented images to participants that had been categorically split into four groups based on their valence and arousal properties. Within the evaluation task, a white border encased the displayed images, and participants were instructed to respond with a vocalisation of the image's valence (e.g. positive or negative). In the affective Simon task, the images were encased by either a blue or green border, and participants' were instructed to respond with pronunciations of "positive" and "negative" respectively. Thus, in the evaluation task the image's valence was relevant whereas in the affective Simon task the image's valence was irrelevant, consequently providing an indirect measure of evaluative appraisals. In both conditions, as hypothesised, participants were faster to respond when the image's valence and arousal were paired as high valence/low arousal and low valence/high arousal rather than low valence/low arousal and high valence/high arousal.

Similarly, Robinson et al. (2004) indirectly measured the evaluative appraisals of valence and arousal whilst asking participants to complete a series of alternate tasks. In all seven studies, participants were presented with emotional images that varied in valence and arousal, and were asked to make evaluative appraisals based on the images' valence. As seen in Eder and Rothermond (2010) and Purkis et al. (2009), the images were categorically separated into four clusters. Evaluative appraisals were measured via participants' response times to appraise and categorise the image as "positive" or "negative"; response latencies linked to participants' emotional reactions to the images (participants were asked to judge whether the image evoked a "good" or "bad" feeling within them by pressing a designated key on a keyboard) and by the incidental effects that making evaluative judgements had on motor tasks (e.g. how quickly a participant could raise their finger from a button or complete a dot probe task which required participants' to decide if one or two dots were presented).

Across all seven studies a consistent interaction was observed that task performance increased when the presented image was congruent in valence and arousal.

Hence, studies utilising both direct and indirect evaluative appraisals of emotional stimuli concluded that individuals are faster to attend and respond to emotional images that are congruent in valence and arousal than those that are incongruent. As such, these studies support the theoretical viewpoint that valence and arousal are interconnected properties that produce a combined effect on higher order processes such as attention (see Watson et al., 1999).

The Current Study

No study has yet investigated the effect of valenced images on the distribution of attention. Whilst valenced words have been used to support the conceptual metaphor theory as well as the broaden-and-build theory, it is not known whether valenced images will produce similar effects. This study aims to examine this, with the central question being whether the conceptual metaphor theory or the broaden-and-build theory is supported.

Experiment 1 was conducted to determine whether valenced images had a processing advantage if they were presented congruently with the physical properties of the *"Good is Up, Bad is Down"* conceptual metaphor. Experiment 2 was conducted to assess whether the presentation of valenced images (the target domain) influenced the activation of the source domain (vertical distance) and consequently shifted vertical attention automatically and in accordance with the *"Good is Up, Bad is Down"* conceptual metaphor; or whether the presentation of valenced images automatically distributed attention globally or narrowly as suggested by the broaden-and-build theory. In both studies, responses were made by pressing a designated key on a computer keyboard, and reaction times were measured. It is hypothesised that 1) presenting valenced images congruently with the physical properties of the *"Good is Up, Bad is Down"* conceptual metaphor would provide a processing advantage,

meaning that high valenced images will be evaluated faster if presented in the upper visual field and low valenced images evaluated faster when presented in the lower visual field 2) the presentation of valenced images would create automatic vertical shifts in attention congruent with the *"Good is Up, Bad is Down"* conceptual metaphor.

This thesis also aimed to investigate the influence, if any, of both valence and arousal of the emotional images. Emotional stimuli were separated into four clusters, based on their valence and arousal characteristics. As such, the four groups were defined as high valence-high arousal, high valence-low arousal, low valence-high arousal, and low valence-low arousal. It was hypothesised that participants would respond fastest to images that were paired high valence/low arousal and low valence/high arousal rather than high valence/high arousal, low valence/low arousal.

Experiment 1

Experiment 1 investigated whether valenced images had a processing advantage if they were presented congruently with the physical properties of the *"Good is Up, Bad is Down"* conceptual metaphor. In other words, evaluative appraisals were utilised to assess whether high valenced images were categorised as "positive" faster when presented in the upper rather than lower visual field, and whether low valenced images were categorised as "negative" faster when presented in the lower rather than upper visual field. As this is the first study to examine the relationship between arousal and attention distribution, there are no specific hypotheses regarding this particular interaction.

Method

Participants

Participants were 49 (34 female, 15 male; mean age 21.02 years) psychology undergraduate students from Victoria University of Wellington, who participated in this study in return for course credits. Ethical approval for the completion of this study was granted

from the Victoria University Human Ethics Committee. All participants received detailed information regarding the study (Appendix A) and provided written consent (Appendix B) before the experiment began.

Design

This study used a within-subject design, with image valence (positive and negative), image arousal (low and high), and vertical position (top and bottom) as the independent variables. Reaction times (measured in milliseconds) for participants to identify images was the dependent variable. The position of each image on the screen (top or bottom) was randomly allocated and participants saw 200 images, with 100 randomly selected images displayed at the top and 100 at the bottom.

Stimuli and Apparatus

Visual Stimuli: The visual stimuli presented to the participants (Appendix C) were coloured photographs selected from the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2008). IAPS is a database of images, created by the Centre for Emotion and Attention (CSEA) at the University of Florida. All images from this database are standardised, emotionally evocative, and their content covers a wide range of semantic categories. Additionally, all images in the IAPS database have attached normative ratings, including average valence and arousal ratings for each picture (1-9 scales; with high numbers indicating high valence and arousal). Two hundred images were selected, and were equally split into four categories; high valence-high arousal, high valence – low arousal, low valance – high arousal and low valence – low arousal (Appendices C-F). The mean arousal and valence ratings for the four categories are as follows: High valence- high arousal (*M* valence = 7.23; *M* arousal = 6.00); High valence-low arousal (*M* valence =7.28; *M* arousal = 3.71); Low valence-high arousal (*M* valence= 2.25; *M* arousal = 6.36); Low valence-low arousal (*M*

valence = 3.36; *M* arousal = 4.29). Eight neutral images (Appendix G) were also chosen for practice trials (*M* valence = 4.14 and *M* arousal = 4.44).

The visual stimuli were presented using a DELL PC running the psychology Software Tool's E-Prime Suite version 1.1 (Schneider, Eschman & Zuccolotto, 2002). The computer screens presenting the visual stimuli were DELL 18 inch (47cm) CRT monitors.

Procedure

Upon arrival, participants were seated in front of a computer screen, and were given an information fact sheet to read and a consent form to sign. They were then instructed to read carefully through the experiment's instructions that were displayed on the computer screen. Following this, the experimenter verbally reinforced instructions, and highlighted that a practice session of 8 trials would precede the official test phase. Participants were told that a one minute rest period would occur in the middle of the experiment, allowing them to rest their eyes and fingers before the second half of the test phase began. Finally, the experimenter stressed the importance of maintaining both speed and accuracy throughout the experiment.

Prior to the presentation of each image, a black fixation cue (+++) in Times New Roman, 60-point font, was presented in the centre of the screen for 300ms. Following this central cue, a 10 x 5 cm valenced image (positive or negative) was presented either at the top or bottom of the screen (2.5 cm from the top or bottom screen edge, respectively). The image remained on the screen until the participant evaluated the image as positive (by pressing the P button on the keyboard with their right index finger) or negative (by pressing the Q button on the keyboard with their left index finger). No feedback was given after responding, and a blank black screen appeared for 500ms prior to the fixation cue for the next image. The participants' index fingers remained on the two respective computer keys in between the

presentation of each image. Once the participants completed the 8 practice trials, they began the official test phase.

Results

All participants were included in the following analyses, as no participant had more than a 20% error rate or an incomplete data set. Response times below 300ms were deemed pre-emptive and times above 1200ms as prolonged detection. Therefore, the response times for all participants were filtered so that only trials on which the response time was greater than 300ms and less than 1200ms were used to calculate a mean reaction time for each valence, arousal, and position combination. Table 1 presents descriptive statistics for reaction times across all six dependent variable combinations.

Table 1

Mean (SD) reaction times (ms) for Experiment 1 across all valence, arousal and position combinations.

	Reaction Times			
	High Arousal		Low Arousal	
Valence	Upper Position *M (SD)*	Lower Position *M (SD)*	Upper Position *M (SD)*	Lower Position *M (SD)*
High-Valence	737.18 (72.24)	757.13 (92.00)	757.22 (85.45)	761.03 (84.33)
Low-Valence	759.00 (83.87)	772.75 (83.52)	745.08 (82.49)	769.42 (88.78)

Reaction times

Participant's reaction times were analysed using a 2 (Valence: high, low) x 2 (Arousal: high, low) x 2 (Position: up, down) repeated measures ANOVA. An alpha level of .05 was used for all statistical analyses. There was no significant main effect for either Valence, $F(1, 48) = 1.42$, $p = 0.24$ or Arousal, $F(1, 48) = 0.10$, $p = 0.75$. However there was a significant main effect for Position, $F(1, 48) = 9.29$, $p = 0.00$, indicating that participants were faster to respond to images presented in upper vertical locations regardless of the

valence or arousal ($M = 749.62$, $SE = 9.58$) than lower vertical locations ($M= 765.08$, $SE = 10.64$).

Contrary to expectation there was no significant interaction between Valence and Position, $F(1, 48) = 0.55$, $p = 0.46$; indicating that participants were not faster to respond to high valence images in upper vertical locations ($M = 747.20$, $SE = 10.26$) than lower vertical positions ($M = 759.08$, $SE = 11.73$) or low valence images in lower vertical positions ($M = 771.08$, $SE = 11.16$) than upper vertical positions ($M = 752.04$, $SE = 10.76$). Conversely, there was a significant interaction between Valence and Arousal, $F(1, 48) = 5.66$, $p = 0.02$; indicating that participants were faster to respond to high valence images that had high arousal levels ($M = 747.16$, $SE = 10.79$) than low arousal levels ($M = 759.13$, $SE = 10.86$) and low valence images that had low arousal levels ($M = 757.25$, $SE = 11.11$) than high arousal levels ($M = 765.87$, $SE = 11.02$). See Figure 2.
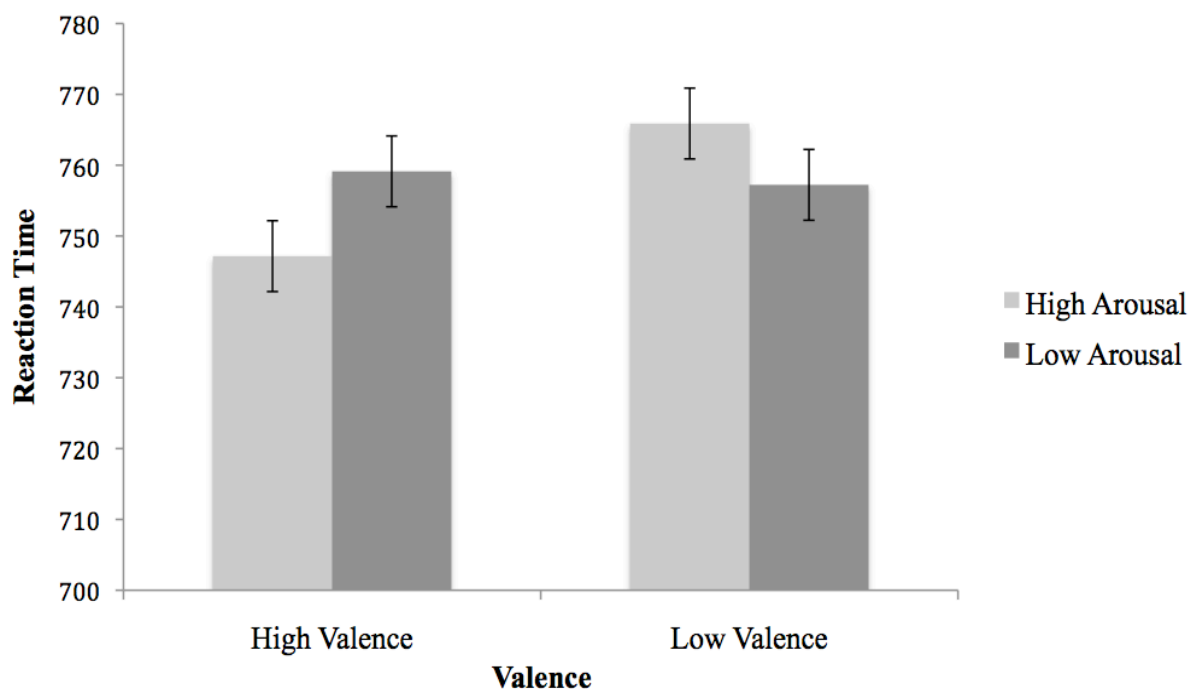

Figure 2. Reaction times for high and low valenced images with high and low arousal levels: Experiment 1.

There was no significant three-way interaction between Valence, Arousal and Position, $F(1, 48) = 1.99$, $p = 0.17$, indicating that there was no difference in reaction times for high and low valenced images that had high or low arousal levels in upper and lower vertical positions. See Figure 3.

Discussion

The results from Experiment 1 were inconsistent with the hypothesis that presenting valenced images congruently with the physical properties of the *"Good is Up, Bad is Down"* conceptual metaphor would provide a processing advantage. Participants did not form faster evaluative appraisals for high valenced images presented in the upper visual field or low valenced images presented in the lower visual field. However, contrary to expectation, the results did show that participant's responded significantly faster to all images, regardless of their valence, when presented in the upper visual field than lower visual field. This result is contradictory to the conceptual metaphor theory, which would forecast participants responding faster to high valence images in the upper visual field and low valenced images in the lower visual field, as seen in prior research utilising valenced words (e.g. Meier and Robinson, 2004).

The results also revealed a Valence-Arousal interaction, with participants making evaluative appraisals faster for high valence/high arousal and low valence/low arousal images than high valence/low arousal and low valence/high arousal images. Whilst this result does support the theory that valence and arousal are underlying dimensions of emotion that interact to influence the automaticity of conscious evaluative appraisals (Purkis et al., 2009); it offers an alternate picture to that supporting the orient response (Robinson, 1998); which theorises that individuals approach familiar stimuli (High Valence/Low Arousal) and avoid threatening stimuli (Low Valence/High Arousal). If the results had supported the orient response, participants would have responded faster to emotional images with these specific

valence and arousal pairings (e.g. high valence/low arousal and low valence/high arousal) than the alternate combinations (e.g. low arousal/low valence and high arousal/high valence).

As neither of the two hypotheses were supported during this first experiment, Experiment 2 was conducted to assess whether the broaden-and-build theory better accounts for shifts in attention distribution when participants are exposed to valenced images. It was also conducted to examine whether a similar valence-arousal interaction, as seen in Experiment 1, would be replicated.

Experiment 2

Experiment 2 was conducted to assess whether the presentation of emotional images, displayed in the centre of the visual field, automatically shifted attention vertically and in congruence with the *"Good is Up, Bad is Down"* conceptual metaphor; or whether attention was distributed globally or narrowly as suggested by the broaden and build theory. If the conceptual metaphor theory is supported, it is hypothesised that participants' will respond faster when high valenced images are followed by a target letter in the upper visual field and when low valenced images are followed by a target letter in the lower visual field. This is because the conceptual metaphor theory posits that the presentation of emotional stimuli should activate relevant perceptual simulations causing congruent shifts in vertical attention. In contrast, if the broaden-and-build theory is supported, it is hypothesised that participants' will respond faster to all target letters following a high rather than low valenced image, as it is theorised that positive emotional states broaden whereas negative emotional states narrow individuals' attention. Furthermore, this experiment aimed to explore the interaction between valence and arousal, and the influence this has on the evaluative appraisals of emotional information. As in experiment 1, there are no specific hypotheses regarding this particular interaction.

Method

Participants

Participants were 49 (33 female, 16 male; mean age 20.02 years) psychology undergraduate students from Victoria University of Wellington, who participated in this study in return for course credit. Ethical approval for the completion of this was granted from the Victoria University Human Ethics Committee, and written consent was obtained from all participants who were recruited for this study.

Design, Materials and Procedure

This experiment used a within-subject design, with image valence (positive and negative), image arousal (low and high), and vertical target letter position (top and bottom) as the independent variables. Reaction time for participants to respond to target identification was the dependent variable. The position of each target letter on the screen (top or bottom) was allocated randomly. The same 200 test images and 8 practice trial images from experiment 1 were used in experiment 2. The images were displayed on the same computer programme and screen as in experiment 1.

In Experiment, 2 all 200 IAPS images were presented in the centre of a computer screen. As with experiment 1, prior to the presentation of each image, each trial began with a black fixation cue (+++) in Times New Roman, 60-point font, in the centre of the screen for 300ms. Following this central cue, an image was presented in the centre of the screen for 500 ms, followed by 300 ms blank screen, followed by a target letter (either a "p" or "q") either at the top of the screen or the bottom of the screen. Participants were instructed to identify the target as quickly and accurately as possible by pressing the corresponding P or Q key on the keyboard. The lettered cue remained on the screen until participants responded. No feedback was given after valence selection, and a blank black screen appeared for 500ms prior to the fixation cue for the next image.

Once the participants completed the 8 practice trials, they were informed that they were about to begin the official test phase.

Results

As in Experiment 1, all participants were included in the data analyses, as no participant had more than a 20% error rate or an incomplete data set. Reaction times below 300ms were deemed pre-emptive and times above 1200ms as prolonged detection and were removed. Table 2 presents means and standard errors for response times across all six dependent variable combinations.

Table 2

Mean (SD) reaction times (ms) for Experiment 2 across all valence, arousal and cue position combinations.

	Reaction Times			
	High Arousal		Low Arousal	
Valence	Upper Target Letter Position *M (SD)*	Lower Target Letter Position *M (SD)*	Upper Target Letter Position *M (SD)*	Lower Target Letter Position *M (SD)*
High-Valence	538.70 (60.17)	580.88 (66.70)	537.19 (66.05)	575.49 (64.90)
Low-Valence	544.15 (63.75)	591.74 (70.17)	541.64 (62.70)	586.64 (72.97)

Reaction Times

As in Experiment 1, participant's reaction times were analysed using a 2 (Valence: high, low) x 2 (Arousal: high, low) x 2 Target Position: up, down) repeated measures ANOVA. An alpha level of .05 was used for all statistical analyses. All three main effects were significant: F (1, 48) = 8.86, p = 0.05 for Valence, F (1, 48) = 4.17, p = 0.047 for Arousal and F (1, 48) = 49.48, p = 0.00 for Target Position. These results indicate that participants responded faster to targets when high valence images were displayed (*M*= 558.06, *SE*= 8.48) than low valence images (*M*= 565.89, *SE*= 8.57), when images had low

arousal levels (*M*= 560.09, *SE*= 8.74) than high arousal levels (*M*= 563.87, *SE*= 8.21), and when the target letter was displayed in the upper visual field *M*= 540.42, *SE*= 8.53) rather than in the lower visual field (*M*= 583.54, *SE*= 9.38).

There was no significant Valence x Arousal interaction, F (1, 48) = 0.18, p = 0.89, Valence x Target Position interaction, F (1, 48) = 1.14, p = .29 or Arousal x Target Position interaction, F (1, 48) = .61, p = 0.44. Neither was there a Valence x Arousal x Target Position interaction, F (1, 48) = 0.05, p = 0.95, indicating that there was no difference in response times for images that were pleasant and unpleasant that had high or low arousal levels with target letters in upper or lower vertical positions.

Discussion

The present experiment aimed to investigate whether the presentation of emotional images, displayed in the centre of the visual field, shifted vertical attention automatically and in congruence with the *"Good is Up, Bad is Down"* conceptual metaphor; or whether attention was distributed globally and narrowly. Results did not support the hypothesis that the presentation of centrally located valenced images would cause an automatic shift in vertical attention, as suggested by the conceptual metaphor theory (Lakoff & Johnson, 1999). This was consistent with the findings in in Experiment 1, where participants' did not display faster reaction times when valenced images were placed in congruence with the physical properties of the *"Good is Up, Bad is Down"* conceptual metaphor. It can therefore be understood why valenced images presented in the centre of the visual field did not cause an automatic shift in vertical attention in Experiment 2.

The major finding from this experiment was that participants responded significantly faster to target letters in both the upper and lower visual field when following a high valenced image rather than a low valenced image. This finding is consistent with Fredrickson's (2004) broaden-and-build theory. It suggests that when high valenced images were presented,

participants' attention was broadened, allowing them to attend and respond faster to target letters in both the upper and lower visual field. Conversely, when a low valenced image was presented, participants' attention may have been narrowed onto the presented image, therefore causing a deceleration in attention distribution and subsequent reaction time.

Results further showed a significant main effect of arousal, with participants' reaction times significantly faster following the presentation of low arousal images than high arousal images. Thus, as no significant Valence-Arousal interaction was observed, these results do not support the theory that valence and arousal are related and cause a combined effect on attention and subsequent evaluative appraisals (Purkis et al., 2009; Robinson et al., 2004). However, the results do support the opposing literature, which states that valence and arousal are orthogonal and independently influence higher-order cognitive processes such as attention (Robinson, 1998; Russell & Barrett, 1999). More specifically, these results support Öhman (1997) and Schimmack (2005), who argued that highly arousing stimuli automatically grab an individual's attention because of their evolutionary link to danger and sub sequential highly attuned sensory systems.

General Discussion

Two opposing theoretical frameworks, the conceptual metaphor theory and the broaden-and-build theory, attempt to explain the effects of emotionally valenced stimuli on attention distribution. The conceptual metaphor theory (Lakoff & Johnson, 1999) asserts that concrete concepts (e.g. vertical distance or brightness) are used as metaphors to scaffold mental representations of abstract concepts (e.g. love and power). These metaphors rely on sensorimotor information in order to be understood, and therefore are said to be embodied. For example, such metaphorical representations include *"Life is a Journey"* (as in "she got a good head start in life"), *"Argument is War"* (as in "he attacked all the weak points in her argument") and *"Time is Money"* (as in "I invested a lot of time in her"). The focus of this

thesis was the *"Good is Up, Bad is Down"* conceptual metaphor, as in "that lifted my spirits" and "she fell into a depression". A central prediction of the conceptual metaphor theory is that emotionally valenced stimuli (the target domain) should activate the physical properties of the *"Good is Up, Bad is Down"* metaphor (the source domain), and automatically shift vertical attention congruently. In other words, if an individual is exposed to high valenced stimuli, this should activate the *"Good is Up"* conceptual metaphor and shift the individual's attention upwards.

In contrast, the broaden-and-build theory (Fredrickson, 2004) is based on evolutionary principles (Frijda, 1986), with negative emotions associated with specific-action tendencies and positive emotions associated with diffuse-action tendencies. The main prediction derived from this theory is that when an individual is induced into a positive emotion their attention is broadened, whereas when induced into a negative emotion their attention is narrowed (Fredrickson, 2004). For example, when an individual is experiencing fear, this is linked to the specific-action tendency to escape or avoid the immediate surroundings. It makes sense that an individual's attention would be narrowed on the situation, in order to gather an accurate and comprehensive understanding of their immediate context. In contrast, when an individual is experiencing joy, this is linked to the diffuse-action tendency of being contempt and inactive, thus allowing the individual to broaden their attention and gain a global view of their surroundings.

Both the conceptual metaphor theory and the broaden-and-build theory have a large pool of empirical evidence supporting their distinct theoretical frameworks, which attempt to explicate the influence of emotional stimuli on attention distribution. Whilst methodologies have varied across independent studies, the majority of research has incorporated the use of emotionally laden words when examining these theories (e.g. Zanolie, 2012; Steic & Dojiman, 2007; Meier, Robinson, Crawford & Ahlvers, 2007, Rowe, Hirsch & Anderson,

2006; Schubert, 2005; Meier & Robinson, 2004; Zwaan &Yaxley, 2003). However, no study to date has investigated the integrity of these theories by presenting participants with emotionally laden images rather than words. Thus, the central aim of this thesis was to gather experimental data in support for either the conceptual metaphor theory or broaden-and-build theory when utilising emotionally laden images.

This thesis was also interested in examining the influence, if any, of both valence and arousal of the emotional images. No prior studies in this area have investigated the effects of valence and arousal on emotional stimuli, and consequently the impact of these dimensions on their observed results. Furthermore, when reviewing literature in this field, it is unclear whether valence and arousal are orthogonal dimensions which independently influence higher order cognitive processes, such as attention (Robinson, 1998); or whether valence and arousal are interconnected and have a profound combined influence on attention (Purkis et al., 2009). For example, empirical evidence seems to suggest that individuals are faster to attend and respond to emotional stimuli that have the following valence and arousal pairings: high valence/low arousal and low valence/high arousal compared to those that are paired high valence/high arousal and low valence/low arousal.

In order to examine both theoretical frameworks, as well as the influence of valence and arousal, two experiments were carried out. In the first experiment, participants viewed 200 coloured images from IAPS (Lang et al., 2008) that were separated into four clusters: high valence/high arousal, high valence/low arousal, low valence/high arousal and low valence/low arousal. The images were displayed in either the upper or lower visual field, and participants' were asked to evaluate and categorise the image as either "positive" or "negative". The hypothesis that presenting valenced images congruently with the physical properties of the *"Good is Up, Bad is Down"* conceptual metaphor (e.g. placing a high valenced image in the upper visual field) would provide a processing advantage was not

supported; as no significant Valence-Position interaction was found. Neither was the hypothesis that participants would react faster when the visual images were paired as high valence/low arousal or low valence/high arousal, as no significant Vance-Arousal interaction was found.

The second study aimed to examine whether the presentation of emotionally laden images automatically shifted vertical attention congruent with the "good is up, bad is down" conceptual metaphor; or whether attention was distributed broadly and narrowly as suggested by the broaden-and-build theory. The same 200 visual images, as seen in experiment 1, were presented in the centre of a different group of participants' visual field. The presentation of each image preceded the display of a target letter ("p" or "q"), which appeared in either the upper or lower visual field. Participants' were instructed to identify the target as quickly as possible by pressing the corresponding P or Q key on their keyboard. The hypothesis that centrally presented valenced images would cause an automatic shift in vertical attention congruent with the *"Good is Up, Bad is Down"* conceptual metaphor was not supported (e.g. when a low valenced image was centrally displayed, sensorimotor properties associated with the metaphor would be activated, causing participants attention to shift upwards); as no significant Valence-Position interaction was observed. Neither was the hypothesis that participants would react faster when the emotionally laden visual images were paired as high valence/low arousal or low valence/high arousal rather than high valence/low arousal and low valence/high arousal.

The major finding from this research was that participants responded significantly faster to target letters in both the upper and lower visual field when following a high rather than low valenced image. As such, this result displays experimental support for the broaden-and-build theory, and is consistent with prior research that exhibited positive emotional states expanding attention and negative emotional states narrowing attention (e.g. Fredrickson &

Branigan, 2005; Rowe et al., 2007; Wadlinger & Isaacowitz, 2006). Additionally, this finding extends the literature by highlighting that emotionally laden images have the ability to broaden and narrow attention, just as words have been shown to do. This finding therefore provides a unique contribution to the broaden-and-build literature, and more widely to the field of cognitive psychology.

The results also revealed that participants responded significantly faster to target letters following emotional images that had low rather than high arousal levels. As this is the first study that has manipulated arousal levels whilst investigating the broaden-and-build theory, it may suggest that low arousal levels contribute to the broadening of individuals' attention and high arousal levels to the narrowing of individuals' attention. This result is also supportive of the theoretical viewpoint that valence and arousal are orthogonal dimensions which individually influence higher-order cognitive processing (Robinson, 1998; Russell & Barrett, 1999). However, this finding was not unanimous across both experiments, with Experiment 1 showing an inverse Valence-Arousal interaction to that hypothesised by the orient response (Robinson, 1998). Therefore, it is with caution that support is more specifically lent to Schimmack (2005) and Öhman's (2007) theory that highly arousing stimuli create urgent allocations of attention as a result of evolutionary processes associated with fear and danger.

When examining possible explanations for why this thesis did not provide support for the conceptual metaphor theory, there appears to be two likely possibilities. Firstly, it may be that the conceptual metaphor theory is primarily founded on lexical metaphors and does not extend to, nor encompass, other manifestations such as image metaphors that have different properties. This idea was voiced in a research article recently published after this thesis' experiments had been designed and conducted (Coëgnarts & Kravanja, 2012). The study had investigated both conceptual and image metaphors in film, and specifically highlighted the

difference between language based conceptual metaphors and image metaphors. Coëgnarts and Kravanja (2012) stated that image metaphors were only able to link concrete concepts (source domain) to other concrete concepts (target domain), instead of linking concrete (source domain) and abstract concepts (target domain) as seen in conceptual metaphors (Lakoff & Johnson, 1980). Deignan (2007) reflected on this difference when exploring the image metaphor *"My wife…whose waist is an hourglass"*. It was stated that this image metaphor differs from a conceptual metaphor because the target and source domain both refer to concrete concepts (a woman and hourglass respectively), which can be visually mapped on to each other. In contrast, when faced with a conceptual metaphor (e,g, *Argument is War*), an individual is unable to easily visualise the metaphor as a result of the abstract concept lacking in tangible detail.

Moreover, Coëgnarts and Kravanja's (2012) identified that whilst conceptual metaphors are grounded in an extensive network of metaphorical mappings, image metaphors are only linked to the singular topic that is reflected in the image. In other words, image metaphors are "more specific than conceptual metaphors in their extension and scope" (Coëgnarts and Kravanja, 2012, pp.99). Previous research (e.g. Meier and Robinson, 2004) has highlighted that the presentation of valenced words may be able to activate the sensorimotor properties linked to the *"Good is Up, Bad is Down"* conceptual metaphor via multiple pathways, as a result of their widespread network of metaphoric mappings. In contrast, the proposal that valenced images have only a singular connection between their source and target domain, may mean that they are only able to activate sensorimotor properties specifically linked to the singular topic displayed in the image.

Therefore, when considering both aspects of Coëgnarts and Kravanja's (2012) research, that image metaphors may be unable to represent abstract concepts and may only have the ability to activate singular schematic representations, it is feasible to see why the

presentations of valenced images in this study did not shift attention congruently with the *"Good is Up, Bad is Down"* conceptual metaphor.

The second possibility for why this study did not show support for the conceptual metaphor theory may be that the brain takes longer to respond, and makes more error interpreting images than it does to words. Karima, Thierry, Yves, and Marie-Noële (2007) investigated the influence of semantic priming on object processing for both image and word stimuli that were presented in isolation. Participants were shown either an image or a word, and had to complete a dual decision task where they indicated if the stimuli depicted a real object or a French word, by pressing an allocated key on a keyboard. The results showed that participants had longer reaction times and made more errors for picture than word stimuli. Administering both experiments in this study, adjusting the image presentation time to perhaps 800ms, might help clarify if having slower reaction time to images rather than words contributed to the current results. If Karima et al., (2007) theory is correct, a longer image presentation time should enable adequate time to attend and process the emotional image, to activate the appropriate sensorimotor properties associated with the *"Good is Up, Bad is Down"* conceptual metaphor, and cause a congruent shift in attention. However, if the change in image presentation time did not yield a significant result, it would throw doubt on the possibility that image presentation time was an issue and would support Coëgnarts and Kravanja's (2012) notion that image metaphors are distinctly different from conceptual metaphors.

A significant limitation to the design of this study is that the results displaying support for the broaden-and-build theory have an alternate theoretical explanation. The data gathered in Experiment 2 is said to support this theory by displaying faster reaction times for target letters following a high rather than low valenced image, regardless of their position. However, it is a possibility that low valence stimuli produce a global slowing effect, resulting

in all low valenced stimuli generating slower reaction times than high valenced stimuli. Literature generated from the emotional Stroop task supports this idea by suggesting that negative stimuli activate the brain's automatic threat vigilance system, causing an interference effect and consequently slowing all cognitive activity (Dresler, Mériau, Heekeren, & Meer, 2009; Larsen, Mercer, & Balota, 2006; McKenna & Sharma, 2004; Pratto & John, 1991). As such, being unable to identify whether the current results genuinely support the broaden-and-build theory is a limitation of this thesis's design. Future replica studies of Experiment 2 would benefit from displaying target letters centrally in addition to those already displayed in the upper and lower visual field. If the broaden-and-build theory was indeed present, participants' should have fastened reaction times to centrally located target letters following low valenced images, as their attention would be narrowed on the centre of the screen. Conversely, participants should display slowed reaction times to centrally located target letters following high valenced images. In other words, this research paradigm should yield results inverse to those found in the current study. However, if the emotional Stroop task literature is accounting for the current main effect of valence in this thesis, it would be expected that this future study would show slowed reaction times following all low valenced images, regardless of target letter position.

A further limitation of this thesis may be that participants were not required to verbally evaluate the image's valence before completing a categorisation task, as seen in Meier and Robinson (2004). However, if participants need to verbally evaluate stimuli in order for congruent shifts in vertical attention to be observed, this would negate the principle that such attention shifts occur automatically (Lakoff & Johnson, 1999). Moreover, it could be hypothesised that the actual motor response of verbally stating the stimuli's valence created a shift in attention, rather than the evaluation of the stimuli. An adaptation of Experiment 2 could assess this hypothesis by investigating the influence of overt labelling on

the distribution of attention. As in Meier and Robinson (2004), participants could be asked to verbally state the image's valence before the target letter categorisation task was presented. If this modification restores *"Good is Up, Bad is Down"* congruent shifts in attention, it would suggest that the conceptual metaphor theory's prediction that the evaluation of emotional stimuli causes automatic shifts in attention congruent with conceptual metaphors is incorrect.

It is unlikely that a lack of statistical power contributed to the failure to find support for shifts in vertical attention congruent with the *"Good is Up, Bad is Down"* conceptual metaphor. The number of participants per study appears to be more than adequate, as prior research has demonstrated metaphor congruent shifts with as few as 25 participants (Meier et al., 2007). Moreover, the number of trials delivered for each of the four image categories (50 trials for each valence/arousal combination) is equal to that used in Meier and Robinson's (2004) research.

In conclusion, this study provides provisional experimental data demonstrating that the presentation of emotional images influences individual's distribution of attention. Specifically, the finding that participants respond significantly faster to target letters in both the upper and lower visual field when following a high rather than low valenced image lends its support to Fredrickson's (2004) broaden-and-build theory. Additionally, the finding that participants respond faster after low arousal images than high arousal images may suggest that arousal levels are an important factor in the broadening and narrowing of attention as described in the broaden-and-build theory. Moreover, this finding provides support for the theory that valence and arousal are orthogonal constructs which independently influence higher-cognitive processes such as attention. This finding is consistent with evolutionary theories that suggest that intense and unfamiliar stimuli produce an urgent "grabbing" of attention. Future replications of this study would benefit from the suggested corrections, and

would therefore be able to provide more accurate experimental data on the relationship between emotionally valenced images and attention distribution.

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Appendix A

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA
UNIVERSITY OF WELLINGTON

Information Sheet: research teams with data for various uses

Jacqui Wall   Dr John McDowall
Masters Student   **Senior Lecturer, School of Psychology**
Email: *Jacqui.wall@vuw.ac.nz*   *John.Mcdowall@vuw.ac.nz*

Tel: 463-6423

What is the purpose of this research?

• This research will investigate the impact of spatial location in an attentional task.
Who is conducting the research?

• Jacqui Wall is a Masters' student in the School of Psychology and is conducting this research, under supervision from Assoc. Prof. John McDowall. This research has been approved by the School of Psychology Human Ethics Committee, under delegated authority of Victoria University of Wellington's Human Ethics Committee.
What is involved if you agree to participate?

• If you agree to participate in this study you will be shown a series of images on a computer screen (some may be violent or erotic) then asked to identify a target letter on the screen. You will be asked to respond as quickly and accurately as possible to this letter by pressing the corresponding letter on the keyboard once you have identified it.
• We anticipate that your total involvement will take no more than 30 minutes.
• During the research you are free to withdraw, without any penalty, at any point before your data have been collected.
Privacy and Confidentiality

• We will keep your consent forms and data for at least five years after publication.
• You will never be identified in my research project or in any other presentation or publication. The information you provide will be coded by number only.
• In accordance with the requirements of some scientific journals and organisations, your coded data may be shared with other competent researchers.
• Your coded data may be used in other, related studies.
• A copy of the coded data will remain in the custody of Assoc. Prof. John McDowall.
What happens to the information that you provide?

• The data you provide may be used for one or more of the following purposes:
  • The overall findings may be submitted for publication in a scientific journal, or presented at scientific conferences.
  • The overall findings may form part of a PhD thesis, Masters' thesis that will be submitted for assessment.
If you would like to know the results of this study, they will be available in approximately December 2012. They will be posted on the 4th floor noticeboard area of the Easterfield building. If you have any further questions regarding this study please contact any one of us above.

Appendix B

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA
UNIVERSITY OF WELLINGTON

Statement of consent

I have read the information about this research and any questions I wanted to ask have been answered to my satisfaction.

I agree to participate in this research. I understand that I can withdraw my consent at any time, without penalty, prior to the end of my participation.

Name: _____

Signature: _____

Date: _____

Student ID: _____

Age:
                 _____

Sex: _____

Appendix C

IAPS Images Presented in Experiments 1 and 2

High Valence/High Arousal	High Valence/Low Arousal	Low Valence/High Arousal	Low Valence/Low Arousal
1710	1333	1050	1270
1722	1340	1202	2039
2045	1440	1300	2101
2071	1441	1304	2104
2209	1604	1930	2110
2216	1610	2059	2141
2300	1620	2345.1	2190
2347	1630	2352.2	2205
4006	1750	2688	2278
4220	2035	2691	2301
4490	2040	2703	2399
4599	2060	2730	2456
4607	2070	2800	2457
4608	2156	2811	2490
4611	2222	2891	2722
4626	2274	3000	2750
4652	2299	3001	3300
4660	2304	3015	6010
4680	2311	3019	6241
5260	2314	3053	7023
5450	2341	3100	7078
5470	2370	3103	7137
5480	2374	3170	7520
5621	2387	3195	9002
7230	2388	3213	9008
7620	2392	3500	9010
7270	2051	3501.1	9031
7330	2510	6021	9041
7405	2530	6212	9045
7451	2598	6260	9046
7460	2791	6313	9090
7499	5000	6415	9110
7502	5001	6520	9171
7508	5010	9040	9186
7650	5200	9042	9190
7660	5201	9050	9220
8001	5202	9163	9265
8030	5220	9183	9290
8034	5551	9525	9291
8041	5631	9300	9330
8163	5711	9325	9331
8185	5725	9405	9341
8190	5760	9410	9342
8200	5779	9414	9390
8210	5780	9571	9395
8300	5800	9600	9404
8370	5811	9635.1	9417
8470	5870	9902	9440
8492	5891	9921	9471
8501	7325	9940	9561